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Reviews of Current Literature on Analytical Methodology and Quality Control

No. 18



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NOTICE

This bulletin is prepared monthly by the staff of the Analytical Methodology Information Center (AMIC), Information Systems Department, Battelle, Columbus Laboratories, Columbus, Ohio, under EPA Contract No. 68-01-1832, to inform personnel of the Analytical Quality Control Laboratory and other segments of the National Analytical Methods Development Research Program of recent publications on methodology. Personnel associated with the center are Mr. Ralph Darby, Project Director, Mr. Robert Little, Project Leader, and Miss Verna Holoman, Abstractor.

The 3" x 5" format of the citations and use of card stock is intended to facilitate removal and filing of items of interest. Because of space limitations, the index terms accompanying the citations are selected from a complete list as representative of the important concepts presented in each article.

Comments and suggestions regarding the content of the "Reviews" or requests from EPA personnel to be placed on the mailing list should be directed to the Project Officer:

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REVIEWS OF CURRENT LITERATURE ON
ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 18

By

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NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM
ANALYTICAL QUALITY CONTROL LABORATORY

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Arrangement of the citations following the major research areas of the Analytical Quality Control Laboratory and other segments of the National Analytical Methods Development Research Program. Items which apply to more than one area are cross-referenced.

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3. MICROBIOLOGICAL METHODS

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Scope: Pollution indicators; Waterborne pathogens; Sampling; Detection; Identification; Enumeration; Monitoring; Survival; Automation; Instrumentation; Cell counting; Selective and differential media; Growth factors; Metabolic products; Membrane filter procedures; Microbiological standards; Specific bacteriophage; Fluorescent antibody techniques; Radioactive tracers; Antigen identification; Photomicroscopy; Optical measurements; Data handling, presentation, and interpretation.

4. METHODS AND PERFORMANCE EVALUATION

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5. INSTRUMENT DEVELOPMENT

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Scope: Intake systems (methods of sampling, connecting lines, wells, motors, pumps, mode of operation); Sensors (electro-chemical, electro-biological, thermodynamic, mechanical, optical, nuclear); Analyzers (analog and digital amplifiers, output displays); Recording systems (telemetry, data logging, digital data processors).

1. PHYSICAL AND CHEMICAL METHODS

AMIC-3789

"PARTICULATE MANGANESE IN SEA WATER STRESSING REGIMES IN MARINE ANOXIC BASINS", Fluoré, E. J., University of Washington, Seattle, Washington, Dissertation Abstracts No. 73-3708, 1972, 150 pp. (Complete report not available from AMIC.)

A method for the analysis of particulate Mn using emission spectroscopy was developed to determine the concentration of Mn in suspended matter. The distribution of particulate Mn in five anoxic basins was observed. The differences and similarities of these basins are shown by data obtained on their chemical and physical characteristics. In addition, the distributions of both particulate Mn and the physical and chemical variables were monitored in Seanich Inlet, a basin whose oxygen-hydrogen sulfide regime changes monthly. The particulate Mn distribution in the observed basins showed a consistent pattern which can be correlated to the oxygen and hydrogen sulfide regime. The results indicate Mn exists mainly in particulate form in the oxygenated water and in a soluble form in water containing hydrogen sulfide. A model based on chemical thermodynamics and inferred kinetics is proposed to explain the distribution of particulate Mn in marine anoxic basin. The concentrations of particulate Mn in the open ocean were found to be low unless influenced by land runoff and the values of the Columbia River reflected the particulate matter distribution described by previous investigations.

INDEX TERMS: Sea water, Manganese, Dissolved oxygen, Distribution patterns, Hydrogen sulfide, Emission spectroscopy.

AMIC-6571

"ASSESSING THE WATER POLLUTION POTENTIAL OF MANUFACTURED PRODUCTS", Berkowitz, J. B., Schimke, G. R., Valeri, V. R., Arthur D. Little Incorporated, Cambridge, Massachusetts, Report No. EPA-R2-73-179a, Contract No. 68-01-0102, April 1973, 34pp.

A Catalog has been compiled of manufactured products which may, during their normal use or disposal, result in water pollution. The Catalog is in three sections, and the products are grouped in accordance with the Standard Industrial Classification (SIC). Section I summarizes the pollution potential of each listed product group. Section II provides data on typical chemical compositions for each product group and indicates the types of water-pollutional effects associated with each chemical ingredient. Section III inverts Section II by providing an alphabetical listing of chemicals and the SIC codes in which they occur. Along with the Catalog, a simple model has been developed to estimate rates of pollutant entry into the waterways via various routes, such as direct discharge, runoff following rainfall, leaching from dumps, discharge to the air and subsequent raindown. A guide including examples is provided on how to use the Catalog and associated models to assess potential water pollution problems arising from finished products in common use.

INDEX TERMS: Water pollution sources, Waste identification, Path of pollutants, Discharge measurement, Model studies, Municipal wastes, Domestic wastes, Chemical properties, Physical properties, Manufactured products, Pollution potential, Chemical composition.

AMIC-6929

"CHARACTERIZATION OF SWEET POTATO PROCESSING WASTES", Raines, B. W., North Carolina State University, Raleigh, North Carolina, Dissertation Abstracts No. 73-1201, 1972, 78 pp. (Complete report not available from AMIC)

Characterization of liquid waste from sweet potato processing plants was conducted in three stages. These were: 1. A study of waste strength as defined by 5-day biochemical oxygen demand, chemical oxygen demand (COD) and total carbon (TC). 2. A study of the potential biodegradability of the waste via chemical determination of individual carbohydrate components. 3. A study of the effect of acclimated versus nonacclimated seed organisms on the biochemical oxygen demand test. The 'readily biodegradable' carbohydrate of sweet potato waste constituted 88 percent of the total carbohydrate, dry weight basis and included sugars (17 percent), starch (56 percent) and pectin gums and mucillages (15 percent). Less 'readily biodegradable' carbohydrates were hemicelluloses (5 percent), cellulose (1 percent) and lignin (0.5 percent). The data demonstrated that substrate availability was not a limiting factor in the 5-day BOD method for sweet potato waste. Duplicate analyses of acclimated seed versus unacclimated seed organisms on BOD revealed little difference in results when utilizing culture material obtained from aerated raw sewage and one grown under conditions experienced in the BOD test. 'Most probable numbers' reached 5 million/ml in one to two days then rapidly decreased to 3000/ml at five days. Preliminary investigations indicated that nitrogen and/or phosphorus concentrations in the BOD analysis were limiting to bacterial growth and may explain the low BOD results.

INDEX TERMS: Industrial wastes, Food processing industry, Sweet potatoes, Characterization, Biochemical oxygen demand, Chemical oxygen demand, Carbohydrates, Lignins.

AMIC-6946

"INVESTIGATION OF THE ENVIRONMENTAL FACTORS WHICH AFFECT THE ANAEROBIC DECOMPOSITION OF FIBROUS SLUDGE BEDS ON STREAM BOTTOMS", Springer, A. M., Lawrence University, The Institute of Paper Chemistry, Appleton, Wisconsin, Dissertation Abstracts No. 73-7166, 1972, 178 pp. (Complete report not available from AMIC)

Redistribution and decomposition of fibrous sludge from paper mills have been studied in the lower Fox River between Lake Winnebago and Green Bay, Wisconsin. In June 1970 approximately 50 percent of the river bottom was covered with fibrous sludge to a depth which ranged from six inches to several feet. A mathematical model was developed to predict sludge distribution, and it appeared to depict actual river conditions quite well. Approximately 4/5 of the lower Fox River is subject to sludge deposition, scour, and redistribution; while the remaining 1/5 is either always free of sludge or contains permanent beds. The principal mechanism for sludge bed destruction is decomposition, since scour and flotation merely relocate the sludge at another position in the river. A linear temperature profile is found in the bed, indicating that the energy generated by the decomposition process is negligible in comparison to that conducted in from outside the bed. Laboratory studies were conducted which demonstrated that anaerobic decomposition is the principal mechanism for the destruction of organic matter in a sludge bed. Chemical pulps anaerobically decompose faster than do groundwood pulps of similar surface-to-volume ratios by a factor of about two. The rate-limiting step in the anaerobic decomposition process is the breakdown of cellulose into glucose and/or cellobiose. Temperature has an appreciable effect on the rate of fibrous sludge anaerobic decomposition. Appreciable differences in rate of decomposition occur at different river locations and at different times of the year

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6946 (Continued)

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in the same location. The life of a fibrous sludge bed in the lower Fox River would be one to two years if no new material were added to the bed.

INDEX TERMS: Distribution, Biodegradation, Pulp wastes, Fox River.

AMIC-6994 (Continued)

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INDEX TERMS: Aqueous solutions, Aromatic compounds, Chemical reactions, Chemical analysis, Hydroxylation, Sample preparation.

AMIC-6994

"AROMATIC HYDROXYLATION AS AN ANALYTICAL REACTION", Albert, K. S., University of Wisconsin, Madison, Wisconsin, Dissertation Abstracts No. 72-31-511, 1972, 169 pp. (Complete report not available from AMIC.)

The Hamilton hydroxylating system consisting of an aqueous solution of ferric ion, catechol, and hydrogen peroxide, hydroxylates aromatic compounds in aqueous solution. This thesis reports the further development and application of this system to the quantitative determination of some aromatic compounds. By reducing the initial ratio of peroxide to aromatic to 2.0 or less, stable absorbance values were obtained, the yield depending upon the ratio. The instability of the initial hydroxylation product has been overcome by incorporating a 'stabilizer' in the reaction mixture. Two such modified Hamilton systems which were studied extensively are those of cyclodextrin at 25 degrees and glucose at 25 degrees and 75 degrees. Using the cyclodextrin - modified Hamilton system, many mono- and disubstituted benzene derivatives give linear absorbance-concentration responses in the range 0.0001-0.0008 M with apparent molar absorptivities between 1000 and 5000. The glucose-modified Hamilton hydroxylating system has been suggested for the analysis of aromatic compounds at 75 degrees. Calibration curves were linear in the range 0.0001-0.001 M of aromatic compound, and molar absorptivities of 1000-5000 were observed. The results establish that (a) hydroxylation is a useful analytical process; (b) a model enzyme system can be exploited for its analytical utility; and (c) the concept of developing analytical selectivity by means of complex formation with cyclodextrins may be worth further exploitation. As one of the few methods available for the phenyl group as a functional group for analytical purposes, this technique has the advantages and limitations of a general functional group method.

AMIC-7063

"AN IMMOBILIZED CHOLINESTERASE PRODUCT FOR USE IN THE RAPID DETECTION OF ENZYME INHIBITORS IN AIR OR WATER", Goodson, L. H., Jacobs, W. B., Davis, A. W., Analytical Biochemistry, Vol. 51, No. 2, February 1973, pp 362-367.

Cholinesterase has been immobilized on the surface of open-pore urethane foam in a two-step process in which (1) cholinesterase is adsorbed on aluminum hydroxide gel during the precipitation of the aluminum hydroxide from a solution of aluminum chlorohydroxide, and (2) the aluminum hydroxide gel-enzyme precipitate is suspended in a starch slurry and applied to urethane foam. The resulting product is shown to retain its activity during monitoring of water for the presence of certain organophosphate and carbamate insecticides. Details are given for the preparation of both the plain starch gel-immobilized product and for the improved aluminum hydroxide gel-starch gel enzyme pads. (See also AMIC-6922)

INDEX TERMS: Monitoring, Water pollution, Insecticides, Pollutant identification, Air pollution, Organophosphorus pesticides, Carbamate pesticides, Adsorption, Stability, Methodology, Enzymatic inhibitors, Cholinesterase, Enzyme activity, Enzyme preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7132

"PREIMPOUNDMENT STUDY OF WEST POINT LAKE, GEORGIA", Schneider, R. F., Hill, D. W., Weldon, M. R., Gentry, R. E., U. S. Environmental Protection Agency, Southeast Water Laboratory, Athens, Georgia, Report No. TS 03-71-208-001.2, January 1972, 200 pp. NTIS Report No. PB 213 306.

The studies provided data on water temperature, color, turbidity, specific conductance, alkalinity, dissolved solids, pH, DO, BOD, total organic carbon, organic N, total P, total Mn, Fe, total and fecal coliforms, Salmonella, periphyton, phytoplankton, and benthic organisms. It is concluded that: (1) The potential for accelerated eutrophication and its associated nuisance problems are increased greatly by both past and current municipal and industrial development in the West Point Lake watershed. (2) Thermal stratification is expected to occur following impoundment. (3) Numerous isolations of Salmonella serotypes from the study area indicate that several areas are hazardous for primary contact recreation at the present time. (4) After closure of the dam, the increased residence time in the lake will tend to dampen water quality variations. (5) Water quality should improve following completion of secondary biological treatment and chlorination at Atlanta's R.M. Clayton wastewater treatment plant.

INDEX TERMS: Water quality, Enteric bacteria, Salmonella, Benthic fauna, Municipal wastes, Industrial wastes, Heavy metals, Diatoms, Chlorophyta, Cyanophyta, Crustaceans, Mollusks, Stoneflies, Mayflies, Stenonema rubrum, Chattahoochee River, West Point Lake, Macroinvertebrates, Preimpoundment studies.

AMIC-7197

"DETERMINATION OF URANIUM IN URINE SPECIMENS FOLLOWING THEIR SEPARATION THROUGH ANION EXCHANGE", Korkisch, J., Steffan, I., Mikrochimica Acta, No. 2, March 1973, pp 273-278.

A separation method that is generally applicable for uranium in the analysis of urine specimens is described. This is based on the adsorption of the uranium on the strongly basic anion exchanger Dowex 1, X8 from human urine that has been strongly acidified with hydrochloric acid, whereby most of the organic components, phosphoric acid and most mineral urine components are removed. Thus it becomes possible to separate the uranium compounds rapidly and simply without prior evaporation of the urine and destruction of the organic compounds. If need be, the foreign ions that are adsorbed along with the uranium, such as iron and also adsorbed urine coloring materials, are removed through subsequent washing of the resin with a mixture of 50 vol percent tetrahydrofuran, 40 vol percent methylglycol and 10 vol percent 6 N hydrochloric acid, and the uranium is eluted with 1 N hydrochloric acid. The determination of the uranium in the eluate can then be conducted without interference by the fluorometric method. (In German)

INDEX TERMS: Urine, Separation techniques, Ion exchange, Uranium.

AMIC-7259

"USE OF X-RAY FLUORESCENCE TO DETERMINE TRACE METALS IN WATER RESOURCES", Blasius, M. B., Kerkhoff, S. J., Wright, R. S., Cothorn, C. R., Water Resources Bulletin, Vol. 8, No. 4, August 1972, pp 704-714.

Samples for analysis by x-ray fluorescence were collected from the Great Miami River near Dayton, Ohio in a closed container. The container was pressurized to about 30 lb/ sq in with a bicycle pump to force the water through filter paper to be used in the analysis. The arrangement for the x-ray fluorescence included a bremsstrahlung source, a Si (Li) solid state detector, a 1024 channel multichannel analyzer and associated electronics. The data were analyzed by a digital computer. The most positive method for element identification was to run standard samples against the suspected elements. Known samples for quantitative calibration were made by vacuum depositing the metals of interest on aluminum foil. The intensity of the peak varied linearly with the thickness of the metal. Metals in particulate form were separated on Watman No. 41 or Millipore filters; metals in ionic form were collected on ion exchange filters. For metals between Ti and Cs on the periodic table detection limits were 30 ppb for particulate forms and 0.4 ppm for ionic forms. Ca, Ti, Cr, Fe, Cu, Zn, Sr, and Cd were found in the Great Miami River samples.

INDEX TERMS: Sampling, X-ray fluorescence, Alkaline earth metals, Separation techniques, Heavy metals, Calcium, Chromium, Iron, Copper, Zinc, Cadmium, Strontium, Titanium.

AMIC-7316

"SENSITIVITY AND DETECTABILITY LIMITS FOR ELEMENTAL ANALYSIS BY PROTON-INDUCED X-RAY FLUORESCENCE WITH A 3 MV VAN DE GRAAFF", Umbarger, C. J., Bearset, R. C., Close, D. A., Malanify, J. J., Report No. Conf-720801-2, 1972, 13 pp. NTIS Report No. LA-DC-72-1069.

Protons from a 3 MV Van de Graaff have been used to produce characteristic x-rays from 21 elements spanning the periodic table. THE ELEMENTS ANALYZED Ti, V, Fe, Ni, Cu, Ge, Rb, Zr, Ag, Sn, Sb, Ce, Sm, Dy, Tm, W, Au, Pb, Bi, Th, and U. Absolute K alpha and L alpha x-ray production cross sections have been determined, allowing one to calculate sensitivities for any given sample, detector geometry, and proton beam parameters. Elemental detectability limits are discussed assuming various backings and matrix materials. The large number of available small proton accelerators throughout the United States promises wide applicability of this technique to environmental and biomedical analysis.

INDEX TERMS: Heavy metals, X-ray fluorescence, Sensitivity, Detection limits.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7494

"CHANGES IN PHYSICAL, CHEMICAL AND BIOLOGICAL PROPERTIES OF NATURAL WATERS AFTER CONSTRUCTION OF DAMS", Jankovic, M., Archives of Biological Sciences, Vol. 23, Nos. 1-2, 1971, pp 49-56.

Limnological studies of the river Batlava and of the Batlava reservoir in the first year of its formation confirmed the hypothesis that physical and chemical factors and the biological composition of river biotopes undergo considerable changes in new reservoirs. The chemical composition of the Batlava reservoir differed a great deal from that of the river. The thermal and gas regimes changed first because the reservoir water with its stagnation and overturn periods was subject to chemical and physical laws different from those of watercourses. The ion content also changed. Compared to the river the reservoir had lower mineralization because the quantities of HCO_3 and Ca decreased considerably, the water in the reservoir thus becoming poor in calcium. Mineral phosphorus also decreased considerably. On the other hand in the reservoir water there was a considerable increase of nitrate nitrogen and especially of dissolved organic matter. This was due to the inflow of large quantities of surface water, bringing a great deal of mineral and organic matter, and to biochemical processes in the reservoir - primarily decomposition of submersed overground flora and the release of salts from the bottom. As a result of basically changed ecological conditions new biocenoses developed. Rheophile species disappeared and were replaced by stagnant rheophile forms, pioneer species of the limnal benthic fauna. Massive development of these forms created transitional biocenoses of mud-rheophile nature with Chironomis thimmi as the dominant. They were later replaced by mud-inhabiting communities with Chironomis plumosus as the dominant. The autochthonous fauna of the river gradually gave way to biocenoses more suited to the new environmental conditions.

AMIC-7494 (Continued)

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INDEX TERMS: Water quality, Impounded waters, Nutrients, Limiting factors, Benthic fauna, Succession, Batlava Reservoir.

AMIC-7502

"POTOMAC RIVER WATER QUALITY NETWORK. WATER YEAR 1972", Interstate Commission on the Potomac River Basin, Washington, D.C., Report, Water Year 1972, 115 pp.

This report is the fifteenth in a series published annually by the Interstate Commission on the Potomac River Basin and contains summaries of data on alkalinity, BOD, chlorides, coliforms, color, DO, nitrites, nitrates, Kjeldahl nitrogen, pH, phosphates, flow rates, temperature, total bacteria, solids, and turbidity. The data were printed from the STORET system. (See also AMIC-3159)

INDEX TERMS: Water quality, Potomac River, Nutrients, Alkalinity, Biochemical oxygen demand, Chlorides, Coliforms, Enteric bacteria, Color, Dissolved oxygen, Nitrites, Nitrates, Nitrogen, Hydrogen ion concentration, Phosphates, Flow rates, Water temperature, Turbidity, Suspended solids, Dissolved solids, Kjeldahl nitrogen, Antietam Creek, Shenandoah River, Rock Creek, Anacostia River, Oxon Run.

AMIC-7532

"ADSORPTION OF CHLORINATED HYDROCARBONS FROM SEAWATER BY A CROSSLINKED POLYMER", Harvey, G. R., Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, Report No. EPA-R2-73-177, March 1973, 26 pp.

The objective of this study was to develop a working analytical method for adsorbing and recovering low concentrations of chlorinated hydrocarbons such as pesticides and polychlorinated biphenyls from seawater using Amberlite XAD-2. It was found that the resin required cleanup before use to eliminate contamination. On the basis of experiments, it is recommended that a column of 1/i.d. of 7 be used and flow rate not exceed five bed volumes. Using these parameters, Woods Hole seawater was analyzed and the results compared with those from solvent extraction. The results were identical, viz. 4 ppt DDT, 10 ppt dieldrin, and 30 ppt PCB. The adsorbed compounds were 100 percent recovered by elution with four bed volumes of acetonitrile or ethanol. One column was reused 15 times with no change in efficiency. It is concluded that the method developed is very efficient for monitoring seawater and should provide detection to about one part per trillion. XAD-2 was not compressed when used in an in situ column at 1000 m depth. It is suggested that the resin be used to monitor coastal areas by mounting columns for towing behind vessels.

INDEX TERMS: Polychlorinated biphenyls, DDT, Dieldrin, Sea water, Separation techniques, Adsorption, Elution, Amberlite XAD-2, Detection limits.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7555

"INSECTICIDE RESIDUES IN WATER AND SEDIMENT FROM CISTERNS ON THE U.S. AND BRITISH VIRGIN ISLANDS - 1970", Lenon, H., Curry, L., Miller, A., Patulski, D., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 188-193.

Samples of water and sediment were collected from cisterns in four of the Virgin Islands during February and March, 1970, to be analyzed for pesticides. Water samples were collected in glass bottles, extracted by liquid-liquid partitioning with purified petroleum ether, partially evaporated, sealed in vials, and mailed to Michigan for analysis. Before analysis samples were dried with anhydrous sodium sulfate, partially evaporated and adjusted to 25 ml. Sediment samples were collected with a plankton net and mailed in screw-capped bottles. These were filtered, the filter containing the sediment dried and the sediment extracted with petroleum ether. Sediment extracts were prepared the same as water extracts. All samples were analyzed for DDE, DDD, DDT, dieldrin, and malathion by electron capture gas chromatography. Evidence of an unknown malathion metabolite was found in all 49 water samples analyzed, whereas malathion was found in only two (0.01 and 0.14 ppb). DDT, its metabolites, and dieldrin were not commonly found in the water samples except those from St. John where dieldrin was detected in approximately 50 percent of the samples (average concentration=0.19 ppb). Sediment samples from cisterns, in general, contained much higher concentrations of pesticides than water, with DDT and its metabolites occurring most frequently. In many of these sediment samples, the residue levels were high enough to be of concern. As a result it is strongly recommended that cisterns be cleaned frequently to remove sediment.

INDEX TERMS: Water analysis, Sediments, Cisterns, Gas chromatography, DDT, DDD, DDE, Dieldrin, Pesticide residues, Virgin Islands, Malathion, Separation techniques.

AMIC-7730

"LOSS OF FERTILIZER NUTRIENTS FROM SOILS TO DRAINAGE WATERS. PART I. STUDIES ON GRASSED WATERSHEDS IN WESTERN NORTH CAROLINA. PART II. NITROGEN CONCENTRATIONS IN SHALLOW GROUNDWATER OF THE NORTH CAROLINA COASTAL PLAIN", Kilmer, V. J., Gilliam, J. W., Joyce, R. T., Lutz, J. F., University of North Carolina, Water Resources Research Institute, Raleigh, North Carolina, Report No. 55, Contract No. 14-31-0001-3233, August 1972, 35 pp. NTIS Report No. PB-213 981.

The loss of nitrogen and phosphorus to surface and subsurface drainage waters from two very similar watersheds with blue grass sod in Western North Carolina was measured for three years. Only one watershed was fertilized the first two years and both were fertilized the third year. The difference in the quantity of N leaving the two watersheds during the first two years was approximately 10 kg/ha per year or 10 percent of that applied. Most of the nitrogen leaving the two watersheds was in the NO sub 3-N form with the greatest losses coming during the winter months. The total N concentration in water leaving the two watersheds during the winter was 2-3 ppm from the unfertilized watershed and 6-10 ppm from the fertilized watershed. Very little P was lost from either watershed. The NO sub 3 -N concentrations found in water samples from 10-foot wells located in the North Carolina Coastal Plain were 1 ppm or less in wooded areas and generally in the range of 1-5 ppm under cultivated fields. The highest concentrations were normally noted during the winter months.

INDEX TERMS: Drainage water, Agricultural watersheds, Nitrogen, Groundwater, Phosphorus, Fertilizers, Agricultural runoff, Discharge (water), Nutrient loss.

AMIC-7733

"PHOSPHORUS RELEASE FROM LAKE SEDIMENTS", Wildung, R. E., Schmidt, R. L., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington, Report No. EPA-R3-73-024, Contract No. 14-12-508, April 1973, 202 pp.

Investigations were undertaken to characterize the major inorganic and organic forms of phosphorus in sediments of Upper Klamath Lake, Oregon, determine the potential for release of phosphorus from the sediment as influenced by water and sediment composition and environmental parameters, and establish the relationship between phosphorus release and algal growth. Sediment characterization was extended to other lake systems including Shagawa Lake in Minnesota, Agency and Diamond Lakes in Oregon and Lake Erie. Sediments of Upper Klamath Lake, although differing in their ability to release phosphorus, exhibited seasonal changes in phosphorus concentration. These changes were most pronounced in the inorganic phosphorus fraction and in a bay which received agricultural runoff and initially contained relatively large quantities of phosphorus in the sediment interstitial water. Release of and resorption of phosphorus associated with the solid phase occurred. Release appeared to be largely from nonoccluded iron forms of phosphorus whereas resorption was primarily in the form of nonoccluded aluminum forms of phosphorus. The rate and extent of phosphorus release, described by regression models, was related to sediment composition. Release was accelerated by increased temperature and the presence of a phosphorus sink such as an anion exchange resin in laboratory studies or actively reproducing phytoplankton in field studies. Algal growth response to phosphorus released from sediments during dialysis was approximately equivalent to the response to orthophosphate.

AMIC-7733 (Continued)

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INDEX TERMS: Eutrophication, Water quality, Lake sediments, Lake Erie, Environmental effects, Laboratory tests, Measurement, Soil properties, Soil analysis, Model studies, Nutrient removal, Cycling nutrients, Upper Klamath Lake, Shagawa Lake, Agency Lake, Diamond Lake, Characterization, Phosphorus release, Nutrient availability.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7735

"ANNOTATED BIBLIOGRAPHY OF LAKE ONTARIO LIMNOLOGICAL AND RELATED STUDIES. VOL. I - CHEMISTRY", Proto, D., Sweeney, R. A., State University College at Buffalo, Great Lakes Laboratory, Buffalo, New York, Report No. EPA-R3-73-028a, March 1973, 104 pp.

One hundred eighty-seven (187) papers concerning chemical aspects of Lake Ontario and influent tributaries were reviewed and abstracted. Each paper was cross-indexed by author, geographic area of lake and/or tributary in which study was performed, technique and instrumentation and parameters. In addition, a list of addresses for the authors and agencies was included along with other possibly pertinent references which the authors were not able to secure and review within the time limitations of the grant. (See also AMIC-7497)

INDEX TERMS: Limnology, Lake Ontario, Bibliographies, Abstracts, Instrumentation, Analytical techniques, Documentation, Reviews, Chemical analysis, Water analysis, Chemical properties, Physical properties, Water properties, Chemical limnology.

AMIC-7738

"MECHANISMS OF MERCURY TRANSFORMATION IN BOTTOM SEDIMENTS", Krenkel, P. A., Reimers, R. S., Shin, E. B., Burrows, W. D., McMullen, E., Vanderbilt University, Environmental and Water Resources Engineering, Nashville, Tennessee, Technical Report No. 29, Contract No. 14-17-0002-571, March 1973, 183 pp.

The objectives of this investigation were: (1) To determine the mechanisms, rates, environmental requirements, and possibilities for inhibition of transformation of mercury into compounds such as methylmercury; (2) To determine whether soil type is a factor in transformation of mercury; and (3) To determine the detention time of mercury and its compounds in a lake or reservoir. To fulfill the objectives, extensive surveys and analyses of the literature were conducted regarding sediment adsorption and desorption; mercury absorption, excretion, and distribution in fish and other organisms; and methylation of mercury followed by laboratory and field investigations on those topics. The study on absorption and desorption included observation of the sorption characteristics of clays, sands, and sediments with varying pH; chlorides; mercury species, compounds, and concentrations; and determination of the potential for inhibition of mercury methylation in sediments. Bioassays were conducted with bluegills and Hg-203 labeled methylmercury to study the uptake and excretion of mercury compounds in fish. Methylation (including biomethylation) studies were conducted in Jenkins tubes containing contaminated sediments, fish, and or seed organisms and investigated the effects of temperature, Hg concentration, pH, chlorides, and BOD and uptake of methylmercury by the fish. Sediment samples were collected from Pickwick Reservoir and analyzed for organic C and N, total Hg, solids, specific gravity, acid insoluble residue, volatile solids, particle size, pH, and COD. The results of the last study were not conclusive.

AMIC-7738 (Continued)

Card 2/2

Extensive data and results from the other studies are given. One of the main conclusions of the study was that many results are questionable because of the inadequacies of the analytical techniques. Round robin tests were conducted in conjunction with several laboratories to demonstrate the variability in analytical data.

INDEX TERMS: Kinetics, Mercury, Absorption, Sediments, Freshwater fish, Adsorption, Bioassay, Methylmercury, Methylation, Bioaccumulation.

AMIC-7739

"WATER POLLUTION POTENTIAL OF MANUFACTURED PRODUCTS CATALOG SECTIONS I, II, AND III", Berkowitz, J. B., Schimke, G. R., Valeri, V. R., U. S. Environmental Protection Agency, Municipal Technology Branch, Washington, D.C., Report Nos. EPA-R2-73-179b,c,d, April 1973.

This set of reports consists of three volumes: (1) Summary, (2) Product Listing, and (3) Chemical Ingredient Listing. Extensive information is given on annual production rates, product lifetimes, toxicity oxygen demand, solids, color, odor, eutrophication, oil and tars, hardness and chemical compositions of a wide range of manufactured products.

INDEX TERMS: Industrial wastes, Toxicity, Industrial production, Oxygen demand, Color, Odor, Eutrophication, Dissolved solids, Suspended solids, Organic acids, Phenols, Resins, Alcohols, Pesticides, Dyes, Detergents, Heavy metals, Organic solvents, Stearates, Portland cement, Clove oil, Spearmint oil, TNT.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7761

"MECHANISMS OF MERCURY TRANSFORMATION IN BOTTOM SEDIMENTS PROGRESS REPORT", Krenkel, P. A., Reimers, R. S., Shin, E. B., Burrows, Vanderbilt University, Environmental and Water Resources Engineering, Nashville, Tennessee, Technical Report No. 27, January 1972, 79 pp.

A brief review is presented of the events that led to the interest in mercury methylation. Problems with the analysis for methyl and total mercury are discussed and the importance of the relationship between methyl and total mercury content in fish is demonstrated. The major existing question with regards to mercury in the environment is its quantitative analysis. Investigations concerned with the analysis of methylmercury are reviewed along with the status of methylmercury analysis at Vanderbilt University as a result of studies sponsored by the Sport Fishing Institute. It is concluded that the reported values for both methyl and total mercury are subject to question and that standardized techniques for both analytical techniques are mandatory. Experimental studies on the effects of various environmental factors on the methylation phenomenon are described and a successful technique for performing these studies is elucidated. Relationships between various forms of mercury and their adsorption in sediments are described and preliminary studies of the kinetics of mercury adsorption/desorption are presented. Preliminary analysis of fish taken from Pickwick Reservoir for total and methylmercury are presented along with corresponding values of methylmercury. It is concluded that, since the FDA standard for mercury in fish is based on methylmercury content, regulatory agencies should routinely analyze fish flesh for methylmercury and act accordingly, since it is quite possible that the methylmercury content is below the 0.5 ppm limit utilized by FDA.

AMIC-7763

"POLLUTION AS A RESULT OF FISH CULTURAL ACTIVITIES", Hinshaw, R. N., Utah State Division of Wildlife Resources, Salt Lake City, Utah, Report No. EPA-R3-73-009, February 1973, 209 pp.

This study was undertaken to evaluate the effect of fish hatchery activities on pollutant levels in streams. A program of semi-monthly physical-chemical analysis was conducted for a year at six trout hatcheries. These determinations were taken at the hatchery influent and outfall, the receiving water above and below the hatchery outfall. Bottom fauna was sampled once a month during the summer and bi-monthly through the winter on selected stations in the receiving waters. Flow data was recorded for the influent, effluent, and receiving waters. There was no correlation between the pounds of food fed in the hatcheries and: (1) changes of chemical quality in the receiving waters or (2) changes in kinds and numbers of bottom fauna organisms in the receiving waters. The analysis of samples revealed degradation of the water quality through every hatchery and in the receiving water. This degradation was beneficial from a fisheries standpoint but water quality and public health considerations may require cleanup before acceptable levels could be achieved.

INDEX TERMS: Fish hatcheries, Water quality, Benthic fauna, Public health, Pathogenic bacteria, Coliforms, Most probable number test, Macroinvertebrates.

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INDEX TERMS: Absorption, Freshwater fish, Sediments, Analytical techniques, Gravimetric analysis, Volumetric analysis, Polarographic analysis, Gas chromatography, Colorimetry, Mass spectrometry, X-ray fluorescence, Neutron activation analysis, Sample preparation, Biological samples, Methylmercury, Transport, Preconcentration, Ion selective electrodes, Emission spectroscopy, Atomic absorption spectrophotometry, Biomethylation, Amperometric analysis, Catalytic analysis.

AMIC-7771

"FLUORESCENT PROBES IN THE DETECTION OF INSECTICIDES IN WATER", Himel, C. M., University of Georgia, Department of Entomology, Athens, Georgia, Report No. EPA-R2-73-217, April 1973, 47 pp.

Fluorescent probes are molecules whose spectral responses are changed by their environment. A fluorescent probe which is in equilibrium with the active site of cholinesterase enzymes will have emission spectra and quantum yields corresponding to (a) the free probe and (b) the probe-enzyme complex. Insecticides in water which compete for the active site will displace the probe from its complex and quench the fluorescence of the probe-enzyme complex. The quenching effect will be related to the concentration of the insecticide and the equilibrium constant and quantum yield of the probe-enzyme complex. The change in spectral response can be the basis of a new analytical methodology for insecticides. The objectives of the present research included synthesis of candidate fluorescent probe molecules for cholinesterase enzymes and evaluation of the feasibility of development of a new analytical method for insecticides in water. Active-site-directed, equilibrium fluorescent probes have been synthesized and used in the development of the analytical system. Results with Dursban, Thiodan, and certain other insecticides are in the range of 0.1 microM. Insecticides which do not compete with, or displace the probe from its complex are not detected. Experimental parameters for design and synthesis of optimum probe molecules were developed.

INDEX TERMS: Insecticides, Analytical techniques, Water pollution, Synthesis, Pollutant identification, Fluorescent probes, Enzyme systems, Cholinesterase, Enzymatic inhibitors.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7778

"PYROGRAPHIC GROSS CHARACTERIZATION OF WATER CONTAMINANTS", Lysyj, I., Newton, P. R., North American Rockwell Corporation, Rocketdyne Division, Canoga Park, California, Report No. EPA-R2-73-227, Contract No. 14-12-802, May 1973, 94 pp.

A hydrochemical instrument and methodology were developed for direct analysis of organic materials in aqueous solutions based on thermal fragmentation followed by gas chromatographic separation and detection of the resulting derivative compositions. The applications of the developed technique to water pollution surveillance, optimization of waste treatment processes, and characterization of natural waters were studied. It was found that a recorded pattern of pyrolytically produced fragments for a given water sample reflects the total nature of its organic composition, and can be interpreted and differentiated in a number of ways. Using a priori established calibration patterns for individual components to be found in a mixture, the pattern produced by a mixture can be analyzed mathematically. The system can be calibrated and the data can be interpreted in terms of pure organic compounds, classes of organic materials, or any other arbitrarily defined organic mixtures such as those found in industrial waste effluents. Application of this technique to pollution surveillance is based on the fact that each industry has a waste whose chemical composition is distinctive to its operation. The uniqueness of such waste compositions offers a means for their characterization as separate entities, rather than as a collection of various chemical species. The validity of this postulate was experimentally demonstrated. With this method, both the identity of the source and the quantity of the waste contributed by each source could be determined.

AMIC-7778 (Continued)

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INDEX TERMS: Waste identification, Water pollution sources, Methodology, Industrial wastes, Effluents, Water analysis, Monitoring, Organic compounds, Instrumentation, Characterization, Pyrographic analysis, Surveillance, Chemical composition, Data interpretation, Thermal fragmentation.

AMIC-7855

"THE QUALITY OF COASTAL WATERS: FIRST ANNUAL PROGRESS REPORT", Lau, I. S., University of Hawaii, Water Resources Research Center, Honolulu, Hawaii, Technical Report No. 60, Sea Grant Program No. UNIHI-SEA GRANT-72-01, September 1972, 213 pp. NTIS Report No. COM 73 10144.

This project attempted to evaluate water quality in terms of stress or well being of aquatic communities, using the traditional chemical, biological, and bacterial parameters of water quality only to identify the factors and their concentrations which are of ecological significance. In turn the ecological findings are utilized to refine the standards and criteria applicable to traditional parameters. Kahana Bay was selected as a coastal water under the influence of relatively undeveloped land. Data already available on the physiography and hydrology of its drainage area, its estuarine and oceanographic aspects, and the nature and movement of its sediments were supplemented by a program of analysis of water and sediments and its biota. DDT and PCB (pesticides) in Kahana Bay waters and sediments appeared at levels which seem to be ubiquitous in nature. Heavy metals, particularly Pb, Cd, Zn, and Cu appeared in the sediments in no identifiable pattern and apparently depend on the parent geologic formations from which the sediments are derived. Sugarcane production and milling wastes were studied on Kauai. Observations of mill waste discharge and coastal water, sediments, and biota were made both before and after the 90-year old Kilauea Sugar Company closed down its operations in north Kauai. Untreated mill wastes were found to be the major contributor of wastes from the industry, carrying coliforms, sediments, trash and bagasse. The effect was largely an extensive visible plume and debris in the waters. Sediments, rather than water, harbored most of the nutrients, heavy metals, and pesticides in the ocean. A striking improvement in the aesthetic aspects of the coastal

AMIC-7855 (Continued)

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water quickly followed the cessation of mill waste discharges. Fish and other aquatic biota reappeared rapidly after the cessation of mill operations. The effects of urban wastewater, especially sewage, were studied during the report period largely by cooperating with agencies in Hawaii engaged in major investigations and projects such as sewage treatment at Sand Island, Pearl Harbor, Kaneohe Bay, and Mokapu Point. In less extensive situations at Sandy Beach, Waikiki, Maunaloa Bay, and Manoa Stream, the Project is amassing data for the effects on the coastal environment of surface runoff and general human activities in urbanized areas.

INDEX TERMS: Water quality, Water pollution effects, Industrial wastes, Municipal wastes, Sediments, Polychlorinated biphenyls, Heavy metals, Coliforms, Irrigation water, Marine fish, Algae, Nutrients, Pesticides, Sugarcane mills, Macroinvertebrates.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7894

"MERCURY DISTRIBUTION IN ESTUARINE-NEARSHORE ENVIRONMENT", Windom, H. L., Journal of the Waterways, Harbors and Coastal Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 99, No. WW2, May 1973, 257-265 pp.

Samples of estuarine and nearshore waters were collected in the area of the southeastern United States between Cape Romain, South Carolina and Jacksonville, Florida for mercury analysis by the reduction aeration flameless atomic absorption technique. Samples of Spartina alterniflora were taken from 2 areas of different salinity; sediment cores were also taken from those areas and from adjacent channels for comparison. Plankton samples were from surface waters nearshore and offshore of the northeast and southeast U. S. coast. All mercury samples were analyzed as the water samples. It was found that the transfer of mercury through an estuarine system of the Southeastern Atlantic Coast to the open ocean is controlled by: (1) mixing of estuarine waters with offshore waters; (2) loss in plant detritus due to rafting offshore; (3) migration of estuarine organisms to offshore areas. An additional loss of mercury from the estuarine system is due to sedimentation. A budget of mercury for estuaries along the Georgia Coast indicates that the dominant salt marsh plant, Spartina alterniflora, exerts a strong control on the migration of this metal. Mercury enters the estuary primarily in solution, delivering approximately 1.5 mg annually to each square meter of salt marsh. The annual uptake of mercury by the plant is approximately 0.7 mg/sq m of salt marsh.

INDEX TERMS: Estuarine environment, Mercury, Path of pollutants, Estuaries, Rivers, Bottom sediments, Plant tissues, Plankton, Water pollution, Nearshore waters.

AMIC-7910

"STEAM STRIPPING ODOROUS SUBSTANCES FROM KRAFT EFFLUENT STREAMS", Hrutfiord, B. F., Johanson, L. N., McCarthy, J. L., University of Washington, Seattle, Washington, Report No. EPA-R2-73-196, April 1973, 89 pp.

Laboratory and design studies have been completed relating to volatile constituents which appear in Kraft black liquor and condensate streams, and how these can best be removed and recovered. In order of decreasing concentration, the volatile constituents are alcohols, terpenes, ketones, sulfur bearing compounds, and phenolic compounds. Methanol, the major alcohol contaminant, is found in from 280 to 8400 ppm in condensate streams, amounting to 11 to 16 pounds per ton of pulp produced. Terpenes are found to range from a few ppm to about 4500 ppm in condensates, 4 to 9 pounds per ton of pulp. Acetone is present at concentrations of 2 to 200 ppm, corresponding to 0.07 to 0.4 pounds per ton of pulp. In all, some 40 compounds were found to be present in condensate streams. The feasibility of combining steam stripping of Kraft liquor with steam stripping of condensates was explored, and the conditions under which this may be warranted are reported. Under most present mill situations, steam stripping of black liquor and the last stages of evaporator condensates does not appear to be warranted except in unusual cases. Exploratory type studies were made and are reported concerning improved methods of predicting vapor-liquid equilibria in such systems, and separation of the resulting volatile oils.

INDEX TERMS: Pulp wastes, Effluent streams, Separation techniques, Waste identification, Organic compounds, Odor-producing pollutants, Steam stripping, Kraft mill condensates, Pollutant removal, Chemical recovery.

AMIC-7912

"PHOSPHATE IN INTERSTITIAL WATERS OF ANOXIC SEDIMENTS: OXIDATION EFFECTS DURING SAMPLING PROCEDURE", Bray, J. T., Bricker, O. P., Troup, B. N., Science, Vol. 180, No. 4093, June 1973, pp 1362-1364.

Ten sediment samples were collected with a Benthos gravity corer from Chesapeake Bay to investigate the effect of sampling procedures on the analysis of phosphate in interstitial water. Samples were homogenized in plastic bags and loaded into two gas-operated nylon squeezers. Sampling and analytical procedures were carried out in nitrogen for the first of each duplicate pair and in air for the second after the second squeezer had been exposed to the atmosphere for 15 minutes to simulate normal procedures. Colorimetric analysis showed that each sample exposed to air contained lower concentrations of soluble reactive phosphate than unexposed samples. Additional experiments were conducted in the laboratory in which samples were exposed to air or prepared under nitrogen, and standard and deaerated filters were used in the squeezers. Phosphate and iron (II) were determined on alternate 3-ml and 1-ml portions. The results demonstrate the importance of protecting against oxidation for the analysis of phosphate in interstitial waters rich in iron (II). It is concluded that either the iron (II) oxidizes to iron (III) which precipitates inorganic phosphate as iron phosphate or the iron precipitates as the hydroxide which scavenges the phosphate by sorption. Using procedures developed to prevent oxidation, samples of interstitial water taken from depths to 100 cm in Chesapeake Bay were analyzed. The results for the upper 1 m of sediments show a general increase in phosphate downstream to about mid-bay. The possible significance of the observed phosphate concentrations, which average 1000 times that of the bay water, is that catastrophic overturn of the top 20 cm of sediment could release large amounts of phosphate to the overlying water.

AMIC-7912 (Continued)

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INDEX TERMS: Connate water, Phosphates, Sampling, Oxidation, Iron, Chesapeake Bay, Errors, Sample preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7917

"CHEMISTRY AND TROPHIC STATUS OF SEVEN NEW ZEALAND LAKES", McColl, R. H. S., New Zealand Journal of Marine and Freshwater Research, Vol. 6, No. 4, December 1972, pp 399-447.

The chemistry of the surface and bottom waters of seven Rotorua lakes (Okataina, Rotoma, Tikitapu, Okareka, Rotokakahi, Ngapouri, and Okaro) was examined monthly between April 1970 and April 1971 in relation to the biology of the lakes. Twenty-four parameters were measured, including dissolved oxygen, major ions, silica, phosphorus, nitrogen, algal pigments, and some trace elements. All lakes were warm monomictic, second-class lakes. The waters were soft and variations between lakes in composition of major cations and anions appeared to be related to catchment differences. The major cations and Cl ion varied little with season. Sulfate varied seasonally in the hypolimnia of the most productive lakes (Okaro, Ngapouri, and Rotokakahi). Silica was abundant in all lakes, except Tikitapu where diatoms were poorly represented. Depletion of silica by diatom populations was only observed in the two most productive lakes (Okaro and Ngapouri). All lakes except Ngapouri showed anomalous silica distribution with lower concentrations in the bottom waters at all times. Copper and zinc varied little between lakes and depths, but showed marked peaks during winter circulation. Data acquired from the analyses were used to classify the lakes by trophic level. Algal growth was most vigorous during winter circulation and in some lakes a related phosphate 'depletion phase' occurred. Nitrate concentrations were low by world standards, except in the most productive lakes during winter circulation. Nitrite occurred irregularly in the surface waters of some lakes and in trace amounts in the hypolimnia of all lakes in late summer.

AMIC-7917 (Continued)

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INDEX TERMS: Trophic level, Heavy metals, Water quality, Nutrients, Chemical analysis, Limnology, New Zealand.

AMIC-7919

"DDT IN SOME NEW ZEALAND MARINE AND FRESHWATER FAUNA", Solly, S. R. B., Harrison, D. L., New Zealand Journal of Marine and Freshwater Research, Vol. 6, No. 4, December 1972, pp 456-62.

Ten species of fish, crustaceans, and mollusks, taken from inland and coastal waters of New Zealand in 1969-70, mostly before the legislative ban on DDT, were analyzed for residues of lindane, polychlorinated biphenyls (PCB), and DDT and its metabolites. Samples were macerated, extracted, and analyzed by gas chromatography. The detection limit was 0.01 ppm and recoveries were 82 percent for DDE, 78 percent for DDD, 78 percent for DDT, 78 percent for lindane, and 95 percent for PCB. DDE was the only organochlorine compound detected in six species, and DDE was the major residue in all others. DDD and/or DDT was present only in eels (*Anguilla australis schmidtii*, *A. dieffenbachii*), gopher (*Polyprion oxygeneus*), and some flounder (*Rhombosolea plebeia*). No lindane or PCB was found in any of the samples. The range of total DDT levels in edible flesh was 0-0.20 parts per million (on a fresh tissue basis) and the mean residue level for all specimens was 0.02 ppm. The incidence of residues appeared to be related to the regional use of DDT.

INDEX TERMS: DDT, DDD, DDE, Polychlorinated biphenyls, Gas chromatography, Freshwater fish, Marine fish, Crayfish, Mussels, Oysters, Sample preparation, Biological samples, Lindane, Detection limits, New Zealand.

AMIC-7923

"OPTICAL PROPERTIES AND COLOR OF LAKE TAHOE AND CRATER LAKE", Smith, R. C., Tyler, J. E., Goldman, C. R., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 189-199.

Spectral irradiance has been measured as a function of depth in Crater Lake, Oregon and Lake Tahoe, California. In Lake Tahoe, Secchi disk observations and submarine photometer measurements have been recorded year round since July 1967 and beam transmittance has been measured as a function of depth. From these data the radiant energy input and certain optical properties of the two lakes are presented. Since color is a principal esthetic feature of these lakes, a complete color analysis is also presented. This information provides an objective standard with which to compare possible future changes in the optical properties and in the esthetic appearance of Crater Lake and Lake Tahoe. The method can be applied generally to quantify the optical deterioration of any aquatic habitat and can detect such deterioration before it is noticeable by casual visual observation.

INDEX TERMS: Optical properties, Color, Depth, Light penetration, Solar radiation, Lake Tahoe, Crater Lake.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7927

"TRACE ELEMENT TRAPPING IN PTEROPOD TESTS", Turekian, K. K., Katz, A., Chan, L., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 240-249.

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 micron) 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 our 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. (Reprinted from Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 240-249. Copyright 1973 by the American Society of Limnology and Oceanography Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Trace elements, Absorption, Plankton, Transport depletion, Gastropods, Sea water, Heavy metals, Path of pollutants, Instrumental neutron activation analysis, Pteropods, Shells, Rare earth elements, Fate of pollutants, Detection limits, Sample preparation.

AMIC-7928

"THORIUM IN WATER AND ALGAE FROM THE ADRIATIC SEA", Strohal, P., Pinter, T., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 250-253.

Samples of seawater and algae collected along the coast of the Rovinji region in the North Adriatic were analyzed for the presence of thorium by neutron activation analysis (NAA). Thorium was preconcentrated by coprecipitation with $\text{Fe}(\text{OH})_3$, which was precipitated by the addition of FeCl_3 solution and NaOH to either filtered or unfiltered seawater. The samples were stirred well and Th separated from solution using Buchner vacuum filters or a centrifuge. The precipitate was dissolved in HCl, Fe removed by organic extraction, water phase evaporated, dried, irradiated and analyzed by NAA. Pa-233 radioactivities were measured in all samples and compared to standards. Samples of algae were measured, carefully separated, identified, and washed with seawater to remove impurities. The samples were slowly dried at 110 C, ignited at 450 C, reduced to constant weight, and analyzed by NAA as were the seawater samples. In filtered seawater, values were 0.8 pg Th/l and lower; for unfiltered seawater samples, values about three orders of magnitude higher were obtained. Thorium concentrations in marine algae are in the range of 1 to 0.01 microgram Th/g ashed material.

INDEX TERMS: Sea water, Chemical analysis, Marine algae, Neutron activation analysis, Heavy metals, Chlorophyta, Phaeophyta, Rhodophyta, Radiochemical analysis, Thorium, Adriatic Sea, Rare earth elements, Preconcentration, Pa-233, Sample preparation.

AMIC-7930

"THE CHARACTERIZATION OF SOLUBLE PHOSPHORUS RELEASED BY LIMNETIC ZOOPLANKTON", Peters, R., Lean, D., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 270-279.

Three rapid techniques were used to characterize the main forms of soluble phosphate released by *Daphnia rosea*. Uniformly P-32-labeled laboratory animals were transferred to nonradioactive water and most of the soluble radiophosphorus was shown to be similar to PO_4 in anion exchange, in gel filtration chromatography, and in a kinetic analysis of incorporation by natural seston. In addition, *Diaptomus minutus* was labeled in situ with P-32 and its release products compared to PO_4 by gel filtration. This analysis and those using *Daphnia* indicated that the released soluble phosphorus was about 90 percent orthophosphate. However, molybdate analyses of the soluble phosphates released in a 10-hr experiment showed them to be only 60 percent orthophosphate. Net reuptake of orthophosphate was insufficient to account for this discrepancy. Recycling of phosphorus is postulated in longer experiments, which leads to a substantial underestimate of the orthophosphate release. (Reprinted from Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 270-279. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Phosphorus, Zooplankton, Pollutant identification, Radiochemical analysis, Phosphates, Waterfleas, Copepods, Radioactivity techniques, Characterization, Orthophosphates.

AMIC-7943

"TOTAL MERCURY ANALYSIS: REVIEW AND CRITIQUE", Reimers, R. S., Burrows, W. D., Krenkel, P. A., Journal Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 814-826.

With the recent concern about mercury as an environmental hazard came numerous reviews and a large amount of research concerning new methods of mercury analysis. The history and an extensive literature review of mercury analysis are presented, as well as a critique of the different methods. Conclusions are presented as to the best method in terms of convenience, cost, simplicity, and sensitivity. At present, wet oxidation with potassium permanganate and potassium persulfate followed by chemical reduction and analysis of the elemental mercury by flameless atomic absorption spectroscopy is the most convenient method for determining total mercury. Economically, the best method remains the classical colorimetric dithizone technique. Atomic absorption instrumentation, because of its economy, simplicity, and sensitivity, is the most useful method for mercury analysis.

INDEX TERMS: Analytical techniques, Reviews, Mercury, Documentation, Methodology, Evaluation, Heavy metals, Aqueous solutions, Inorganic compounds, Organomercury compounds, Biological samples, Environmental samples, Sample preparation, Chemical interference, Natural waters.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7946

"NITROGEN RELEASE FROM LAKE SEDIMENTS", Austin, E. R., Lee, G. F., Journal Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 870-879.

A study was made of the release of nitrogen compounds from two Wisconsin lakes sediments that were completely mixed with the water at all times. Ekman dredge sediment samples were taken from the shallow (5 m) and deep (22 m) areas of Lake Mendota, and the deeper areas (27-32 m) of Lake Trout. Under aerobic conditions, over 49 percent of the total nitrogen present in one sample was released as soluble organic nitrogen, ammonia, and nitrate in approximately 200 days. Under anaerobic conditions, these sediments released about 6 percent of the nitrogen in a similar period of time. Sediments from the second lake released 5 and 2 percent, respectively, of the potentially released nitrogen in 100 days under aerobic and anaerobic conditions. Similar tests conducted on unstirred sediments showed that the amount of mixing was probably one of the controlling factors of nitrogen release.

INDEX TERMS: Lake sediments, Nitrogen, Nitrogen compounds, Anaerobic conditions, aerobic conditions, Mixing, Shallow water, Deep water, Laboratory tests, Lake Mendota, Lake Trout, Nitrogen release, Chemical composition.

AMIC-7950

"SPECTROPHOTOMETRIC DETERMINATION OF AMMONIA", Zadorojny, C., Saxton, S., Finger, R., Journal Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 905-912.

An improved indophenol blue method was investigated for the determination of ammonia in fresh, estuarine, marine, and wastewaters. Absorbance curves were prepared by adding known amounts of ammonium-nitrogen to ammonia-free water and to Puget Sound seawater. Wastewaters were diluted, spiked, and analyzed to determine reproducibility of the method. Analyses were conducted to study the effects of 20 inorganic electrolytes, urea, or amino acids. No major interferences occurred with these substances or as a result of variations in salinity. The range of ammonia determination was as follows: with intensifier, 0.001 to 1.0 mg/l ammonia nitrogen; without intensifier, 1 to 51 mg/l ammonia nitrogen. It is concluded that the method is simple and well suited for routine use.

INDEX TERMS: Ammonia, Water analysis, Sea water, Estuaries, Colorimetry, Spectrophotometry, Salinity, Waste water (pollution), Ureas, Amino acids, Fresh water, Chemical interference, Detection limits, Indophenol blue method, Sample preparation, Reproducibility, Chemical recovery.

AMIC-7949

"LITHIUM SILICATE SEDIMENTATION TRACER FOR SHOAL DEPOSIT STUDIES", Nedved, T. K., Fochtman, E. G., Langdon, W. M., Sullivan, F. C., Journal Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 896-904.

Investigations were conducted on a 12-mile section of the Calumet River to determine the relationships between the ss discharges by outfalls and the buildup of shoals in a waterway. Shoal soundings were used to determine the long-term overall rate of shoal buildup, as well as the volume and distribution of the shoal material in a selected study area. The data indicated an average rate of shoal buildup of 0.19 ft/month. The shoals were sampled extensively to determine the physical and chemical properties of the deposited materials. The wet density of the shoals in the area averaged 87 lb/cu ft. The ss concentration of the river in the immediate vicinity of the study outfall indicated rapid dispersion of the materials discharged. These surveys further demonstrated the extreme complexities of the processes involved in shoal buildups in this particular area. Techniques were developed for quantitative tracing of the contribution of a particular discharge to the formation of shoals. Lithium metasilicate was used as the tracer material. A proton-capture technique was used to assay for the lithium. Special pan type sedimentation samplers were designed, constructed, and used in a field demonstration study. This investigation indicated that the suspended matter discharged by the study outfall traveled considerably in both the upstream and downstream directions. Although only 30 percent of the tracer material was recovered, this study amply demonstrated that lithium metasilicate could be used successfully as a sedimentation tracer.

INDEX TERMS: Tracers, Shoals, Sedimentation, Suspended solids, Distribution patterns, Tracking techniques, Lithium silicate, Calumet River.

AMIC-7955

"DITHIZONE PROCEDURE FOR MERCURY ANALYSIS", Ely, C. T., Journal Water Pollution Control Federation, Vol 45, No. 5, May 1973, pp 940-945.

The dithizone procedure for mercury in receiving water and effluents is a fairly sensitive, direct method for the spectrophotometric determination of microgram quantities of mercury (II) in sulfuric acid solution. Temperature is not critical between 20 degrees and 28 degrees C, but strict control of pH is necessary to eliminate metal interference. The advantages of the method are its low relative standard deviation and relative error, low cost, and simplicity of reagents and equipment. Disadvantages include free chlorine interference, possible copper (I) and iron (III) interference, too many variables affecting sensitivity, questionable ability to measure all mercury forms without digestion, and inability to detect less than 2 micrograms/l of mercury (II).

INDEX TERMS: Separation techniques, Mercury, Water analysis, Waste water (pollution), Dithizone method, Chemical interference, Detection limits.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7966

"STEAM DISTILLATION: A SIMPLE TECHNIQUE FOR RECOVERY OF PETROLEUM HYDROCARBONS FROM TAINTED FISH", Ackman, R. G., Noble, D., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 5, May 1973, pp 711-714.

Fish caught in the Athabaska River were filleted when required, blended with distilled water and transferred to a distillation flask along with flask washings. Antibumping granules were added and the fish muscle blend was simmered for 30 min before distillation to reduce foaming. Neohexane was added to the condensate in a centrifuge tube and shaken vigorously. The neohexane layer which was allowed to separate upon standing for 1 hr or less was analyzed by flame ionization chromatography using a support-coated open-tubular (SCOT) stainless steel column. Samples of diesel oil and fish obtained from a source apparently free from contamination were examined as controls. Simple steam distillation was found to be efficacious for isolation of hydrocarbons from contaminated whitefish. Gas-liquid chromatography on support-coated open-tubular Apiezon-L columns demonstrated that hydrocarbons recovered from the tainted fish had a composition pattern qualitatively similar in detail to that from a sample of diesel oil suspected as the source of contamination.

INDEX TERMS: Fish, Separation techniques, Methodology, Pollutant identification, Steam distillation, Recovery, Petroleum hydrocarbons, Sample preparation, Muscle.

AMIC-7970

"REMOVAL OF MERCURY FROM AQUEOUS SOLUTIONS BY NITROGEN-CONTAINING CHEMICALLY MODIFIED COTTON", Roberts, E. J., Rowland, S. P., Environmental Science and Technology, Vol. 7, No. 6, June 1973, pp 552-555.

Four chemically modified cotton celluloses were investigated for effectiveness in sorbing mercury Hg(2 plus) from aqueous solutions. The modified cottons were generally used in the chopped form. Each was suspended in 500 ml of aqueous solution containing the Hg salt and shaken for 16 hr at room temperature. The modified cotton was then removed from the solution by filtration and the filtrate was analyzed by flameless AAS. The cross-linked polyethylenimine (CPEI) cotton containing adsorbed Hg was collected on a sintered glass filter and air-dried. The filtrate was analyzed for Hg; portions of the cotton were washed in sodium citrate, EDTA, and sodium thiocyanate and in each case the wash solution was analyzed for Hg. Effectiveness of these compositions was due to amine units of the following types: ethylenimine network polymer formed in the fibers, polyethylenimine sorbed on the filters, 2-diethylaminoethyl substituents in the cellulose, and 2-aminoethyl substituents in the cellulose. Cotton cellulose modified with 2-diethylaminoethyl or 2-aminoethyl substituents were the more effective compositions at concentrations of mercury above 1000 ppb. Cotton cellulose containing ethylenimine network polymer was most effective on the basis of the weight of the cellulosic composition. Sorbed mercury can be readily removed from the chemically modified cottons for recovery of the former and reuse of the latter.

INDEX TERMS: Mercury, Aqueous solutions, Adsorption, Separation techniques, Pollutant removal, Cotton celluloses, Recovery.

AMIC-7969

"DETERMINATION OF ALKYL BENZENESULFONATE (ABS) IN BOTTOM SEDIMENT", Ambe, Y., Environmental Science and Technology, Vol. 7, No. 6, June 1973, pp 542-545.

A new method for the analysis of alkylbenzenesulfonate (ABS) in bottom sediments of a polluted river, a lake, and the sea was examined and the availability of the method was verified. Methylene blue active substance (MBAS) was extracted from dried mud sample with methanol benzene (1:1) mixture. After the solvent was completely evaporated, the residue was dissolved into distilled water and the concentration of MBAS was determined from the ratio of peak heights at wavenumber 1010/cm and at 890/cm of the infrared spectrum of MB-MBAS complex. Multiplying the value of MBAS by ABS/MBAS, the net content of ABS in the sediment was determined. Applying this method for the studies of polluted lake sediment and marine sediment, some geochemically interesting information on the process and rate of recent sedimentation in the lake and sea was obtained.

INDEX TERMS: Alkylbenzene sulfonates, Bottom sediments, Lakes, Oceans, Colorimetry, Methodology, Pollutant identification, Chemical analysis, Rivers, Infrared spectrophotometry, Methylene blue active substance, Sample preparation, Chemical recovery.

AMIC-7973

"DETERMINATION OF LEAD IN PETROLEUM ADDITIVES USING ATOMIC ABSORPTION SPECTROPHOTOMETRY", Supp, G. R., Gibbs, I., Jusze, M., Atomic Absorption Newsletter, Vol. 12, No. 3, May-June 1973, pp 66-67.

Petroleum samples were analyzed for lead compounds by dissolving samples and standards directly in MIBK and analyzing by atomic absorption. This procedure eliminated separations and acid breakdown followed by titration or precipitation reactions. Results of analysis by AA and wet chemistry agreed within experimental error when samples containing lead cyclohexanecarboxylate, lead diethylthiocarbamate, lead naphthenate, or lead dinonylnaphthalene sulfonate were analyzed.

INDEX TERMS: Oil, Lead, Atomic absorption spectrophotometry, Sample preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7974

"AN IMPROVED AA MICROSAMPLING SYSTEM", Fernandez, F. J., Atomic Absorption Newsletter, Vol. 12, No. 3, May-June 1973, pp 68-70.

The Perkin-Elmer AA Microsampling System has been redesigned to improve performance, mechanical stability, and ease of operation. The changes include a new mounting system which attaches directly to the burner mount base, a slide mechanism having a smoother and shorter action, a heat shield usable with both the Delves Cup and Sampling Boat systems, plus a new mounting system for the Sampling Boat which permits rapid boat installation and interchange. Blood samples analyzed for lead show that the reproducibility of results is very good using the new system.

INDEX TERMS: Laboratory equipment, Lead, Atomic absorption spectrophotometers, Reproducibility, Microsampling system, Blood.

AMIC-7978

"THE MONITORING OF ORGANIC MATTER WITH POLYURETHANE FOAM", Gesser, H. D., Sparling, A. B., Chow, A., Turner, C. W., Journal Water Pollution Control Federation, Vol. 65, No. 3, March 1973, pp 220-221.

Standard carbon adsorption apparatuses with the carbon replaced by previously cleaned and extracted polyurethane foam plugs were installed at the municipal water treatment plant at Morris, Manitoba, to determine the feasibility of the test method and the efficiency of the water treatment process. Water from the Red River which enters the plant is treated by the carbon-alum-chlorine method. The foam plugs were extracted with hexane, concentrated in a flash evaporator, made up to a standard volume, and analyzed by electron capture gas chromatography. The results obtained showed that the treatment process did not reduce the organic contaminant level to any significant extent. The use of polyurethane foam plugs is a promising alternate to the carbon adsorption method for the determination of trace organic contaminants in water.

INDEX TERMS: Organic matter, Monitoring, Water analysis, Water pollution, Pollutant identification, Organic compounds, Methodology, Polyurethane foam, Trace levels.

AMC-7976

"AN IMPROVED METHOD FOR DETERMINING ORGANICS BY ACTIVATED CARBON ADSORPTION AND SOLVENT EXTRACTION - PT. II (TEST METHOD)", Buelow, R. W., Carswell, J. K., Symons, J. M., Journal American Water Works Association, Vol. 65, No. 3, March 1973, pp 195-199.

The complete test procedure is presented for determining organics in water in the dissolved form by activated carbon adsorption and solvent extraction. Organic materials adsorbed on a sample of activated carbon are removed by sequential extraction with two organic solvents. The extracts are processed by volume reduction through distillation and drying. The quantities of organic materials are then determined gravimetrically. This method is primarily for monitoring the general organic content of water and is not designed as a collector of organics for further identification, although, with certain precautions, the resulting extracts can be reprocessed. This method does not require expensive instrumentation and divides the organics into 2 general classes - chloroform soluble and alcohol soluble. A special sampler (miniature CAM sampler) must be used in order to obtain a representative sample for this method. (See also AMIC-6453)

INDEX TERMS: Solvent extractions, Adsorption, Pollutant identification, Activated carbon, Water pollution, Organic wastes, Organic compounds, Laboratory tests, Water analysis, Dissolved organic matter.

AMIC-7981

"STREAM-VELOCITY EFFECTS ON THE HEAVY-METAL CONCENTRATIONS", Williams, L. G., Joyce, J. C., Monk, J. T., Jr., Journal American Water Works Association, Vol. 65, No. 4, April 1973, pp 275-279.

Water samples were collected twice weekly in two 20-liter polyethylene jugs from the Black Warrior River and three of its tributaries from February 17 to October 6, 1971. One sample was flocculated by the addition of aluminum ammonium sulfate to remove suspended matter; suspended matter from the other was concentrated by siphoning the sample through a 60 millimicron screen and settling. Samples were digested and analyzed for Cd, Cr, Cu, Hg, Mn, Zn, and Fe by atomic absorption spectrophotometry. River flow rates were also monitored. No correlation was found to exist between streamflow and the soluble concentrations of the selected heavy metals. However, a strong positive correlation did exist between the concentration of these metals and the resuspended bottom sediments, mostly in the form of ooze deposits, present in the water column following increased flow and scour from heavy rain runoff. Copper, iron, manganese, mercury, and zinc concentrations were associated with ooze sediments that accumulated during periods of low or negligible streamflow and were resuspended into the water column following scours in a complex that was destructive to favorable balance of river biota and produced slugs of water unfit for good domestic supply. Suspended particles larger than 60 millimicrons that were screened from the water samples were mostly organic and held the highest concentrations of the selected metals, whereas inorganic large particles had relatively low carrying power.

INDEX TERMS: Heavy metals, Suspended solids, Toxicity, Biological communities, Cadmium, Atomic absorption spectrophotometry, Transport, Chromium, Copper, Mercury, Manganese, Zinc, Iron, Runoff, Scour.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7983

"CHARACTERIZATION OF CHEMICAL SLUDGES", Calkins, R. J., Novak, J. T., Journal American Water Works Association, Vol. 65, No 6, June 1973, pp 423-428.

A study was conducted to determine or evaluate the characteristics of sludges generated from the Missouri River. The sludges collected from several treatment plants were characterized by their settled-solids concentration, filtering rate which includes the parameter 'specific resistance', and cake solids. The solids concentrations in the settled sludges were found to vary to some extent with the type of coagulant used, the turbidity of the water, and, in the case of mixed sludges (softening-coagulant), the variations in the lime dose. In evaluating sludge characteristics generated from a combined softening and coagulation process, the authors found that the concentration of magnesium may greatly influence the results obtained. Comparisons of sludge solids from processes where no lime was added indicate that sludges generated from turbid waters can be expected to attain much higher settled-solids concentration than sludges from relatively clean waters. A relationship between cake solids and settled solids was found to exist for all sludges in this study. No simple relationship was found to exist for specific resistances of the various sludges. Several trends can be seen from the data, however. In general, combined softening-coagulant sludges filter much more readily than do pure coagulants. The presence or absence of magnesium seemed to have no influence on filtering characteristics of mixed sludges. Changes in the sludge characterization parameters occurred with time, primarily for the iron and alum residues. None of the changes was dramatic, but all indicate that sludge initially discharged from a treatment plant is somewhat different from sludge that is stored or lagooned.

INDEX TERMS: Sewage sludge, Waste identification, Characterization, Chemical sludges, Sludge treatment, Pollutant identification, Missouri River, Settleable solids.

AMIC-7990

"INSTRUMENTAL AND NUMERICAL CONSIDERATIONS FOR ON-LINE INTERPRETATION OF HIGH RESOLUTION MASS SPECTRAL DATA", Hilmer, R. M., Taylor, J. W., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1031-1045.

Several important instrumental characteristics of an AEI-MS9 double focusing mass spectrometer in the Nier-Johnson configuration are discussed which influence the choice of techniques for on-line data acquisition and numerical methodology for high resolution mass spectral data processing. The approach described yields an average error of less than 10 ppm in mass measurement, and peaks as small as 0.05 percent of the tallest peak are observed. Instrument vibration raises the average mass error. Values below 3 ppm are obtained from data where vibration isolation has been attempted. The time of execution of the data reduction is about 3-10 min on the Raytheon 706 computer, and about 15-60 sec per spectrum on the Univac 1108. The computing times depend on the number of multiplet peaks to be deconvoluted, the number of peaks in the spectrum, and the number of atoms allowed in the elemental formulas. (Reprinted from Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1031-1045. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Data processing, Computer programs, Mass spectrometry, Pollutant identification, Mass spectra.

AMIC-7991

"POLYAROMATIC HYDROCARBONS IN HIGH-BOILING PETROLEUM DISTILLATES] ISOLATION BY GEL PERMEATION CHROMATOGRAPHY AND IDENTIFICATION BY FLUORESCENCE SPECTROMETRY", McKay, J. F., Iatham, D. R., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1050-1055.

The identification of seven polyaromatic ring systems in petroleum is reported. The ring systems are 1,12,2,3-dibenzoperylene; 1,12-o-phenyleneperylene, pyreno-(1,3:10',2')pyrene; 2,3,10,11-dibenzoperylene; 1,2,4,5-dibenzopyrene, benzo(e)pyrene, and benzo(g)chrysene. These polyaromatic hydrocarbons were isolated by a separation scheme involving ion exchange chromatography, gel permeation chromatography, and thin-layer chromatography and were identified by fluorescence spectroscopy. Gel permeation chromatography separated pericondensed aromatic ring systems from catacondensed ring systems and the other components of an acid concentrate. (Reprinted from Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1050-1055. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Separation techniques, Polyaromatic hydrocarbons, Gel permeation chromatography, Ion exchange chromatography, Thin layer chromatography, Fluorescence spectroscopy.

AMIC-7992

"OPTIMUM PROCEDURE FOR THE DETERMINATION OF SELENIUM IN BIOLOGICAL SPECIMENS USING Se-77m NEUTRON ACTIVATION", Blotcky, A. J., Arsenault, L. J., Rack, E. P., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1056-1060.

An optimum procedure is outlined for the rapid quantitative determination of trace (greater than or equal to 0.06 microgram) selenium in serum and tissue using Se-77m neutron activation. Sample preparation, irradiation procedures, types of detector assemblies, and spectral analyses and data reduction are discussed. The optimum procedure utilizing a low-power nuclear reactor consisted of irradiating lyophilized tissue samples or dialyzed-lyophilized serum samples for 20 sec, with a 20-sec decay time prior to radioassay. The most suitable radioassay assembly was the 5-mm X 3-in NaI (Tl) detector system. Spectral analyses and data reduction consisted of eliminating the interferences of isotopes of relatively long half-lives by spectrum subtraction and correction. Comparisons between the results obtained by the discussed Se-77m procedure and values quoted for an NBS Bovine Liver Standard were excellent.

INDEX TERMS: Neutron activation analysis, Data processing, Tissue, Blood, Selenium.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8009

"APPLICATION OF LIQUID CHROMATOGRAPHY TO POLLUTION ABATEMENT STUDIES OF MUNITION WASTES", Walsh, J. T., Chalk, R. C., Merritt, C., Jr., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1215-1220.

Since waste waters from TNT manufacture contain nitrobenzenes which are toxic (2.5 ppm toxic to fish), explosive, and colored, they constitute a serious pollution hazard. The application of liquid chromatography to pollution abatement studies of TNT waste waters is described. These studies include the characterization by liquid chromatography of the color formation occurring in TNT water, the development of a simple, direct analysis for alpha-TNT and a description of how liquid chromatography was used to evaluate pollution abatement processes for the removal of nitrobenzenes from munition waste waters. The abatement processes investigated were the column adsorption type, which required absorption isotherm, breakthrough capacity, saturation capacity, and column regeneration efficiency data. The acquisition of these data by liquid chromatographic means is described. The results showed that an adsorbent resin of the styrene-divinylbenzene copolymer type possessed nitrobenzene adsorption efficiencies at least equal to those of activated carbon and had the important added advantages of easy chemical regeneration and a significantly long life cycle.

INDEX TERMS: Waste water (pollution), Water analysis, Adsorption, Resins, Industrial wastes, Pollution abatement, Separation techniques, Color, Activated carbon, Fish, Toxicity, TNT, Liquid chromatography.

AMIC-8017

"IRON SPECTRAL INTERFERENCE IN THE DETERMINATION OF ZINC BY ATOMIC ABSORPTION SPECTROMETRY", Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1274-1275.

Aqueous solutions were prepared for atomic absorption spectrometry by dissolving iron sponge in HCl, drying, and dissolving in distilled water. These solutions were used to demonstrate that iron solutions, completely free of zinc, absorbed at the zinc resonance line. Iron was extracted from samples of the solution for analysis of zinc. Absorption curves showed that the determination of low levels of zinc in ferrous materials may lead to erroneously high results unless steps are taken to remove iron from the samples prior to analysis. Solutions which contain between 0.2 to 2.0 percent iron will be erroneously high by 16 and 13 micrograms/g Zn, respectively. It is suggested that existing analyses of zinc on ferrous materials should be approached with caution.

INDEX TERMS: Zinc, Aqueous solutions, Chemical interference, Atomic absorption spectrophotometry.

AMIC-8016

"CHELOMETRIC TITRATIONS OF METAL CATIONS USING THE TUNGSTEN BRONZE ELECTRODE", Wechter, M. A., Hahn, P. B., Ebert, G. M., Montoya, P. R., Voigt, A. F., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1267-1269.

Tungsten bronze electrodes were used with saturated calomel electrodes in the potentiometric titration of solutions of Al(III), Zn(II), Cu(II), Fe(III), Ca(II), and Mg(II). Solutions were prepared by dissolving Al, Zn, and Cu in HNO₃ and diluting and by dissolving salts of the remaining elements. Solutions were buffered with NH₃/NH₄Cl or NH₄NO₃ and titrated with EDTA. There was excellent agreement between calculated and observed values. Oxygen in the solutions did not interfere in the titrations. It is concluded that in order to perform a successful metal ion titration, only one of the following criteria need be met: the metal ion be titratable in basic solution either directly or indirectly, the ion be easily reducible directly at the electrode surface, or a metal redox couple be present which undergoes a change in concentration ratio at the end point.

INDEX TERMS: Volumetric analysis, Aluminum, Zinc, Copper, Iron, Calcium, Magnesium, Tungsten bronze electrodes, Ion selective electrodes.

AMIC-8018

"APPLICATION OF A SULFATE-SENSITIVE ELECTRODE TO NATURAL WATERS", Jasinski, R., Trachtenberg, I., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1277-1279.

Iron-doped chalcogenide glass electrodes were used to investigate potential interferences during analysis of sulfate ions in natural waters of high sulfate content. The method was based on barium sulfate precipitation. Test solutions were prepared in which Ca, K, and Mg were added as interfering ions. Samples of waste water, brackish water, and sea water were also analyzed. A Ag/AgCl electrode was used as reference in the analyses. The resulting difficulties introduced by the ions considered were essentially the same as in all barium sulfate methods. Sodium ion and chloride ion at a hundredfold excess caused no problems. Potassium ion interfered at this concentration level via coprecipitation; 94 percent recovery was obtained for 0.02 M sulfate ion in 0.1 M KCl. Magnesium and calcium distort the end point because of simultaneous complexation with sulfate ion; this does not cause a major problem with the titration technique. Although calcium also coprecipitates, this effect is sufficiently reproducible to allow for correction if the Ca content is known. At high sulfate concentrations the sample can be diluted to minimize interference.

INDEX TERMS: Sulfates, Sea water, Waste Water (pollution), Brackish water, Potassium, Chlorides, Magnesium, Ion selective electrodes, Chemical interference.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8020

"PREDICTION OF K SUB sp FROM R SUB f VALUES. CHROMATOGRAPHY OF 48 METAL IONS ON STANNIC ARSENATE AND PLAIN PAPERS IN BUTANOL-NITRIC ACID MEDIA", Quereshi, M., Sharma, S. D., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1283-1288.

The chromatography of 48 metal ions was systematically studied in butanol-HNO₃ systems on plain and ion exchange papers. Solutions were prepared of K, Rb, Cs, Cu, Ca, Pd, Zn, Mn, Co, Ni, Hg, Cd, Ba, Sr, Be, Mg, Pb, UO₂, Fe₂(III), VO, Sm, Pr, Nd, Fe(III), In, Ga, La, Y, Al, Cr, Ce(III), Bi, Sb, Au, Ru, Ir, Th, Hf, Ti, Ce(IV), Cb, Mo, W, Pt, Ag, and Tl and spotted on the papers. Separations are given on the basis of R sub f values. In addition, the K sub sp of the arsenates of K, Rb, Cs, Tl, Y, La, Ga, and Ce were predicted on the basis of the R sub f values.

INDEX TERMS: Metals, Separation techniques, Ion exchange, Paper chromatography.

AMIC-8022

"DETERMINATION OF TRACES OF THALLIUM IN URINE BY ANODIC STRIPPING AC VOLTAMMETRY", Levit, D. I., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1291-1292.

The purpose of this work was to apply the ac anodic stripping voltammetry technique with the hanging mercury drop electrode (HMDE) in a body fluid urine in order to determine, rapidly and directly, traces of thallium by measuring the current peak which results from the fundamental harmonic as stripping voltammogram record. The behavior of thallium was examined, and the presence of interferences such as lead, dissolved oxygen, organic compounds, and other complication that effect the electrode process by adsorption were minimized under the selected conditions of experimentation. The sensitivity of the method was improved by a low background current and was reproducible within 2.5 percent for 0.05 ppm thallium in urine. The Tl (I) wave had a symmetrical shape, and its ac peak was a linear function of the concentration in the micromolar range without interference from overlapping waves. Pre-treatment by dilution, cell exchange, use of complexing agents, degasification, and foaming were not required.

INDEX TERMS: Urine, Thallium, Chemical interference, Anodic stripping voltammetry.

AMIC-8021

"DETERMINATION OF NITROGEN-15 BY CHEMICAL IONIZATION MASS SPECTROMETRY", Lundeen, C. V., Viscomi, A. S., Field, F. H., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1288-1290.

A technique is presented for determining N-15 using isobutane chemical ionization mass spectrometry. The method is based on the fact that ammonia is easily protonated by the tert-butyl ion in isobutane chemical ionization mass spectrometry to produce the NH₄⁺ ion, but water is not protonated to produce the H₃O⁺ ion. Consequently, the relative amounts of N-15 and N-14 in ammonia containing both of these isotopes are obtained from the intensities of the m/e 18 and 19 ions produced where ammonia is introduced into the mass spectrometer. The ammonia to be measured is produced from the original nitrogenous material by acid digestion and is absorbed on solid stearic acid. The stearic acid is placed in the solids introduction probe and heated to release the ammonia.

INDEX TERMS: Mass spectrometry, Sample preparation, N-15.

AMIC-8030

"GAS CHROMATOGRAPHIC DETERMINATION OF RESIDUES OF METHYLCARBAMATE INSECTICIDES IN CROPS AS THEIR 2,4-DINITROPHENYL ETHER DERIVATIVES", Holden, E. R., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 3, May 1973, pp 713-717.

A general procedure was developed for determining methylcarbamates in plant materials. The pesticides investigated were Aminocarb, Bay 32651, Bay 78537, Bux, Carbanolate, Carbaryl, Carbofuran, Ciba C-9643, Decarbofuran, Hercules 5727, Hercules 9007, Landrin, Mesurol, Mexacarbate, Mobam, Promecarb, and Propoxur. The residue was extracted from crop material with acetonitrile, and the extractive purified by partitioning with petroleum ether and coagulating with phosphoric acid-ammonium chloride solution. Phenolic impurities were largely eliminated by partitioning a methylene chloride extract with 0.1 N potassium hydroxide. Carbamate residues were then treated with 1-fluoro-2,4-dinitrobenzene to form the ether derivative without a prior hydrolysis step. Efficiency in the conversion of the phenolic moieties to the phenyl ethers was essentially 100 percent, thus providing for good reproducibility. Residues were determined at levels as low as 0.05 ppm. Recoveries generally ranged between 90 and 110 percent.

INDEX TERMS: Separation techniques, Gas chromatography, Plant tissues, Sample preparation, Detection limits, Methylcarbamate pesticides, Aminocarb, Bay 32651, Bay 78537, Bux, Carbanolate, Carbaryl, Carbofuran, Ciba C-9643, Decarbofuran, Hercules 5727, Hercules 9007, Landrin, Mesurol, Mexacarbate, Mobam, Promecarb, Propoxur.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8032

"COMPARATIVE EXTRACTION OF CHLORINATED HYDROCARBON INSECTICIDES FROM SOILS 20 YEARS AFTER TREATMENT", Nash, R. G., Harris, W. G., Ensor, P. D., Woolson, E. A., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 3, May 1973, pp 728-732.

Three methods, shake, Soxhlet, and column, were compared for efficiency of extraction of certain chlorinated hydrocarbon insecticides from a Congaree sandy loam soil which had been treated 20 years earlier. Column extraction had a tendency to be less efficient than the other 2 methods, but statistically there were no differences in extraction efficiencies among the 3 methods for aldrin, dieldrin, heptachlor, chlordane, isodrin, endrin, toxaphene, or Dilan and their residue products. However, shake extraction was significantly more efficient for the BHC isomers than Soxhlet extraction and the latter was significantly more efficient than column extraction.

INDEX TERMS: Soil analysis, Pesticide residues, Chlorinated hydrocarbon pesticides, Aldrin, Dieldrin, Endrin, Heptachlor, DDT, Shake extraction, Soxhlet extraction, Column extraction, Isodrin, Chlordane, Toxaphene, BHC, Delan, Heptachlor epoxide, Nonachlor, Lindane.

AMIC-8038

"MERCURY CONTAMINATION OF FISH IN NORTHWESTERN ONTARIO", Fimreite, N., Reynolds, L. M., Journal of Wildlife Management, Vol. 37, No. 1, January 1973, pp 62-68.

Fish to be analyzed for mercury were gill-netted from 18 lakes and rivers in Northern Ontario, some of which were upstream and downstream from a chlorine plant which had leaked about 3,000 lbs of mercury annually from 1962-1970. Samples consisted of 186 specimens of walleye, northern pike, lake trout, burbot, rock bass, and white sucker. Mercury content was determined in lateral musculature by wet digestion of the samples followed by cold vapor atomic absorption spectrophotometry. The maximum mercury levels in northern pike, burbot, and walleye were 27.8, 24.8, and 19.6 ppm respectively, measured in specimens taken 50-60 miles downstream from the plant. They decreased proportionally to the distance from the plant but were clearly elevated even 200 miles downstream. The levels in specimens from suspected uncontaminated lakes were generally below 1 ppm but frequently above the 0.2 ppm often considered as the maximum background concentrations. The latter finding may possibly be explained on the basis of the oligotrophic conditions characteristic for these lakes.

INDEX TERMS: Mercury, Freshwater fish, Water pollution effects, Industrial wastes, Water pollution sources, Rock bass, Walleye, Lake trout, Chlorine plants, Atomic absorption.

AMIC-8034

"AN ISOLATION AND CLEANUP PROCEDURE FOR LOW LEVELS OF ORGANOCHLORINE PESTICIDE RESIDUES IN FATS AND OILS", Porter, M. L., Burke, J. A., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 3, May 1973, pp 733-738.

An isolation and cleanup is described for low levels of organochlorine residues (about 0.005 ppm) in fats and oils, prior to electron capture gas-liquid chromatography. Corn oil, butterfat, cod liver oil, chicken fat, and several dietary composites were used in the analyses for lindane, DDE, TDE, DDT, Mirex, heptachlor epoxide, endosulfan I and II, dieldrin, endosulfan sulfate, and Aroclor 1254. The fat or oil was distributed on a column of unactivated Florisil and the residues partitioned into an eluant of 10 percent water in acetonitrile. Florisil column chromatography with an elution solvent system comprised of mixtures of methylene chloride, acetonitrile, and hexane was used for the final cleanup. Extracts prepared in this manner were sufficiently free of fatty extractives to permit injection of the equivalent of 50-60 mg fat sample for GLC. The procedure should be especially useful in determination of low levels of organochlorine pesticide residues in the fat of certain dietary composites.

INDEX TERMS: Oil, Chlorinated hydrocarbon pesticides, Lipids, DDE, DDD, DDT, Dieldrin, Aroclors, Separation techniques, Pesticide residues, Polychlorinated biphenyls, Cleanup, Lindane, Mirex, Heptachlor epoxide, Endosulfan I, Endosulfan II, Endosulfan sulfate, Aroclor 1254.

AMIC-8045

"A METHOD FOR THE DETECTION OF TRACES OF NITROSAMINES USING COMBINED GAS CHROMATOGRAPHY AND MASS SPECTROMETRY", Gough, T. A., Webb, K. S., Journal of Chromatography, Vol. 79, May 16, 1973, pp 57-63.

A gas chromatograph and high-resolution mass spectrometer, coupled via a membrane separator, were used for the analysis of samples of water and foods for traces of nitrosamines. The nitrosamines studied were dimethyl, diethyl, dipropyl, dibutyl, piperidyl, and pyrrolidyl. The nitrosamines were detected by parent ion monitoring with a detection limit of 11 mg/l on injected material. The gas chromatograph incorporates a pressure-programming and peak-cutting device which is described in detail. Overall analysis time is substantially shorter than for isothermal or temperature-programmed runs.

INDEX TERMS: Water analysis, Foods, GC-Mass spectrometry, Nitrosamines.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8046

"CHROMATOGRAPHIC SEPARATION OF PHENOLS USING AN ACRYLIC RESIN", Fritz, J. S., Willis, R. B., Journal of Chromatography, Vol. 79, May 16, 1973, pp 107-119.

A liquid chromatograph is described that uses gas pressure on water to force eluents through the column. A macroporous polyacrylate resin, Amberlyst XAD-7, was used in conjunction with methanol-water or basic aqueous eluents for separation of mixtures of phenols. The elution characteristics of twenty-one phenols are described. These included bromophenols, chlorophenols, cresols, and methylphenols. Several separations of actual mixtures are shown to demonstrate the separation capabilities of this system.

INDEX TERMS: Separation techniques, Phenols, Resins, Aqueous solutions, Amberlyst XAD-7, Liquid chromatography, Chlorophenol, Methylphenol, Bromophenol.

AMIC-8053

"A NEW CHROMOGENIC REAGENT FOR THE DETECTION OF PHENOLIC COMPOUNDS ON THIN-LAYER PLATES", Bhatia, I. S., Singh, J., Bajaj, K. L., Journal of Chromatography, Vol. 79, May 16, 1973, pp 350-352.

A sensitive chromogenic reagent has been described that not only detects most of the naturally occurring phenolic compounds, but can also be used to detect specifically the ortho-dihydroxy group on both Silica Gel G and polyamide thin layers. Four micrograms of phenolic compounds dissolved in acetone were spotted on to thin-layer plates. The plates were sprayed with chromogenic reagent I which consists of sodium tungstate, TCA, HCl, and sodium nitrite solution. After 3 min, chromogenic reagent II (NaOH solution) was sprayed on the plates. With polyamide, after using reagent I, the thin layers are dried at 30 degrees for a few minutes and then lightly sprayed with reagent II. Fifty-two phenolic compounds are listed giving the color reaction with the reagent on thin-layer plates.

INDEX TERMS: Phenols, Pollutant identification, Color reactions, Methodology, Chemical analysis, Organic acids, Thin-layer plates, Chromogenic reagents, Silica gel G, Polyamide, Aldehydes.

AMIC-8051

"SEPARATION OF MANGANESE, IRON, COBALT, NICKEL, COPPER, ZINC AND CADMIUM BY REVERSED-PHASE CHROMATOGRAPHY USING TRI-N-OCTYLAMINE AS THE STATIONARY PHASE AND APPLYING A GRADIENT ELUTION TECHNIQUE", Neef, B., Grosse-Ruyken, H., Journal of Chromatography, Vol. 79, May 16, 1973, pp 275-285.

A procedure is described for the separation of manganese, iron, cobalt, nickel, copper, zinc and cadmium by means of reversed-phase chromatography. The distribution coefficients of these elements were determined by extraction with tri-n-octylamine-benzene (1:1) solution from hydrochloric acid and hydrochloric acid-nitric acid mixtures. In addition, the influence of particle size, degree of loading of silica gel with tri-n-octylamine, flow-rate and temperature on the height of effective theoretical plate was investigated. A gradient apparatus which was developed for this kind of separation is described; by insertion of circuitous tubes between the mixing vessels and the column head, a concentration gradient can be obtained for the eluent that is partly constant and partly decreased.

INDEX TERMS: Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Cadmium, Separation techniques, Heavy metals, Reversed phase chromatography, Distribution coefficients, Chromatograms.

AMIC-8054

"SEPARATION OF NTA AND EDTA CHELATES BY THIN-LAYER CHROMATOGRAPHY", Rajabalee, F. J. M., Potvin, M., Laham, S., Journal of Chromatography, Vol. 79, May 16, 1973, pp 375-379.

The chromatographic behavior of metal-NTA chelates on silica gel is described as well as their separation from the corresponding EDTA chelates. The metal-EDTA and metal-NTA chelates, and metal ions were applied to silica gel thin-layer plates in aqueous solutions. The amount spotted was 0.5 microgram for the metal ions and NTA chelates, and 2 micrograms for the EDTA chelates. The spots were revealed by the spraying technique and the colors observed in daylight. At high pH (solvents containing more than 1 percent of ammonia) chelate decomposition occurs and, in several cases, double fronts are observed. Only the nickel-NTA chelates were stable under these conditions. In weakly basic and neutral solvents, separation occurred and reliable R sub F values were obtained. These were identical for the different NTA chelates of the same metal, irrespective of the number of NTA moieties in the molecule. The TLC method is rather effective for separating mixtures of EDTA and NTA chelates. The metal cations can also be distinguished by the characteristic colors observed with the different spray reagents used. For a given divalent metal, the NTA chelate migrates faster in the same solvent than its EDTA analog, being less polar than the latter.

INDEX TERMS: Separation techniques, Pollutant identification, Aqueous solutions, Color reactions, Alkali metals, Heavy metals, Methodology, Thin layer chromatography, Metal-EDTA chelates, Metal-NTA chelates, Mixtures, Chromogenic reagents.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8077

"HYDROCARBONS IN THE PELAGIC SARGASSUM COMMUNITY", Burns, K. A., Teal, J. M., Deep-Sea Research and Oceanographic Abstracts, Vol. 20, No. 2, February 1973, pp 207-211.

Samples of pelagic Sargassum weed and associated macrofauna were collected by dip-netting from ships using precautions against shipboard contamination described by Grice et al (1972). Before extraction, the plants were shaken free of animals and washed with pentane to remove surface contamination without disrupting the cells. These washings were analyzed to determine hydrocarbons adsorbed on the plant surface. Pentane-washed animals were gutted for stomach analysis, cut into small pieces, Soxhlet extracted with distilled methanol for 48 hr, and this lipid extract partitioned into acid-washed, sodium distilled pentane. The pentane extract was concentrated, dried, purified on a 1:1 (vol: vol) column of alumina over silica gel, eluted and chromatographed on a 3 percent Apiezon L on Chromasorb W AW-DM CS) column. All the organisms appeared contaminated with petroleum hydrocarbons. There was no relation between the amount of natural, recently biosynthesized hydrocarbons in an organism and the amount of petroleum contamination. Animals had a larger ratio of petroleum to natural compounds than the Sargassum. There was no relation between the hydrocarbon content and the animals supposed positions in the food chain.

INDEX TERMS: Chemical analysis, Plant tissues, Biological communities, Water sampling, Gas chromatography, Marine algae, Marine fish, Crustaceans, Food chains, Hydrocarbons, Sargassum natans, Animal tissues, Fingerprinting, Sample preparation, Petroleum hydrocarbons, Natural hydrocarbons.

AMIC-8081

"PARATHION EXPOSURE STUDIES. A GAS CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF LOW LEVELS OF p-NITROPHENOL IN HUMAN AND ANIMAL URINE", Bradway, D. E., Shafik, T. M., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 3, March 1973, pp 134-139.

A method for the determination of low levels of p-nitrophenol in rat and human urine was developed. The method involves acid hydrolysis of urine, extraction with benzene, derivatization of p-nitrophenol using an electron capture detector. Recoveries of fortified rat and human urine samples averaged in the range of 85-97 percent. The limits of detectability were 0.05 ppm for rat urine and 0.02 ppm for human urine. The method was applied to the analysis of p-nitrophenol in urine of rats exposed to 0.1 and 0.01 LD50 of parathion.

INDEX TERMS: Urine, Methodology, Chemical analysis, Organic compounds, Animal metabolism, Electron capture gas chromatography, p-Nitrophenol, Sample preparation, Chemical recovery, Detection limits.

AMIC-8083

"GEOTHERMAL MERCURY POLLUTION IN NEW ZEALAND", Weissberg, B. G., Zobel, M. G. R., Bulletin of Environmental and Toxicology, Vol. 9, No. 3, March 1973, pp 148-155.

In connection with the study of the magnitude and extent of natural mercury pollution arising from geothermal sources in New Zealand, rainbow and brown trout and sediments from the Waikato River lakes and some of the Rotorua lakes were analyzed for total mercury. A modified, stannous chloride reduction-aeration flameless AA technique, after wet ashing with nitric and sulfuric acids was used in the analysis. Check analyses, specific for methylmercury, were performed by gas chromatography on half of the trout samples. The results indicate much higher concentrations of mercury in trout living in waters receiving considerable geothermal discharges (Upper Waikato River, Lake Rotorua, and Lake Rotomahana) than in trout living in similar waters receiving little or no geothermal discharges (Lake Taupo and Lake Okareka). The concentrations of mercury in trout within a given lake increased with increasing fish weight, consistent with observations by others, and no distinct differences in mercury concentrations were observed between rainbow and brown trout, or between male and female trout of the same species, apart from the weight factor. The concentrations of mercury in sediments showed no apparent variation with increasing depth (i.e. age) of sediments.

INDEX TERMS: Mercury, Rainbow trout, Brown trout, Bottom sediments, Chemical analysis, Lake sediments, Fluvial sediments, Water pollution sources, New Zealand, Muscle, Reduction aeration technique, Flameless atomic absorption spectrophotometry, Sample preparation.

AMIC-8084

"ELECTRON CAPTURE GAS CHROMATOGRAPHIC ANALYSIS OF DDA: UTILIZATION OF 2-CHLOROETHANOL DERIVATIVE", Cranmer, M. F., Copeland, M. F., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 3, March 1973, pp 186-192.

The use of the 2-chloroethanol derivative is reported in the electron capture gas chromatographic analysis of DDA (the carboxylic acid metabolite of DDT). The efficiency of conversion of DDA to the 2-chloroethanol derivative was 91.5 plus or minus 1.0 percent. The utilization of a silica gel column for clean up prior to electron capture analysis is discussed and the elution pattern for the 2-chloroethanol derivative is given with a recovery of 97.3 plus or minus 0.1 times more responsive to electron capture detection than the methyl ester of DDA and produces a retention time which separates the DDA from other chlorinated hydrocarbon pesticides which might interfere with the analysis.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Chemical analysis, Pollutant identification, Electron capture gas chromatography, p p'-DDA.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8090

"GLUCOSE FLUX AT THE SEDIMENT-WATER INTERFACE OF TORONTO HARBOUR, LAKE ONTARIO, WITH REFERENCE TO POLLUTION STRESS", Wood, L. W., Chua, K. E., Canadian Journal of Microbiology, Vol. 19, No. 4, April 1973, pp 413-420.

Cycling of glucose at the sediment-water interface was determined through coupling measurement of natural substrate concentrations with heterotrophic uptake by the natural microbial communities in the sediment and in the water column. Freshly collected cores containing both a sample of the water column above the sediment-water interface as well as 20 cm of undisturbed benthic community were used for glucose analysis. The analysis for glucose followed the biochemical method of Hicks and Carey (1968). Determinations of heterotrophy in water were done by the methods of Wright and Hobbie (1966) as corrected for respiratory loss of C-1402 by Hobbie and Crawford (1969). Determinations of aerobic heterotrophy in sediment were essentially the same as those using water except that the added glucose (5-20 microliters) ranged from 27.5 to 102.5 micrograms/liter. The same general cycling pattern was found for both polluted and less polluted parts of Toronto Harbour, so that other labile organic species possibly have similar cycles. Velocity of uptake of glucose (flux) and turnover time showed no relationship to either substrate concentration or total organic matter of the sediments. Activity in the water column could be supported to a major extent by sediment export of substrate by turbulent diffusion. Sediment activity must be supported by particulate sedimentation and hydrolysis of large organic molecules, which may be aided by the macrobenthic community. Pollution stress apparently alters the catabolism of the substrate. The observed substrate concentrations may reflect a minimum of residual concentration, below which the microbial community has difficulty in taking up the substrate.

AMIC-8090 (Continued)

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INDEX TERMS: Cycling nutrients, Sediment-water interfaces, Lake Ontario, Water pollution effects, Aquatic microorganisms, Water analysis, Lake sediments, Glucose, Heterotrophy, Nutrient flux, Fate of pollutants.

AMIC-8105

"IMPROVED WATER ANALYSIS KIT", Collins, W. H., Franklin Institute Research Laboratories, Philadelphia, Pennsylvania, Report Nos. LWL-CR-03B69, FIRL-F3222-02/03, Contract No. DAAD05-72-C-0113, December 1972, 20 pp. NITS Report No. AD-756 952.

An Improved Water Test Kit which is smaller in size and simpler to use and stock than Water Quality Control Set, PSN 6630-262-7288, Standard B, has been developed by The Franklin Institute Research Laboratories for the U. S. Army Land Warfare Laboratory. The kit has a minimum of glassware, weighs 4 1/2 pounds, measures 9 X 6 X 6 inches and used techniques completely different than former methods. Eliminated is the need of preparing reagents, performing titrations and other tedious measurements. Most of the tests are conducted by dipping a paper or plastic strip into the water sample and reading the height of a column or comparing the color obtained to a chart. No complicated calculations are required. Water samples can be examined for pH, acidity, alkalinity, chlorine residual, chlorine demand, chloride, sulfate, turbidity and coagulation characteristics. Each kit contains enough material to examine at least 50 water samples for each of the above characteristics before requiring refill. The simplicity of the kit allows personnel with little or no training to use it effectively.

INDEX TERMS: Water analysis, Water quality, Equipment, On-site tests, Testing procedures, Instrumentation, Water properties, On-site investigations, Physical properties, Chemical properties.

AMIC-8108

"ANALYTICAL METHOD FOR DETERMINATION OF INORGANIC NITRITES IN NATURAL STREAM WATER", Sam, D., Naval Ordnance Laboratory, Silver Spring, Maryland, Report No. NOLTR-72-295, Contract No. ORD332005-201-23, December 26, 1972, 10 pp. NTIS Report No. AD-755 697.

A sensitive and reliable procedure has been developed which is applicable for determination of inorganic nitrites in natural stream water in concentrations as low as 0.1 micromole/liter or for the determination of 1.4 ppb of nitrogen. Samples are concentrated by an ion exchange procedure prior to the spectrophotometric measurement of the nitrite in the form of an azo dye. The spectrophotometric measurement of the azo dye is found to conform to Beer's law. The nitrite sample is treated with sulfanilic acid and N-(1-Naphthyl)-ethylenediamine dihydrochloride to form a red azo dye. The dye is passed through a column of Dowex 1-X8, 50-100 mesh, anion exchange resin and then it is eluted with 60 percent acetic acid. The resulting effluent is measured in a Cary 16 spectrophotometer at 550 nm in a cell of 10 cm optical path. Natural stream water samples were used to check the validity of the procedure.

INDEX TERMS: Nitrites, Water analysis, Natural streams, Chemical analysis, Methodology, Anion exchange, Inorganic compounds, Spectrophotometry, Water pollution, Color reactions, Nitrogen, Degradation (decomposition), Pollutant identification, Natural waters, Detection limits, Sample preparation, Ion exchange resins, TNT.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8117

"EVIDENCE FOR BUFFERING OF DISSOLVED SILICON IN FRESH WATERS", Edwards, A. M. C., Liss, P. S., Nature, Vol. 243, No. 5406, June 1973, pp 341-342.

Documented studies are presented which illustrate the low temporal and spatial variability found for dissolved silicon levels in freshwater. Sorption reactions involving dissolved silicon and solid phases are posed as the more likely buffer mechanism responsible for controlling the concentration of dissolved silicon in rivers, lakes and soils.

INDEX TERMS: Freshwater, Temporal distribution, Spatial distribution, Variability.

MIC-8128

"ANALYSIS OF ORGANIC CONSTITUENTS PRESENT IN DRINKING WATER", Novak, J., Zluticky, J., Kubelka, V., Mostecky, J., Journal of Chromatography, Vol. 76, February 7, 1973, pp 45-50.

Polluted drinking water was extracted with carbon tetrachloride or nitrobenzene and the extracts were analyzed by GC-mass spectrometry. The UV and IR spectra were also recorded. A further extraction procedure consisted of bubbling an inert gas (helium) through the water and analyzing by GC-MS. The carbon tetrachloride and nitrobenzene extracts did not reveal the presence of any organic compounds; however, when the inert gas was bubbled through the water, several organic compounds were detected. These were C1-C4 hydrocarbons, pentene, cyclopentane, cyclopene, and methylcyclopentane, cyclopentadiene, cyclohexane, cyclohexene, isobutanol, tetrachloromethane, benzene, trichloromethylene, chloroform, tetrachloroethylene, toluene, dichloroethane, and xylene. Although the source of the compounds was not determined, it was concluded that the limit of detection with bubbling inert gas through the sample is two to three orders higher than with extraction by organic solvents. One limitation of the method is that substances which boil above 100 C cannot be determined.

INDEX TERMS: Separation techniques, Organic compounds, Potable water, GC-Mass spectrometry, Detection limits, Organic solvents, Inert gases, Gas bubbling.

AMIC-8136

"MASS SPECTROMETRIC DETERMINATION OF DIETHYLDITHIOCARBAMATES", Wood, B. C., Skogerboe, R. K., Applied Spectroscopy 27, No. 1, January/February 1973, pp 10-12.

The determination of diethyldithiocarbamate chelates of As, Cd, Cu, Pb, and In by direct insertion probe mass spectrometry is reported. Extractions directly into the diethylammonium diethyldithiocarbamate-methyl isobutyl ketone (DADDC-MIBK) solutions were carried out at the appropriate pH by the procedures outlined by Joyner and Finley (1966), Nix and Goodwin (1970), and Trujillo (1971). The extracts were stored in clean vials from which microliter quantities were delivered to the quartz sample holder of the direct insertion probe. The measurements made on the above elements were generally reproducible to plus or minus 10 percent. Assuming an instrument blank of 1 ng, each of these elements can be determined at levels ranging from 0.5 to 1 ng via this technique. Such determination capabilities are equivalent to 0.01 ppm in a 10-ml aqueous sample extracted into 1 ml of MIBK using a 10-microliter sample of the extract for the analysis.

INDEX TERMS: Heavy metals, Mass spectrometry, Methodology, Aqueous solutions, Pollutant identification, Chemical analysis, Cadmium, Copper, Lead, Zinc, Solvent extraction extractions, Chelation, Metal chelates, Diethyldithiocarbamates, Direct insertion probe, Sample preparation, Organic solvents, Arsenic, Reproducibility, Mass spectra, Detection limits, Accuracy.

AMIC-8144

"IN SITU ACTIVATION ANALYSIS OF MARINE SEDIMENTS WITH CALIFORNIUM-252", Wogman, N. A., Rieck, H. G. Jr., Kosorok, J. R., Perkins, R. W., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington, Report No. CONF-721010-4, September 1972, 14 pp. NTIS Report No. BNWL-SA-4434.

A seabed nuclear probe has been developed which permits the measurement of up to 33 elements at the parts per thousand to parts per million levels in continental shelf areas. These elements include S, Ca, Cl, Mo, Mg, Al, F, K, Na, In, Ga, Nd, Ni, Co, Cu, Ba, Sn, V, I, Eu, Ti, Pb, W, Sb, Dy, Ag, Os, Br, Rh, Pt, La, Ir, and As. The probe consists of a neutron irradiation source, californium-252, which neutron activates the elements in the minerals of interest. These resulting radio-active elements emit characteristic gamma radiation which is analyzed in situ in 2- to 10-minute counting intervals with a Ge(Li) detector system. Details of the irradiation source, the Ge(Li) detector, and spectra taken in situ in a marine environment are discussed with respect to the detection of the minerals at concentrations of economic interest.

INDEX TERMS: Neutron activation analysis, Sediments, On-site investigations, Metals, Halogens, Detection limits, Cf-252.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8164

"FRITTED DISC FUNNELS AND TAPERED STAINLESS STEEL TUBES AND STOPPERS FOR USE IN PESTICIDE RESIDUE ANALYSIS", Levi, I., Nowicki, T. W., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 1, January 1973, pp 20-23.

It has been shown that teflon and other gaskets in blender-extractor apparatus and filter papers give rise to interfering GLC peaks during analysis of pesticide residues in wheat and barley. Two pieces of equipment were developed to avoid these problems. The first was a fritted disc funnel for filtering residue extractions. It consists of a pyrex funnel fitted with a 50 mm diameter medium porosity fritted disc which is annealed to the funnel. The funnel requires suction. The second piece of equipment is a stainless steel tapered tube and stopper assembly which requires no gaskets. Schematic drawings of the tube and stopper are included.

INDEX TERMS: Pesticide residues, Filtration, Laboratory equipment, Filters, Tubes, Chemical interference, Sample preparation, Funnels, Gas liquid chromatography.

AMIC-8168

"RESIDUES OF DDT IN COD FROM NORWEGIAN FJORDS", Bjerk, J. E., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 2, February 1973, pp 89-97.

Samples of cod from four fiords located at the south-western coast of Norway were analyzed for DDT residues by GC. At locality A there were large fruit orchards and a small forest nursery. At C there were fruit orchards, while at B there was a forest nursery only. The fourth locality, D, had no known source of contamination. At A samples were collected at intervals during the spring of 1970. The DDT content in cod liver in samples from A and C was high. The mean values of 10-15 specimens ranged between 12 and 40 ppm, calculated on a wet weight basis, and between 26 and 99 ppm, calculated on the basis of extractable lipids. Three specimens of cod showed residue levels of 90-135 ppm DDT in liver tissue. DDT values in cod from the two other localities were less than 5 ppm. The specimens from A were caught at three sub-localities, and it was found that DDT levels decreased with increased distance from the head of the fiord, where the majority of fruit orchards were located. Significant correlations were found between fish size and DDT content in liver tissue, but not in the sample from locality D. The correlations were destroyed during the spring breakup, the DDT content increasing during this period. o,p'-DDT was also found in samples taken during May and June. The high DDT levels were attributed to the runoff from fruit orchards located on steep slopes in this mountainous area.

INDEX TERMS: Gas chromatography, Pesticide residues, DDT, Water pollution sources, Lipids, Liver, Muscle, Cod (fish).

AMIC-8165

"EFFECTS OF FIXATION ON THE EXTRACTION OF DIELDRIN AND p,p'-DDT FROM MUSCLE TISSUE", Deubert, K. H., Timmerman, J. S., McCloskey, L. R., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 1, January 1973, pp 54-56.

Samples of muscle tissue were taken from codfish, smelt, and brook trout and fixed in formalin or Bouin's fixative to study the effect of fixation on extraction of dieldrin and p,p'-DDT. Frozen samples were used for reference. The results indicate that the use of formalin or Bouin's mixture does not affect the extractability of p,p'-DDT and dieldrin at the low levels occurring in environmental samples. As well, the results indicate that tissue samples fixed in Bouin's solution for histological studies can still be used for dieldrin and DDT analysis.

INDEX TERMS: Separation techniques, Freshwater fish, Marine fish, Dieldrin, DDT, Sample preservation, Formalin, Biological samples, Fixation, Muscle, Bouin's fixative.

AMIC-8171

"GAS-LIQUID CHROMATOGRAPHIC SEPARATION OF SULFUR FROM CHLORINATED PESTICIDE RESIDUES IN WASTEWATER SAMPLES", Baird, R. B., Carmona, L. G., Kuo, C. L., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 2, February 1973, pp 108-115.

Sulfur interference in the GC analysis of chlorinated pesticides was eliminated by the addition of 1.0 percent DC-200 to the column packing of 4.4 percent OV-17 and 4.7 percent QF-1 on 80/100 mesh Gas-Chrom Q solid support. Samples of 13 chlorinated pesticides were analyzed with the column. The effect of the DC-200 addition was to shift the major interfering sulfur peak between those of o,p'-DDE and p,p'-DDE, thus eliminating the sulfur interference with the analysis of these compounds without diminishing the resolution of the remaining pesticides of interest. Routine use of this mixed column demonstrated that satisfactory analysis of sulfur-containing wastewaters and sediments may be performed without lengthy chemical desulfurization or extraction of large quantities of sample followed by detection with a highly selective detector.

INDEX TERMS: Water analysis, Waste water (pollution), Sediments, Sulfur compounds, Separation techniques, Chlorinated hydrocarbon pesticides, DDT, DDD, Endrin, Dieldrin, DDE, Aldrin, Heptachlor, Sulfur, Insecticides, Pesticide residues, Chemical interference, Gas liquid chromatography, Column packing, Heptachlor epoxide, Lindane, BHC.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8175

"COLORIMETRIC ASSAY FOR CARBOXYMETHYLOXYSUCCINATE, A NEW DETERGENT BUILDER",
Viccario, J. P., Ambye, E. L., Journal of the American Oil Chemists' Society, Vol. 50,
No. 6, June 1973, pp 213-217.

A spectrophotometric assay was developed for the quantitative determination of carboxymethyloxysuccinate (CMOS), a new detergent builder. The method was based on the color produced with beta-naphthol in 92.5 percent (w/w) sulfuric acid. As little as 1.0 microgram of carboxymethyloxysuccinate can be measured. Pretreated and untreated samples from sewage effluents and river waters were prepared with solutions of CMOS ranging from 1 to 30 ppm. The samples were centrifuged, Millipore-filtered through a 0.22-micron membrane, and acidified with concentrated HCl to 1.0 N. Milliliter samples were placed into test tubes, evaporated to dryness and assayed according to the prescribed procedure. The CMOS recovery values were almost identical in both the sewage effluent and river water samples; the mean absolute recovery values (least squares slopes) were 97 and 96.4 percent, respectively. The recovery of similar amounts from the same samples, which were treated as described under the pretreatment procedure in Materials and Methods, was 94.5 percent for the primary sewage and 93.7 percent for river water. The results of an investigation to determine which compounds may interfere with detection of CMOS showed that under the prescribed assay conditions, glycolic, lactic, tartaric and dextrose equal in weight to CMOS, contributed only 1.2, 1.5, 4.7 and 1.5 percent errors, respectively. These small errors could be tolerated in most instances. Of particular significance was the lack of interference from the Krebs cycle intermediates, citric, fumaric, malic, oxaloacetic and succinic acids. Formaldehyde and acetaldehyde were also included in this experiment but displayed no absorbances, since both compounds were removed during the evaporation step. The addition of HCl and

AMIC-8175 (Continued)

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evaporation steps not only permitted the use of very dilute samples and an initial concentration of 92.5 percent for maximum sensitivity, but also provided additional specificity to the method by reducing interferences from glycolic and lactic acids, and dextrose.

INDEX TERMS: Assay, Detergents, Methodology, Water analysis, Pollutant identification, Spectrophotometry, Waste identification, Colorimetry, Sewage effluents, Color reactions, Chemical reactions, Waste water (pollution), Trisodium carboxymethyloxysuccinate, Chemical interference, Sample preparation, Sensitivity, Accuracy, Quantitative analysis, Detection limits.

AMIC-8176

"THE DETERMINATION OF ALL DETECTABLE ELEMENTS IN THE AQUATIC PLANTS OF LINSLEY POND AND CEDAR LAKE (NORTH BRADFORD, CONNECTICUT) BY X-RAY EMISSION AND OPTICAL EMISSION SPECTROSCOPY", Cowgill, U. M., Applied Spectroscopy, Vol. 27, No. 1, January/February 1973, pp 5-9.

A method, employing optical and x-ray emission, is described for the determination of all detectable elements in aquatic plants growing in the littoral zone of two lakes in Connecticut. The pondweed and the hornwort accumulate As. Comparative data are presented for the determination of this element by atomic absorption and x-ray emission. The chemical composition of some plants is shown as well as the distribution of the rare earths in various portions of the yellow water lily.

INDEX TERMS: Aquatic plants, Plant tissues, Methodology, Chemical analysis, Littoral, Leaves, Root systems, Floating plants, Rooted aquatic plants, Heavy metals, Alkali metals, Alkaline earth metals, Halogens, X-ray emission spectroscopy, Optical emission spectroscopy, Chemical composition, Macrophytes, Rare earth elements, Linsley Pond, Clear Lake, Sample preparation, Stems, Blossoms.

AMIC-8178

"ATOMIC FLUORESCENCE SPECTROMETRY WITH A GRAPHITE ROD ATOMIZER AND THERMOSTATED ELECTRODELESS DISCHARGE LAMPS", Patel, B. M., Reeves, R. D., Browner, R. F., Molnar, C. J., Winefordner, J. D., Applied Spectroscopy, Vol. 27, No. 3, May/June 1973, pp 171-176.

Atomic fluorescence investigations with a graphite rod atomizer and thermostated multiple element electrodeless discharge lamps (EDL's) are reported for Ag, Cd, Cu, Hg, Pb, Sn, Tl, and Zn. Detection limits in the range 0.1 ng to 0.01 pg have been obtained for these elements using a sample volume of 0.5 microliter. The detection limits are better than, or close to, the lowest reported values obtained by other workers using atomic spectrometric methods. No spectral or chemical interferences have been observed when using multiple element EDL's or standard multielement solutions. The atomic fluorescence signal obtained using argon and argon-hydrogen atmospheres has been studied as a function of the gas flow rates and as a function of height above the graphite rod atomizer. Except for Hg, better fluorescence signals are obtained with argon-hydrogen.

INDEX TERMS: Heavy metals, Aqueous solutions, Cadmium, Copper, Mercury, Lead, Zinc, Chemical analysis, Methodology, Atomic fluorescence spectroscopy, Multielemental analysis, Graphite rod atomizer, Electrodeless discharge lamps, Oil-based solutions, Detection limits, Tin, Thallium, Organometallics.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8187

"GAS CHROMATOGRAPHY OF VARIOUS ELEMENTS AS PHENYL COMPOUNDS", Schwedt, G., Russel, H. A., Zeitschrift fur Analytische Chemie, Vol. 264, No. 4, May 7, 1973, pp 301-303.

The phenyl compounds of thallium, selenium, tellurium, mercury, arsenic, antimony, bismuth and tin are suitable for the analysis of these elements by gas chromatography. They are produced quantitatively except thallium triphenyl when the diethyldithiocarbamates, which are extracted out of acid solution, are reacted with magnesium organic compounds. By gas chromatography the phenyl compounds of all eight elements are separated with one column by utilizing a temperature program. In case of mercury diphenyl complete elution could not be realized. (In German)

INDEX TERMS: Heavy metals, Gas chromatography, Methodology, Pollutant identification, Organic compounds, Mercury, Separation techniques, Chemical analysis, Solvent extractions, Organometallics, Rare earth elements, Thallium, Selenium, Tellurium, Arsenic, Antimony, Bismuth, Tin, Mercury diphenyl, Thallium triphenyl, Complexation, Selenium diphenyl, Tellurium diphenyl, Arsenic triphenyl, Antimony triphenyl, Bismuth triphenyl, Tin tetraphenyl.

AMIC-8193

"SULPHATE DEPOSITION BY PRECIPITATION INTO LAKE ONTARIO", Shaw, R. W., Whelpdale, D. M., Water, Air, and Soil Pollution Vol. 2, No. 1, March 1973, pp 125-128.

Samples of falling precipitation were collected three times at eleven sites along western Lake Ontario. Care was taken that the sampling was done during periods of prolonged, continuous precipitation and also that the collectors (suitably cleaned polyethylene pails) were set out and taken in within approximately 1 hr of the beginning and end of the precipitation, respectively. Measurements of the sulfate concentration in precipitation from individual snow storms of several hours duration indicate that approximately 9-66 mg/sq m of sulfate is being deposited per storm. Using a mean sulfate concentration in precipitation in this region (throughout the year) of 4 mg/l and an annual accumulation of precipitation of 760 mm, the total annual deposition of sulfate by precipitation alone is almost 3 g/sq m, or a total of 4,000 metric tons over the western end of the Lake. The annual deposition of sulfate by precipitation is, therefore, about 0.1 percent of the total mass of sulfate. This is significantly of the same order of magnitude as that discharged directly into the Lake by industry.

INDEX TERMS: Sulfates, Water pollution sources, Precipitation (atmospheric), Snowfall, Lake Ontario, Fate of pollutants.

AMIC-8192

"DISTRIBUTION AND BACKGROUND LEVELS OF MERCURY IN SEDIMENT CORES FROM SELECTED WISCONSIN LAKES", Syers, J. K., Iskandar, I. K., Keeney, D. R., Water, Air, and Soil Pollution, Vol. 2, No. 1, March 1973, pp 105-118.

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. Core samples were collected in the winter of 1970-1971 from deep-water areas from each lake and two cores were also taken from shallow water areas in Mendota and Monocqua. Cores were sectioned at 5-cm intervals and transferred to precleaned glass bottles. Surficial sediments were collected with an Ekman dredge. The samples were stored at 4 C and analyzed within a week post collection. Total Hg was determined on undried samples by wet digestion with H₂SO₄/HNO₃ and subsequent flameless atomic absorption spectrophotometry. A sub-sample was freeze dried and used for the determination of organic C, free iron oxides extractable with citrate-dithionite-bicarbonate, and CaCO₃. The pH of undried samples was measured with a glass electrode. All results were expressed on an oven-dry basis. 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 of 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.

INDEX TERMS: Mercury, Cores, Lake sediments, Pollutant identification, Spatial distribution, Flameless atomic absorption spectrophotometry, Vertical distribution, Sample preparation.

AMIC-8197

"SOME PROCEDURES FOR ISOLATING TOXIC METABOLITES OF PHOSPHOROTHIONATE PESTICIDES FROM ANIMAL TISSUES AND FLUIDS", Machin, A. F., Proceedings of the Society for Analytical Chemistry, Vol. 10, No. 4, April 1973, pp 92-93.

The chromatographic procedures used in separating the metabolites of diazinon, together with some more recent improvements, are discussed. The methods, which include thin-layer, gas, column and high-pressure liquid chromatography, are thought to be generally applicable to metabolites of phosphorothionate pesticides. Thin-layer chromatography is useful both for recognizing toxic metabolites by their inhibition of esterases and for isolating them. Gas chromatography is used extensively for detecting metabolites that contain phosphorus, determining residues and monitoring the progress of purification. A thermionic detector is generally used: its high and selective sensitivity probably make it more suitable than the specific but less sensitive flame-photometric detector. Gas chromatography is convenient for isolating metabolites in microgram amounts for mass spectrometry, for which purpose an instrument designed especially for the collection of labile compounds is used. It is not satisfactory for purifying the much larger amounts needed for nuclear magnetic resonance measurements, however, owing to the difficulty of collecting large fractions quantitatively. Column chromatography is tedious but so far has been the only way to separate dehydrodiazinon from the much larger amounts of diazinon and fat which accompany it. High-pressure liquid chromatography is now being used for some of the isolations. Simple equipment, including a pump built at the author's laboratory, is used with a commercial ultraviolet detector.

INDEX TERMS: Phosphothioate pesticides, Methodology, Chemical analysis, Isolation, Metabolites, Animal tissues, Body fluids.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8206

"MECHANISMS OF TRACE METAL TRANSPORT IN RIVERS", Gibbs, R. J., Science, Vol. 180, No. 4081, April 6, 1973, pp 71-73.

Trace metals transported by the Amazon and Yukon rivers were analytically partitioned among the transport phases: in solutions, ion exchange, organic materials, metallic coatings, and crystalline solids. All samples of water and suspended sediments were obtained at 60 percent of the depth of the main channel in both rivers, upstream of any influence from salt water. All samples were filtered under pressure within 2 hours after sampling, acidified with redistilled HCl to pH 1.5 and stored in polyethylene bottles. The trace metals in solution were concentrated, extracted with MIBK and analyzed by atomic absorption spectrophotometry. The distribution for both rivers is similarly proportioned, with copper and chromium transported mainly in the crystalline solids, manganese in coatings, and iron, nickel, and cobalt distributed equally between precipitated metallic coatings and crystalline solids.

INDEX TERMS: Trace elements, Path of pollutants, Distribution patterns, Heavy metals, Ion exchange, Organic matter, Copper, Chromium, Iron, Nickel, Cobalt, Manganese, Water sampling, Detritus, Chemical precipitation, Sediments, Adsorption, Dissolved solids, Chelation, Pollutants, Amazon River, Yukon River, Transport mechanisms, Metallic coatings, Sample preparation, Crystalline solids, Coprecipitation, Organometallics.

AMIC-8212

"POLYCHLOROBIPHENYLS IN NORTH ATLANTIC OCEAN WATER", Harvey, G. R., Steinhauer, W. G., Teal, J. M., Science, Vol. 180, No. 4086, May 11, 1973, pp 643-644.

Concentrations of polychlorobiphenyls (PCB's) have been measured at the surface and at various depths in the water of the North Atlantic Ocean between 26 degrees N and 63 degrees N. Water samples were either extracted with a hexane-ether mixture, concentrated, and analyzed by electron capture gas chromatography (ECGC) or pumped through a brass or glass column packed with Amberlite XAD-2 resin, eluted with boiling acetonitrile, diluted with distilled water or seawater; extracted with hexane, concentrated and analyzed by ECGC. All analyses were completed on shipboard within 4 hours of sampling. Unfiltered seawater samples collected and analyzed simultaneously with water filtered through a 0.3-micron glass fiber filter or a glass wool plug contained a maximum of 10 percent more PCB than the filtered seawater samples. Three observations can be made from the data: (1) Although the range is very broad, the concentrations of PCB's in the northern North Atlantic average 35 ng/kg (35 parts per trillion (ppt)) in surface waters, and 10 ppt at 200 m. (2) The PCB concentrations decrease with depth. (3) The surface waters of the Sargasso Sea (stations 25-41) have slightly lower surface concentrations of PCB's (27 ppt) than surface waters in other parts of the North Atlantic. The widespread distribution of PCB's in the open North Atlantic supports previous observations that the atmosphere must be the predominant mode of transport.

INDEX TERMS: Polychlorinated biphenyls, Atlantic Ocean, Sea water, Surface waters, Water analysis, Pollutant identification, Organic compounds, Water pollution, Solvent extractions, Chemical analysis, Separation techniques, Electron capture gas chromatography, On board analysis, Sample preparation, Sargasso Sea.

AMIC-8229

"A SIMPLE COULOMETRIC METHOD FOR THE DETERMINATION OF CHLORIDE IN NATURAL WATER", Jacobsen, E., Tandberg, G., Analytica Chimica Acta, Vol. 64, No. 2, April 1973, pp 280-283.

A study was undertaken in order to construct a simple instrument for the coulometric titration of chloride in water. It was found that a very simple battery-operated constant-current source can be used for the titrations. Experiments showed that the current remained constant during the titration at all settings (0.1-4 mA). A 1-mm silver wire was used as generating electrode. The cathode (1-mm silver wire) was isolated in a glass tube with a fine-porosity fritted-glass disc. The shield tube was filled with the supporting electrolyte used in the sample solution. The end-point was determined by applying a constant current of about 1.1 microA between two treated silver wire electrodes and recording the potential-time curve with a strip-chart recorder. (Any kind of recorder with sensitivity in the range 1-10 mV/s can be used, provided that it is equipped with zero suppression). The proposed method is simple and rapid and gives satisfactory results in the range of 0.1-100 micrograms of chloride per ml. The method has the advantage that the blank is not affected by coloured substances like iron and humus. Of common ions bromide, iodide, thiocyanate and cyanide interfere and must be absent from the solution; these ions interfere also in the spectrophotometric method.

INDEX TERMS: Chlorides, Water analysis, Methodology, Chemical analysis, Electrolysis, Iodides, Bromides, Iron, Humus, Pollutant identification, Coulometry, Natural waters, Detection limits, Ionic interference, Chemical interference, Cyanides, Thiocyanates.

AMIC-8232

"EXTRACTION AND GAS CHROMATOGRAPHIC DETERMINATION OF METHYL-, ETHYL-, AND METHOXYETHYLMERCURY(II) HALIDES", Ealy, J. E., Shults, W. D., Dean, J. A., Analytica Chimica Acta, Vol. 64, No. 2, April 1973, pp 235-241.

The separation, identification, and determination of methyl-, ethyl-, and methoxyethylmercury(II) halides in biological materials were studied. The procedure developed involved a 24-h leach with 1 M sodium iodide, equilibration of the aqueous phase for 2 min with an equal volume of benzene, and then injection of an aliquot of the benzene phase onto a gas chromatographic column consisting of 5 percent cyclohexanedimethanol succinate held on Anakrom ABS. Excellent baseline separation of the chromatographic peaks was obtained. The extraction steps were monitored with RHgX compounds tagged with Hg-203. Partition coefficients are reported for methyl- and ethylmercury(II) chlorides, bromides, and iodides; several overall formation constants of the anionic complexes RHgCl sub n to the 1-n power (n equals 2,3) were determined. Results are reported for the recovery of methyl- and ethylmercury(II) halides from inoculated rye seed, humic and inorganic sediment, and fish grown in an aquarium. A single 24-h leach of 1-g samples gave the following D values: 12.0 plus or minus 0.2 for inorganic sediment; 7.7 plus or minus 0.5 for organic sediment; 5.6 plus or minus 0.8 for fish tissue; and 9.0 plus or minus 0.5 for rye seeds.

INDEX TERMS: Separation techniques, Pollutant identification, Solvent extractions, Sediments, Fish, Seeds, Chemical analysis, Biological samples, Organomercury compounds, Electron capture gas chromatography, Methylmercury halides, Ethylmercury halides, Methoxyethylmercury halides, Sample preparation, Chemical recovery, Reproducibility.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8233

"THE NEW METHOD FOR THE DETERMINATION OF COBALT IN SEA WATER BY SOLVENT EXTRACTION WITH 2-NITROSO-5-DIETHYLAMINOPHENOL", Motomizu, S., *Analytica Chimica Acta*, Vol. 64, No. 2, April 1973, pp 217-224.

A method is described for determining cobalt in seawater spectrophotometrically by means 2-nitroso-5-diethylaminophenol after extraction of the complex into 1,2-dichloroethane. This method eliminates preconcentration, requires relatively small volumes of sample solution, and provides simplicity and precision. The procedure was used in studying the effects of pH, shaking time, standing time and amounts of the reagent added on the extraction of cobalt. The optimal pH range was 4.5-8.5 for distilled water containing 0.24 microgram of cobalt, but 5.5-7.5 for sea waters. The minimal shaking time was 6 min in both cases, and a time of 10 min was selected for certainty. The standing time necessary for development of the complex was only 10 min, but a period of 30 min was considered advisable. When distilled water containing 0.24 microgram of cobalt was used, maximal absorbance was obtained with a reagent addition of 10 ml of 0.2 percent solution per liter. Those metal ions that are extracted along with the cobalt complex can be stripped completely with HCl, thus eliminating interference. Other metal ions and anions existing commonly in seawater do not interfere. The method is applicable over the range 0-0.24 microgram Co/l when 1-1 or 2-1 samples are taken. The relative standard deviation is 4 percent for 0.15 microgram Co/l. The stability of cobalt in sea water samples is discussed.

INDEX TERMS: Cobalt, Sea water, Methodology, Solvent extractions, Pollutant identification, Spectrophotometry, Water analysis, Chemical analysis, 2-Nitroso-5-diethylaminophenol, Precision, Chemical interference, Reproducibility.

AMIC-8234

"A SIMULTANEOUS DETERMINATION OF LEAD-210 AND POLONIUM-210 IN SEA WATER", Nozaki, Y., Tsunogai, S., *Analytica Chimica Acta*, Vol. 64, No. 2, April 1973, pp 209-216.

A simpler and more precise method is described for the determination of lead-210 and polonium-210 in seawater. In the proposed method, these nuclides are coprecipitated with calcium carbonate and then polonium is selectively separated from other nuclides by spontaneous deposition onto a silver disc. The content of lead-210 is measured by the activity of its granddaughter, polonium-210, produced during the storage of the sample containing lead-210 for more than 3 months. In the development of this method, particular caution was taken to avoid the adsorption loss of polonium-210 onto the wall of the container used during analysis and storage. Replicate analyses done on about 45-1 seawater samples gave a counting error of about plus or minus 10 percent for Po-210 stored for about 5 months. Seawater samples collected from the North Pacific Ocean during the cruise of R/V Hakuho-maru, KH-71-3 in 1971 analyzed by the above procedure showed that the ratios of Po-210 to Pb-210 were smaller than unity in the surface layer of the ocean.

INDEX TERMS: Sea water, Radiochemical analysis, Methodology, Water analysis, Chemical analysis, Lead radioisotopes, Radioactivity, Chemical precipitation, Heavy metals, Pollutant identification, Pollutants, Pb-210, Po-210, Polonium radioisotopes, Sample preparation, Alpha spectrometry, Coprecipitation, Accuracy.

AMIC-8236

"THE DETERMINATION OF SELENIUM IN SEA WATER BY GAS CHROMATOGRAPHY WITH ELECTRON-CAPTURE DETECTION", Shimoishi, Y., *Analytica Chimica Acta*, Vol. 64, No. 3, May 1973, pp 465-468.

A description is given of a direct gas chromatographic method for the determination of selenium in seawater without preconcentration. A volume of seawater and HCl were combined in a separatory funnel to which was added 1 percent 4-nitro-o-phenylenediamine solution. This mixture was allowed to stand for 2 hr and the 5-nitropiaselenol formed was extracted into toluene by shaking for 5 min. The toluene extract was washed with 7.5 M HCl and 5-microliter aliquots were injected into a gas chromatograph equipped with an electron capture detector, and the peak height measured. Seawater samples were prepared for the procedure by membrane filtration and shaking with toluene to extract toluene-soluble material. This caused no loss in Se. Analysis of seawater samples showed an average Se content of 0.04-0.08 plus or minus 0.01 microgram/l. As even about 0.002 microgram of selenium in 1 ml of organic extract can be detected by this procedure, only 50-100 ml of sea water is needed.

INDEX TERMS: Sea water, Water analysis, Methodology, Gas chromatography, Chemical analysis, Pollutant identification, Pollutants, Solvent extractions, Separation techniques, Electron capture gas chromatography, Selenium, Sample preparation, Detection limits, 4-Nitro-o-phenylenediamine hydrochloride.

AMIC-8240

"POTENTIOMETRIC STUDIES ON THIOACETAMIDE BY MEANS OF A SULPHIDE ION-SELECTIVE MEMBRANE ELECTRODE", Papay, M. K., Toth, K., Izvekov, V., Pungor, E., *Analytica Chimica Acta*, Vol. 64, No. 3, May 1973, pp 409-415.

The sulphide ion-selective electrode has been found to be applicable to the determination of thioacetamide in the concentration range of 0.1-0.001 M by direct potentiometry and titration with silver nitrate. The effects of the acid and alkali content of the solutions on the titration reaction have been studied. In alkaline and slightly acidic solutions the product of the reaction is silver sulphide; in solutions in which the acid concentration exceeds 0.5 M, a precipitate of silver thioacetamide is formed. If the alkali concentration of the solution is lower than that corresponding to the amount of acid formed during the titration, another potential jump occurs before the end-point owing to the decrease of sulphide concentration governed by hydrolysis.

INDEX TERMS: Chemical analysis, Aqueous solutions, Pollutant identification, Thioacetamide, Quantitative analysis, Potentiometric titration, Ion selective electrodes, Sulfide electrodes.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8242

"ATOMIC ABSORPTION INHIBITION TITRATION OF ORTHOPHOSPHATE AND POLYPHOSPHATES", Crawford, W. E., Lin, C. I., Huber, C. O., Analytica Chimica Acta, Vol. 64, No. 3, May 1973, pp 387-395.

The atomic absorption inhibition titration of phosphates was studied for two types of burner. It involves titration of the anion solution with a metal cation solution while the atomic absorption signal for the metal is monitored. Magnesium was selected as the monitor metal because of its sensitivity for measurement and the high extent of inhibition by refractory forming anions. The anions selected in this study are ortho-, pyro-, tetra- and hexaphosphates. Observations were made with both total consumption and pre-mix slot burners. A hydrogen-air flame was used in order to have the relatively low flame temperatures and the flame temperature control which is necessary. The method with a pre-mix burner was used to determine phosphate in surface and waste waters. The results compared quite favorably with those by the standard method. The proposed method was found to be rapid, simple and accurate. A complete manual titration curve was obtained in less than 30 min and semi-automatic titration required less than 5 min.

INDEX TERMS: Aqueous solutions, Water analysis, Phosphates, Chemical analysis, Volumetric analysis, Methodology, Anions, Surface waters, Silicates, Waste water (pollution), Sulfates, Detergents, Pollutant identification, Water pollution, Polyphosphates, Orthophosphates, Atomic absorption spectrophotometry, Total consumption burner, Premix burner, Inhibition titration, Sensitivity, Gas flow rates, Accuracy, Chemical interference, Ionic interference.

AMIC-8243

"THE DETERMINATION OF MOLYBDENUM IN SEA WATER BY HOT GRAPHITE ATOMIC ABSORPTION SPECTROMETRY AFTER CONCENTRATION ON p-AMINO BENZYLCELLULOSE OR CHITOSAN", Muzzarelli, R. A. A., Rocchetti, R., Analytica Chimica Acta, Vol. 64, No. 3, May 1973, pp 371-379.

A comparative study of the chelating ability of chitosan, p-aminobenzylcellulose and diethylaminoethylcellulose, for a number of metal ions is discussed. There is a strong interaction between molybdenum and these polymers in thiocyanate solutions and in sea water. By combining the sensitivity of graphite-furnace atomic absorption spectrometry with the efficiency of the selective collection of molybdenum on p-aminobenzylcellulose or chitosan at pH 2.5, it was possible to determine molybdenum in as little as 50 mg of sea water.

INDEX TERMS: Molybdenum, Sea water, Chemical analysis, Separation techniques, Chelation, Cations, Water analysis, Methodology, Anions, Pollutant identification, Hot graphite atomizer, Atomic absorption spectrophotometry, Preconcentration, p-Aminobenzylcellulose, Chitosan, Chemical interference.

AMIC-8245

"ATOMIC EMISSION SPECTROMETRY WITH AN INDUCTION-COUPLED HIGH-FREQUENCY PLASMA SOURCE. THE DETERMINATION OF IODINE, MERCURY, ARSENIC AND SELENIUM", Kirkbright, G. F., Ward, A. F., West, T. S., Analytica Chimica Acta, Vol. 64, No. 3, May 1973, pp 353-362.

The application is reported of an inductively coupled high-frequency plasma source to the determination of arsenic, iodine, mercury and selenium in aqueous solution by atomic emission spectrometry at wavelengths less 200 nm. In the apparatus used in this study, only a simple indirect nebulizer and expansion chamber are used to introduce aqueous sample solutions into the plasma. Optimal conditions have been established, and the spectral interference effects at different atomic lines for each element have been investigated. With the type of instrumentation employed, the determination of iodine at 183.04 nm, mercury at 184.96 nm, arsenic at 189.0 nm and selenium at 196.09 nm is recommended to minimize spectral interferences. No chemical or physical interferences resulting from the influence of foreign ions on the solute vaporization process have been noted.

INDEX TERMS: Iodine, Mercury, Aqueous solutions, Cations, Anions, Heavy metals, Chemical analysis, Alkali metals, Alkaline earth metals, Halogens, Arsenic, Selenium, Atomic emission spectrophotometry, High frequency plasma source, Induction-coupled plasma source, Spectral interference, Detection limits.

AMIC-8257

"PRECISE SHIPBOARD DETERMINATION OF DISSOLVED NITROGEN, OXYGEN, ARGON, AND TOTAL INORGANIC CARBON BY GAS CHROMATOGRAPHY", Weiss, R. F., Craig, H., Deep-Sea Research and Oceanographic Abstracts, Vol. 20, No. 4, April 1973, pp 291-303.

A seagoing gas chromatographic system for the rapid and precise determination of dissolved gases in sea water is described. Separate instruments are employed for total inorganic carbon, and for nitrogen, oxygen, and argon analyses. Factors affecting the design, calibration, and shipboard operation of the system are discussed in detail. Results of intercomparisons with other analytical techniques confirm the accuracy of the gas chromatographic method. Profiles of sigma CO2, O2, and N2 measured aboard ship are presented and discussed.

INDEX TERMS: Dissolved oxygen, Gas chromatography, Sea water, Chemical analysis, Water analysis, Instrumentation, Calibrations, Methodology, Pollutant identification, On-site data collections, On-site investigations, Shipboard measurements, Dissolved nitrogen, Dissolved carbon, Dissolved argon, On board analysis, Dissolved gases, Thermal conductivity gas chromatography, Precision, Accuracy, Winkler method.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8258

"HYDROCARBONS FROM SEA WATER", Barbier, M., Joly, D., Salliot, A., Tourres, D., Deep-Sea Research and Oceanographic Abstracts, Vol. 20, No. 4, April 1973, pp 305-314.

Dissolved hydrocarbons have been extracted by means of chloroform, from coastal and open sea waters; after isolation of the unsaponifiable fraction and preparative thin-layer chromatography, there were analyzed by gas-liquid chromatography and mass spectrometry. Hydrocarbons represent ca 20 percent of the total extracts; concentrations may vary from 10 to 140 micrograms l. N-Paraffins occur to an extent of ca 12 percent, from n-C14 to n-C37, with a maximum at n-C27 to n-C30; odd carbon paraffins are not predominant. Sea waters of different origins (collected at depths of as much as 4500 metres) show a similar composition in dissolved hydrocarbons; this composition does not differ much from the hydrocarbons usually found in algae. A probable hypothesis is that sea-water hydrocarbons originate from the micro-or macro phytoplankton. Coastal waters clearly indicate pollution by hydrocarbons of lower molecular weight or chlorinated hydrocarbons.

INDEX TERMS: Sea water, Mass spectrometry, Water analysis, Chemical analysis, X-ray fluorescence, Pollutant identification, Atlantic Ocean, Dissolved organic matter, Hydrocarbons, Gas liquid chromatography.

AMIC-8281

"LEAD OUTPUTS IN STREAMFLOW FROM A WATERSHED ECOSYSTEM", Rolfe, G., Edgington, J., Water Resources Bulletin, Vol. 9, No. 2, April 1973, pp 372-375.

A study was undertaken to understand and mathematically model the movements and effects of lead in an ecosystem. The ecosystem used in the study was a watershed which was 84 percent agricultural and 16 percent urban. Lead emitted through the combustion of gasoline containing tetraethyl lead was considered to be the predominant source of lead input to the ecosystem. The primary exit was through streamflow, including lead associated with suspended sediments. Streamflow was continuously monitored with 4 stream gaging stations and continuous duty automatic water samplers were developed to collect water samples at each location. The liquid portion of the water sample was analyzed by anodic stripping voltammetry. Concentrations were generally in the 0 to 15 ppb range. Suspended solids in the sample were removed by filtration with a 5-micron millipore filter and analyzed separately. The ratio of lead associated with suspended solids to lead dissolved in the filtrate varied from approximately 29:1 to 2:1 in the urban compartment. In the rural compartment the same ratio varied from 5:1 to 1:1. In comparing total lead output from the watershed with total lead input for the same six-month period, it appeared that only about 2-3 percent of the lead input was exiting through the water system. This indicates a large buildup of lead in ecosystems of this type. Possible accumulation points in the ecosystem include stream bottom sediments, soils, and biota.

INDEX TERMS: Lead, Watersheds (divides), Urban drainage, Agricultural runoff, Streamflow, Discharge (water), Ecosystems, Path of pollutants, Suspended solids.

AMIC-8265

"RESIDUE DETERMINATION OF ETHYLENETHIOUREA (2-IMIDAZOLIDINETHIONE) FROM TOMATO FOLIAGE, SOIL, AND WATER", Blazquez, C. H., Journal of Agricultural and Food Chemistry, Vol. 21, No. 3, May/June 1973, pp 330-332.

A thin-layer chromatographic method was developed for the analysis of ethylenethiourea (ETU) (2-imidazolidinethione) from tomato foliage, soil, and water. High yields of ETU were obtained when heat was applied during the evaporation of dioxane-water suspensions of the fungicides ethylenethiuram monosulfide (ETM) and ethylenebisdithiocarbamate (Dithane M-45). Investigations indicate that no ETU was detected from Dithane M-45 applications on tomato foliage, soil surface, or ditch water. The tlc method had a sensitivity of 1 ppm, which is adequate in residue analysis experiments. ETU was detected as low as 1 ppm with the tlc method, a concentration adequate in field investigations of the degradation of ethylenebisdithiocarbamate fungicide residues and their biological activity. The tlc method coupled with a bioassay technique fit well into residue monitoring (RM) method of the EWDC system for more efficient timing of pesticide applications.

INDEX TERMS: Pesticide residues, Soil contamination, Water pollution, Foliar, Bioassay, Pollutant identification, Chemical analysis, Tomatoes, Ethylenethiourea, Detection limits, Thin layer chromatography, Maneb, Zineb, Dithane M-45, Sample preparation, Sensitivity.

AMIC-8285

"DISTORTION OF MIREX RESIDUES IN INSECTS OWING TO USE OF ISOPROPYL ALCOHOL AS A COLLECTION SOLVENT", Carlson, D. A., Banks, W. A., Wojcik, D. P., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 6, June 1973, pp 365-369.

Collection or storage of insects in 70 percent isopropyl alcohol (IPA) was found to cause loss of body weight, major loss of nonpolar insecticides from submerged specimens, and transfer of insecticide to previously uncontaminated specimens. These effects may by no means be limited to mirex, since any chlorinated hydrocarbon is relatively lipophilic and may behave similarly. Residues reported for treated insects that have been collected or stored in alcohol may have been reduced to 12 percent of the original value. Moreover, small untreated vertebrates and invertebrates trapped in alcohol with insecticide-laden insects are likely to absorb significant amounts of insecticide for the solution.

INDEX TERMS: Pesticide residues, Pollutant identification, Insects, Chlorinated hydrocarbon pesticides, Mirex, Isopropyl alcohol, Sample preservation, Sample preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-8286

"CHLORINATED HYDROCARBONS IN PLANKTON FROM THE GULF OF MEXICO AND NORTHERN CARIBBEAN", Giam, C. S., Wong, M. K., Hanks, A. R., Sackett, W. M., Richardson, R. L., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 6, June 1973, pp 376-382.

During 1971 and 1972 a baseline study of pollutants in the open Gulf of Mexico and Northern Caribbean, sponsored by the International Decade of Ocean Exploration, was conducted. Plankton samples were collected over extensive areas of the Gulf of Mexico and Northern Caribbean. The samples were analyzed by electron capture gas chromatography for DDT, its metabolites and PCBs, in order to determine the concentration and distribution of these contaminants in the lowest levels of the marine food chain. From the results, it appears that DDT's and PCB's are widely spread but at a low level. There were few discernible geographic trends in the sampled areas. About 70 percent of the samples gave higher PCB than DDT values. No definite trend can be observed from the PCB/DDT ratio of the samples analyzed. Generally, the total DDT and PCB levels in plankton samples is comparable to that in small whole fish and muscle of some larger fish.

INDEX TERMS: Plankton, Polychlorinated biphenyls, DDT, Chlorinated hydrocarbon pesticides, Sampling, Gulf of Mexico, Chemical analysis, Solvent extractions, Pollutant identification, Marine animals, Marine plants, Zooplankton, Phytoplankton, Phytoplankton, Sea water, Metabolites, Caribbean Sea, Electron capture gas chromatography, Sample preparation, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Detection limits.

AMIC-8308

"KINETIC MICRODETERMINATION OF MERCURY IN NATURAL WATERS AND BIOLOGICAL MATERIALS", Ke, P. J., Thibert, R. J., Mikrochimica Acta, No. 3, 1973, pp 417-427.

A wet digestion has been developed to prepare water and biological samples for a kinetic determination of mercury using an iodide-catalyzed reaction between cerium(IV) and arsenite(III). A mercury-free control, prepared using ion-exchange with a selective chelating resin, was used by adding mercury standards to make a calibration curve. Both inorganic and organic mercury can be determined by the method described either in water or biological samples containing mercury in the range of 0.05 to 2.0 micrograms per ml. The procedure can be used satisfactorily down to the 0.005-ppm level for fresh water and urine with an overall error of less than 5 percent. The method can also be employed for the determination of mercury in sea water or blood serum with an error of 10 percent or less and gives results which compare favourably with other procedures.

INDEX TERMS: Mercury, Methodology, Chemical analysis, Water analysis, Heavy metals, Urine, Chemical reactions, Chelation, Freshwater, Sea water, Rivers, Lakes, Biological samples, Trace levels, Ion exchange resins, Detection limits, Blood serum, Errors, Organomercury compounds, Organometallics, Body fluids, Natural waters, Sample preparation.

AMIC-8310

"MICRO AND SEMIMICRO DETERMINATION OF THIOLS WITH ION-SELECTIVE ELECTRODES", Selig, W., Mikrochimica Acta, No. 3, 1973, pp 453-466.

Described is the potentiometric determination of a variety of thiols. Microamounts (0.01 to 0.1 mM) are titrated with 0.01 N mercuric perchlorate while semimicroamounts (0.1 to 0.5 mM) are titrated with 0.05 N mercuric perchlorate. A bromide selective indicator electrode and a single-junction reference electrode are used with an expanded-scale pH meter to monitor the emf. Other indicator electrodes based on a silver sulfide matrix may also be used. The preferred solvent is acetone while ethanol and p-dioxane have limited applicability. The electrode response is slower in general than for other titrations using ion-selective electrodes, particularly for the more complex thiols and those attached to a heterocyclic ring system.

INDEX TERMS: Sulfur compounds, Pollutant identification, Methodology, Electrochemistry, Ion selective electrodes, Trace levels, Thiols, Potentiometric titration, Reproducibility, Iodide electrodes, Sulfide electrodes, Chloride electrodes, Copper electrodes, Lead electrodes, Bromide electrodes.

AMIC-8312

"ATOMIC ABSORPTION SPECTROMETRY OF TRACES OF TRI- AND HEXAVALENT CHROMIUM", Yanagisawa, M., Suzuki, M., Takeuchi, T., Mikrochimica Acta, No. 3, 1973, pp 475-480.

Atomic absorption spectrometry combined with extraction has been shown to be a rapid and precise method (reproducibility of plus or minus 1 to approximately 2 percent for 5 determinations) for the determination of traces of tri- and hexavalent chromium. The chromium diethyldithiocarbamate chelate was used for chromium(VI), whereas hydroxyquinolate or thenoyltrifluoroacetate chelate for chromium(III). A series of solutions in the range of pH 2 to approximately 8 was prepared and investigated to confirm the optimum pH range for extraction of chromium chelates. The optimum pH range for quantitative extraction of chromium chelates is 5 to approximately 7. Two extractions were necessary for complete extraction of the chromium hydroxyquinolate. Acetate buffer was suitable for the extraction of the chromium chelate, in contrast to poor extraction results in a phosphate buffer. Fe, Cu, Al, V, and Mo did not interfere with Cr absorption. The optimum flame conditions were: flow rate of air, 6 l/min; flow rate of acetylene, 2 l/min; beam height, 10 mm above burner top.

INDEX TERMS: Pollutant identification, Chemical analysis, Methodology, Aqueous solutions, Chromium, Hydrogen ion concentration, Trace levels, Atomic absorption spectrophotometry, Metal chelates, Reproducibility.

2. BIOLOGICAL METHODS

AMIC-6908

"SOME MARINE DIATOMS FROM THE GALAPAGOS ISLANDS", Hendey, N. I., Nova Hedwigia, Vol. 22, Nos. 1-2, 1971, pp 371-422.

One hundred and seventy-six specific taxa of marine diatoms have been identified and four previously unknown taxa have been described from material collected by Dr. Ira L. Wiggins from Isla Fernandina, Galapagos Islands, on January 27, 1967. The material was taken from foam washed up by surf at Punta Espinosa. The classification used is according to Hendey (1958, 1964). Descriptions are given only of the lesser known taxa; the only reference cited is that in which the species was first described.

INDEX TERMS: Diatoms, Marine algae, Speciation, Classification, Chrysophyta, Varieties, Systematics, Plant groupings, Galapagos Islands.

AMIC-6913

"THE PHYSIOGNOMY AND STRUCTURE OF THE BENTHIC MACROPHYTE COMMUNITIES ON ROCKY SHORES IN THE SOUTHWESTERN ARCHIPELAGO OF FINLAND (SEILI ISLANDS)", Ravanko, O., Nova Hedwigia, Vol. 23, Nos. 2-3, 1972, pp 363-404.

The physiognomy and structure of the benthic macrophyte communities on rocky shores in the southwestern archipelago of Finland (Seili Islands) have been studied. Rows of 1 sq m quadrats were marked out along 23 lines, their vegetation was mapped and the macrophytes were then harvested. The species were determined and belts were named according to the dominant species. The fresh and dry weights and the ash content of the material were determined. The vegetation can mostly be divided into three main belts: the Cladophora, Fucus and Potamogeton belts. Besides differing in species composition these three belts also differ in biomass. For comparison, the water and ash contents of some individual species were determined. The ash contents differ greatly between the species. Some taxonomic problems and sources of error in the research methods are treated. The extent to which the vegetation of the study area is typical of the southwestern archipelago of Finland is discussed, and some of the results are compared with those from other areas.

INDEX TERMS: Biomass, Marine plants, Biological communities, Benthic flora, Marine algae, Cyanophyta, Chlorophyta, Phaeophyta, Rhodophyta, Marsh plants, Finland, Macrophytes, Physiognomy, Marine environment, Vegetation profiles, Spermatophytes.

AMIC-7559

"ARTIFICIAL RESERVOIR DESTRATIFICATION EFFECTS ON PHYTOPLANKTON", Lackey, R. T., Journal Water Pollution Control Federation, Vol. 45, No. 4, April 1973, pp 668-673.

A 19-ha Colorado montane reservoir was kept thermally destratified by continuous aeration for 1 yr. Samples were taken on a single day near the middle of each month from five permanently marked stations and consisted of four 3-liter hauls taken at each 0.5-m depth within each 2-m stratum. Samples were strained through a 75-mm mesh net, preserved in 4 percent formaldehyde, and enumerated in Palmer counting cells. Individual plankters were enumerated where practical, but colonies and chains were also treated as individuals. Statistical methods were used in analyzing the results. Total phytoplankton abundance was reduced, but phyla varied in their response. Green phytoplankton (Chlorophyta) decreased in abundance and diatoms (Bacillariophyceae) were nearly eliminated during destratification. Blue-green algae (Cyanophyta), however, increased in abundance and this phenomenon may limit the use of destratification in water management. Vertical distribution of phytoplankton was not affected by destratification.

INDEX TERMS: Phytoplankton, Reservoirs, Environmental effects, Aeration, Chlorophyta, Cyanophyta, Sampling, Pyrrophyta, Thermal destratification, Vertical distribution, Sample preservation.

AMIC-7568

"EFFECT OF INCUBATION TEMPERATURE ON THE MACROMOLECULAR AND LIPID CONTENT OF THE PHYTOPLAGELLATE OCHROMONAS DANICA", Aaronson, S., Journal of Phycology, Vol. 9, No. 1, March 1973, pp 111-113.

Ochromonas danica grown in a chemically defined medium under controlled conditions at different incubation temperatures showed marked changes in chemical composition and secretory pattern. As the incubation temperature rose from 15 to 30 C, the cell number per unit volume of medium increased; the cell mass reached a maximum and then declined slightly, and the weight per single cell decreased. The chemical composition of the cells changed with increasing temperature: carbohydrates decreased dramatically; proteins quadrupled at 20 C and then declined 25 percent; lipids increased to about 40 percent of maximum at 30 C. The extracellular secretion by the cells of carbohydrates seemed to increase and then decline; RNA decreased; proteins increased; and lipids remained approximately constant, as the temperature increased. Increased oxygen utilization in the decay process that may result from these changes and lower oxygen solubility in warmer waters may well enhance the eutrophication process already rampant in much of our aquatic environment. On the other hand, knowledge of the ecological changes produced by thermal pollution at the primary food chain level may permit the exploitation of this pollutant for aquaculture.

INDEX TERMS: Cytological studies, Thermal stress, Environmental effects, Proteins, Lipids, Aquatic algae, Carbohydrates, Biomass, Ochromonas danica, Chemical composition, RNA, Culture media.

2. BIOLOGICAL METHODS

AMIC-7578

"SWIMMING PERFORMANCE OF YOUNG ATLANTIC SALMON (*Salmo salar*) AS AFFECTED BY REDUCED AMBIENT OXYGEN CONCENTRATION", Kutty, M. N., Saunders, R. L., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 223-227.

As oxygen concentration is lowered, a point is reached, the critical oxygen level, at which juvenile Atlantic salmon (*Salmo salar*) stop swimming in a tunnel respirometer. At concentrations just above the critical level, salmon frequently lose position in the upstream end of the respirometer and fall back to the downstream end while still headed into the current. There appears to be a progressive decrease in locomotor activity, indicated by reduced tailbeat frequency, on approaching the critical concentration. Swimming performance of Atlantic salmon is more highly dependent on oxygen concentration than is that of rainbow trout (*Salmo gairdneri*), goldfish (*Carassius auratus*), or Tilapia. The critical oxygen level for salmon swimming at 55 cm/sec is about 4.5 mg/liter, in comparison with 2.0 for rainbow trout, 1.7 for goldfish, and 1.0 for Tilapia. Between the minimum speed at which a salmon swims steadily and the maximum of which the fish is capable, the critical oxygen level rises with increase in swimming speed. Stoppage of swimming at the critical level is not owing to fatigue; fish resume swimming within minutes of the oxygen level being raised only slightly. The high critical oxygen levels for salmon in relation to other species including rainbow trout, another salmonid, point up the need for maintenance of stringent water quality criteria for oxygen levels in salmon rivers.

INDEX TERMS: Atlantic salmon, Oxygen sag, Fish behavior, Swimming, Juvenile fish, Laboratory tests, Water pollution effects, Dissolved oxygen, Bioassay, Smolt, *Salmo salar*, *Salmo gairdneri*, *Carassius auratus*, Goldfish.

AMIC-7591

"ANNUAL LIFE CYCLE AND PRODUCTION OF THE CHAETOGNATH *SAGITTA ELEGANS* IN BEDFORD BASIN, NOVA SCOTIA", Sameoto, D. D., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 333-344.

A study has been made on the population of *Sagitta elegans* in Bedford Basin for which comparable data on the basic production system are available (Sameoto, 1971a). Horizontal and oblique samples of zooplankton were taken after dark at five stations inside and two stations outside the Basin. The samples were analyzed within a week of collection. *S. elegans* over 5 mm long were removed, counted, and weighed after blotting on filter paper. The remaining sample was split and the stages of *S. elegans* less than 5 mm were counted. Free water was removed from the sample of copepods obtained upon sorting and the sample weighed to obtain a biomass estimate. The method used to stage the animals and analyze the different modes of the *S. elegans* population was that used by Sameoto (1971). In Bedford Basin, Nova Scotia, *Sagitta elegans* has two main generations per year, one in the spring and one in the fall. The biomass of *S. elegans* per 100 cu m of water was an order of magnitude greater in the Basin than that reported previously for St. Margaret's Bay, N.S. The growth rate and the number of degree days needed to mature were similar to those found for *S. elegans* in St. Margaret's Bay. Annual turnover rate for *S. elegans* in the Basin was 5.6 and yearly production was estimated at 27.0 kcal per year or 9.0 percent of the yearly copepod production. It was calculated that the species used 90.4 kcal per sq m per year in respiration. The percentage of the total yearly production of copepods consumed by *S. elegans* was estimated at 36 percent.

INDEX TERMS: Secondary productivity, Zooplankton, Life cycles, Biomass, Canada, Growth rates, Energy budget, Growth stages, Annual turnover, Chaetognaths, *Sagitta elegans*, Bedford Basin.

AMIC-7618

"DESIGN OF A TRAPNET WITH INTERCHANGEABLE PARTS FOR THE CAPTURE OF LARGE AND SMALL FISHES FROM VARYING DEPTHS", Beamish, R. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 587-590.

A new design is described for a convertible trapnet that is effective in catching small and large fishes in depths ranging from 3 to 15 ft (1-5 m). The nets are constructed from 1/32-inch (0.8-mm) square mesh, green mosquito-type nylon netting. Details of construction are included. Three designs have been successfully tested: (1) a basic 3-ft design, weight 31 lb; (2) a 9-ft net, weight 48 lb, that converts to the basic 3-ft design, and (3) a 6-ft net, weight 35 lb, that is similar to the 9-ft model but reduced in proportions and not convertible. These three designs when fished in Wolf Lake (New York) captured nine of the ten species reported to be present. Trapnets of similar design have captured many other species of small and large freshwater fishes including arctic char, lake whitefish, rainbow trout, walleye, and yellow perch. They have also fished successfully in some marine habitats.

INDEX TERMS: Fishing gear, Freshwater fish, Marine fish, Design, Fabrication, Depth, Convertible trapnets, Trapnets, Wolf Lake.

AMIC-7621

"DESCRIPTION AND ECOLOGY OF *HYALELLA TEXANA* N. SP. (CRUSTACEA: AMPHIPODA) FROM THE EDWARDS PLATEAU OF TEXAS", Stevenson, M. M., Peden, A. E., The American Midland Naturalist, Vol. 89, No. 2, April 1973, pp 426-436.

Hyalella texana, a new species of amphipod crustacean, is described from Clear Creek Spring, Menard County, Texas, 16.7 km W of Menard. It is distinguished from *H. azteca*, which also occurs at this locality, by the presence of four large tergite spines, enlarged mouth parts, more antennal segments and narrower body and appendage segments. Each species is found predominantly in different habitats of the spring area.

INDEX TERMS: Amphipoda, Crustaceans, Ecology, Systematics, Speciation, Texas, Aquatic habitats, Invertebrates, Aquatic animals, Classification, Animal populations, Water temperature, *Hyalella texana*, *Hyalella azteca*, Clear Creek, Arthropods, Animal morphology, Population density, Macroinvertebrates, Scuds.

2. BIOLOGICAL METHODS

AMIC-7628

"PHYSIOLOGICAL CHANGES IN *MYTILUS EDULIS* L. INDUCED BY TEMPERATURE AND NUTRITIVE STRESS", Bayne, B. L., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 1, February 1973, pp 39-58.

The results of the determination of oxygen consumption, nitrogen excretion (both as ammonia-N and alpha-amino-N) and of the concentration of blood metabolites in *Mytilus edulis* are described in relation to seasonal cycle and to changes induced by temperature and nutritive stress in the laboratory. Four routine stress experiments were set up using 100 animals of uniform length per experiment in aquaria with re-circulating seawater. Three levels of oxygen consumption rate were identified, viz. standard, routine and active. Animals fed above the maintenance energy requirement adjust their oxygen consumption rate to a routine level. Animals fed below the maintenance requirement reduce their oxygen consumption rate to a standard level within 35-40 days. The routine rate is seasonally variable, with high values in the winter and low values in the summer. The standard rate also varies seasonally. The exponent that relates oxygen consumption to body size varies from a high value in the summer to a lower value in the winter. Rates of excretion of ammonia-N and alpha-amino-N vary seasonally from high values in winter to low values in summer. Significant amounts of alpha-amino-N are lost from the body at all times, and especially during stress. In unstressed animals the atomic ratio of oxygen consumed to ammonia-N excreted remains at about 100 for most of the year, but rises to much higher values in the summer. The relationship observed in the O:N values under stress suggests that the O:N ratio is a sensitive index of nutritive stress in *Mytilus*. Changes in blood sugars were interpreted in terms of an index of blood sugar energy reserve, which varies with stress. Temperature and nutritive stress

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is seen to alter seasonal steady-state values of physiological indices. New steady states are established as a result of stress, and the measured shifts in these indices provide estimates of the physiological effects of environmental change.

INDEX TERMS: Thermal stress, Animal physiology, Laboratory tests, Physiological ecology, Environmental effects, Nitrogen, Animal metabolism, Nutritive stress, Seasonal variation, Oxygen consumption, Excretion.

AMIC-7631

"THE ASSOCIATION OF AMPHIPODS IN THE SHALLOW-WATER SAND HABITAT OF STRANGFORD LOUGH, CO. DOWN", Finchan, A. A., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 1, February 1973, pp 119-125.

Ten stations were sampled in the shallow-water sand habitat of Strangford Lough using a naturalist's dredge. Sediment samples were analyzed to determine median diameter (ranging from 1.13 to 3.23 phi), Phi quartile deviation (ranging from 0.17 to 0.65 phi) and Phi quartile skewness (ranging from -0.11 to -0.04 phi). Twenty-two species of amphipod belonging to thirteen families were identified; ten species were new records for Strangford Lough and the Family Phoxocephalidae was recorded for the first time. The average number of species per station was nine and average abundance was 660 amphipods per station. The most frequently occurring species was the caprellid *Phthisica marina* (present in 90 percent of the samples); the overall dominant species was the corophiid *Corophium crassicornis* representing 52 percent of all specimens recorded. A matrix of indices of similarity between stations based on species composition and of sediment type based on median diameter showed a close correlation; in-faunal species showed a marked preference for sediment type. There were two main groupings: (1) at the entrance to the Lough, characterized by coarser sediments and rapid tidal streams and (2) stations further in the Lough with finer sediments and more gentle water movement. The evolution of this amphipod fauna is discussed and compared with the adjacent western Irish Sea shallow-water sand amphipod fauna. Post-glacial isolation and fine sediment deposition have acted as selection pressures in maintaining the association of amphipods found.

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INDEX TERMS: Amphipoda, Shallow water, Systematics, Speciation, Crustaceans, Benthic fauna, Dominant organisms, Sands, Marine habitats, Strangford Lough, Beach fleas, Macroinvertebrates, Arthropods.

2. BIOLOGICAL METHODS

AMIC-7643

"BIOMASS CHARACTERISTICS OF THE ASCIDIAN *MOLGULA MANHATTENSIS* (DEKAY)", Hamilton, D. H., Jr., Yurchyk, J., Chesapeake Science, Vol. 14, No. 1, March 1973, pp 67-68.

Data are reported on wet weight, dry weight, ash-free dry weight, and volume for a random sample of 101 *Molgula* for the purpose of simplifying future calculations of its productivity. The relationships were examined between the various weight measures and between volume and weight by linear regression analysis. The average measurements were as follows (range in parentheses): Volume, 5.26 cc (0.67-11.56 cc); dry weight, 0.125 g (0.02-0.26 g); wet weight, 3.98 g (0.43-9.09 g); ash-free dry weight, 0.05 g (0.01-0.09 g). The correlation of volume with either weight measure is not strong and this is probably a consequence of assuming a spherical shape. Each of the weight measures is strongly correlated with the others (r greater than 0.90); in the future measurement of wet weight alone will permit rapid determination of biomass in the preferred units of ash-free dry weight.

INDEX TERMS: Biomass, Biological properties, Invertebrates, Regression analysis, Volume, Marine animals, Secondary productivity, Chemical analysis, Macroinvertebrates, *Molgula manhattensis*, Tunicates, Characterization, Linear regression analysis, Dry weight, Wet weight, Ash-free dry weight.

AMIC-7674

"DISPERSION, DISPERSAL, AND PERSISTENCE OF THE ANNUAL INTERTIDAL ALGA, *POSTELSIA PALMAEFORMIS* RUPRECHT", Dayton, P. K., Ecology, Vol. 54, No. 2, Early Spring 1973, pp 433-438.

Postelsia palmaeformis is an annual brown alga that occurs on the Washington coast at upper intertidal sites subjected to extreme wave exposure. The alga occurs in patches within beds of *Mytilus californianus*, the competitive dominant in this region. *Postelsia* sporophytes are shown to colonize experimentally cleared spaces in beds of *Mytilus* with no concurrent colonization of adjacent uncleared controls. However, unlike many annual algae which have high spore dispersal abilities, *Postelsia* seems to have an effective distance of sporophyte colonization also. *Postelsia* patches are maintained through time by settlement of *Postelsia* on other algal and animal species. By increasing the probability of both being ripped from the substratum, and by overgrowing and smothering barnacles, *Postelsia* sporophytes clear primary substratum for the eventual use of sporophytes of their own species.

INDEX TERMS: Phaeophyta, Intertidal areas, Ecological distribution, Persistence, Dispersion, *Postelsia palmaeformis*, Colonization.

AMIC-7672

"THE UTILIZATION OF LEAF LITTER BY STREAM DETRITIVORES", Cummins, K. W., Perersen, R. C., Howard, F. O., Wuycheck, J. C., Holt, V. I., Ecology, Vol. 54, No. 2, Early Spring 1973, pp 336-345.

Investigations of large and fine particle feeding detritivores (shredders and collectors) fed on conditioned hickory leaves (*Carya glabra*) revealed density-dependent intra- and interspecific interactions. Shredder (*Tipula* and *Pycnopsyche*) growth rates ranged from 0.47 to 1.53 percent increase in body wt/day depending upon density, species combinations, and culture temperature. Collector (*Stenonema*) growth rate ranged from 0.13 to 1.80 percent body wt/day, being greatest at high densities, particularly in combination with shredders. Food consumption ranged from 15.7 to 33.2 percent body wt/day for shredders and 4.0 to 23.2 percent body wt/day for collectors. After non-shredder feeding losses are accounted for, estimated shredder standing crop required to account for processing of reported leaf litter inputs compare generally to measured shredder standing crop.

INDEX TERMS: Animal growth, Mortality, Aquatic insects, Laboratory tests, Natural streams, Secondary productivity, Hickory trees, Caddisflies, Stoneflies, Immature growth stage, Mayflies, Standing crops, Detritivores, Leaf litter, Heterotrophic nutrition, Dissolved organic matter, Particulate organic matter, Flies, Species density, Food conversion.

AMIC-7702

"EFFECTS OF CHEMICAL VARIATIONS ON AQUATIC ENVIRONMENTS. VOLUME III. LEAD TOXICITY TO RAINBOW TROUT AND TESTING APPLICATION FACTOR CONCEPT", Davies, P. H., Everhart, W. H., Colorado State University, Department of Fishery and Wildlife Biology, Fort Collins, Colorado, Report No. EPA-R3-73-011c, February 1973, 80 pp.

Acute and chronic bioassays were conducted with rainbow trout exposed to various levels of lead in hard water (alkalinity 243.1 mg/l) and soft water (alkalinity 26.4 mg/l) to test the application factor approach as related to different water qualities. Lead was added as lead nitrate. Water was analyzed by atomic absorption and pulse polarography and regularly monitored for various water quality parameters in addition to lead concentration. Fish were observed for growth and feeding rates and were hematologically analyzed for hemoglobin, hematocrits, and plasma proteins. The toxicity of lead to rainbow trout in hard water was determined on a total and dissolved lead basis. The 96-hr TL sub 50 and maximum acceptable toxicant concentration 'MATC' on a total lead basis were 471 mg/liter and 0.12 to 0.36 mg/liter respectively, which yielded an application factor of 0.0002 to 0.0008. Analysis of the free or dissolved lead gave a 96-hr TL sub 50 of 1.38 mg/liter and a 'MATC' of 0.018 to 0.032 mg/liter, resulting in an application factor of 0.0130 to 0.0232. Total and free lead were considered to be the same in soft water. The 18-day TL sub 50 and 'MATC' obtained from the soft water bioassays were 140 micrograms/liter and 6.0 to 11.9 micrograms/liter lead, respectively. Computations using the TL sub 50 and 'MATC' values gave a soft water application factor of 0.0429 to 0.0850. The 'MATC' was determined in both hard and soft water bioassays on the occurrence of abnormal black tails caused by chronic lead exposure. The application factor approach as related to different water qualities was found to be very promising when lead analysis was limited to the free or dissolved metal and failed when total hard water lead concentrations were used.

2. BIOLOGICAL METHODS

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INDEX TERMS: Bioassay, Hardness (water), Alkalinity, Water quality, Toxicity, Fish reproduction, Rainbow trout, Lead, Atomic absorption spectrophotometry, Pulse polarography, Hematology.

AMIC-7720

"COMMUNITY STRUCTURE OF THE BENTHOS IN SCOTTISH SEA-LOCHS. II. SPATIAL PATTERN", Gage, J., Geekie, A. D., Marine Biology, Vol. 19, No. 1, March 1973, pp 41-53.

Spatial pattern in the distribution of the macrobenthos was studied from series of van Veen grab samples taken in a systematic pattern in Lochs Etive and Creran, W. Scotland. Each series was collected in a circular pattern at 7 stations. Plots of the variances of the numerical occurrences of the species in the samples against their means revealed greater deviation from the random expectation in the case of the 2 muddy sand stations than for the soft-mud stations, with only 1 exception. Two tests of goodness-of-fit to the Poisson distribution were also applied. The degree of concordance between the 3 measures of non-randomness applied was measured. The best correlation was found between values of the ratio of variance: mean and the test statistic D of the Kolmogorov-Smirnov goodness-of-fit test. It was not possible to discuss the biological basis for the pattern measured, except for a few species shown to be markedly aggregated. No clear trend emerged from attempts to detect differences in pattern with various ecological groupings of the macrobenthos. However, from the use of the test values as sample statistics illustrative of overall community pattern, it was possible to conclude that the fauna of the shallow, usually current-swept areas of muddy sand in the sea-lochs investigated was more aggregated than that on the, usually deeper, soft-mud sediments in quieter water.

INDEX TERMS: Spatial distribution, Benthos, Biological communities, Benthic fauna, Distribution patterns, Statistical methods, Environmental effects, Data interpretation, Macroinvertebrates.

AMIC-7703

"IMPAIRMENT OF THE FLAVOR OF FISH BY WATER POLLUTANTS", Shumway, D. L., Palensky, J. R., Oregon State University, Department of Fisheries and Wildlife, Corvallis, Oregon, Report No. EPA-R3-73-010, February 1973, 85 pp.

Laboratory studies with fish were conducted to determine an appropriate bioassay procedure for the examination of the flavor-imparting capacity of wastes and waste components (organic compounds). In addition, the flavor-imparting capacity and estimated threshold concentrations were determined for a number of organic compounds and effluents. Flavor evaluations were obtained through the use of taste panels. Estimated threshold concentrations were determined for twenty two organic compounds. The values ranged from 0.4 ppb (2,4-dichlorophenol) to 95 ppm (formaldehyde). An additional twelve compounds were tested, seven of which were not found to impair flavor at or near lethal levels. Estimated threshold concentrations were determined for effluents from kraft paper mills and a sulfite-base paper mill. The estimated threshold concentrations for the effluents from the kraft and sulfite-base paper mills were about 6 and 36 percent by volume. The estimated threshold concentrations for primary, secondary, and secondary chlorinated effluents from the Corvallis Sewage Treatment Plant were determined to be 11-13, 21-23, and 20-26 percent by volume, respectively.

INDEX TERMS: Laboratory tests, Freshwater fish, Sewage effluents, Pulp wastes, Taste, Organoleptic properties, Evaluation, Organic wastes, Rainbow trout, Water pollution, Sulfite liquors, Taste-producing pollutants, Largemouth bass, Bluegills.

AMIC-7724

"SIMULATION STUDY OF PHYTOPLANKTON PHOTOSYNTHESIS AND GROWTH IN THE FRASER RIVER ESTUARY", Takahashi, M., Fujii, K., Parsons, T. R., Marine Biology, Vol. 19, No. 2, March 1973, pp 102-116.

Phytoplankton photosynthesis was estimated by a simulation model of the Fraser River estuary (Canada). For this estimation, two kinds of information were considered; (1) the photosynthetic response of phytoplankton taken from the estuary to each environmental factor; (2) actual measurement of changes in each environmental factor in the estuary. As the major limiting factors, light, intensity, temperature, and nitrate were taken into account. Variations in these parameters were combined together under the assumption of the 'law of the minimum'; that is, only one of the environmental factors was considered to limit photosynthesis at any given time and place. From the results obtained, it could be shown which environmental factors actually limited phytoplankton photosynthesis in the Fraser River estuary at different times of the year and at different depths.

INDEX TERMS: Photosynthesis, Phytoplankton, Plant growth, Model studies, Limiting factors, Primary productivity, Estuarine environment, On-site investigations, Light intensity, Water temperature, Nitrates, Saline water-freshwater interfaces, Salinity, Phosphorus, Fraser River.

2. BIOLOGICAL METHODS

AMIC-7726

"ECOLOGICAL STUDIES OF *Codium fragile* IN NEW ENGLAND, USA", Fraclick, R. A., Mathieson, A. C., *Marine Biology*, Vol. 19, No. 2, March 1973, pp 127-132.

Because of the abundance of *Codium fragile* (Chlorophyta) in New England and its economic importance to scallop and oyster industries, a study was made of the factors responsible for its local growth and distribution. Systematic monthly collections and observations of the algal populations were made with SCUBA equipment in the sublittoral zones at each site in Boothbay Harbor, Maine and in Woods Hole and Wing Neck, Massachusetts. Results of the various growth studies conducted were recorded monthly; hydrographic data were correlated with the growth and reproductive studies. It is suggested that *C. fragile* is a warm-temperate plant that is growing near its northern limits in New England, but one that has not extended to its potential southern limits.

INDEX TERMS: Ecology, Marine algae, Ecological distribution, Limiting factors, Plant physiology, Photosynthesis, Maine, Massachusetts, Surface waters, Plant growth, Standing crops, Reproduction, *Codium fragile*, Seasonal variation.

AMIC-7731

"LASER INDUCED FLUORESCENCE IN ALGAE: A NEW TECHNIQUE FOR REMOTE DETECTION", Friedman, E. J., Hickman, G. D., Sparcom, Incorporated, Alexandria, Virginia, Report No. NASA-CR-62090, Contract No. NASS-2018, October 1972, 108 pp. NTIS Report No. N73-12527.

Measurements of the absorption and fluorescence spectra were obtained for four types of marine and fresh water algae using a pulsed N₂/Ne dye laser as the source of excitation. The algae investigated were *Agmenellum*, *Chlorella*, *Chlamydomonas*, and *Porphyridium*. The absorption maxima for the algae ranged from 420 to 675 nm while their fluorescent spectra ranged from 580 to 685 nm. It appears feasible that various algal species can be identified by detection of their fluorescent signatures using a tunable laser as the excitation source. However, if one is concerned only with detection of chlorophyll a, the optimum excitation is approximately 600 plus or minus 50 nm while detection is at 685 nm. An analysis of both calculations and laboratory results indicates that it should be feasible to measure chlorophyll a in concentrations as low as 1.0 mg/cu m using a 100 kv peak pulsed laser from an altitude of 500 meters.

INDEX TERMS: Remote sensing, Absorption, Fluorescence, Pigments, Pollutant identification, Chlorophyll a, Laser-excited fluorescence, *Porphyridium*.

AMIC-7732

"AN IN SITU EVALUATION OF NUTRIENT EFFECTS IN LAKES", Jordan, R. A., Bender, M. E., Virginia Institute of Marine Science, Gloucester Point, Virginia, Report No. EPA-R3-73-018, April 1973, 237 pp.

A method for performing in situ nutrient enrichment experiments on natural lake phytoplankton communities was developed and evaluated. One set of experiments in which it was employed was designed to detect limiting nutrients and to provide a basis for predicting future experiment results. Productivity increased in response to all three of the treatment variables used, N, P, and EDTA, but response patterns varied from experiment to experiment. Individual species responded differently to different treatments, and interactions among the treatment variables were important in shaping the community responses to mixtures of two or three variables. The most consistent features of the productivity results were incorporated into a "most probable response pattern," which was partially validated by a second series of experiments. The second experiment series was also used to test the ability of NTA to stimulate phytoplankton productivity. Stimulation was continually obtained. In a third series of experiments sewage effluents were tested in parallel with N and P. Varying degrees of overlap between the species complexes responding to the sewage and to the N and P treatments were found. Recommendations for the use of in situ enrichment experiments in eutrophication studies are presented.

INDEX TERMS: Limiting factors, Nutrients, On-site investigations, Nitrates, Nitritotriacetic acid, Sewage effluents, Bioassay, Growth rates, Chlorophyta, Cyanophyta, Chrysophyta, Pyrrophyta, Phosphates, EDTA, Cryptomonads.

AMIC-7752

"PHOSPHATE CHEMISTRY IN LAKE SEDIMENTS", Syers, J. K., Harris, R. F., Armstrong, D. E., *Journal of Environmental Quality*, Vol. 2, No. 1, January-March 1973, pp 1-14.

The amounts and forms of inorganic and organic phosphate (P) in lake sediments are discussed in relation to sediment composition and properties. The ability of noncalcareous and calcareous sediments to sorb and desorb added P in the laboratory and in the lake environment is interpreted in terms of the amounts and reactivities of sediment components involved in the sorption of P; emphasis is placed on the role of an Fe-rich gel complex. Factors controlling the chemical mobility and biological availability of sediment inorganic and organic P are considered. Whether sediments act as a P source or sink is determined by sediment composition and limnological conditions. The factors involved in the interchange of P between the sediment interstitial water and the overlying water column are reviewed. The role of P in lake eutrophication is discussed briefly.

INDEX TERMS: Phosphates, Reviews, Lake sediments, Sorption, Eutrophication, Solubility, Mineralogy, Algae, Oxidation-reduction potential, Cycling nutrients, Sediment-water interfaces, Nutrient interchange, Desorption, Chemical mobility.

2. BIOLOGICAL METHODS

AMIC-7753

"THE NITROGEN CYCLE IN SEDIMENT-WATER SYSTEMS", Keeney, D. R., Journal of Environmental Quality, Vol. 2, No. 1, January-March 1973, pp 15-29.

The available literature on the fate of nitrogen in waters and sediments is reviewed. Emphasis is placed on the importance of N to aquatic productivity, the pathways leading to N gains or losses in aquatic ecosystems, and the availability of N in sediments to the overlying waters. Important biological reactions include N mineralization and immobilization, nitrification and denitrification, and N fixation. The effect of sediment properties, lake morphology and environmental factors (pH, temperature, dissolved oxygen, oxidation-reduction) on the pathways and rates of N turnover are considered. The mixing process in sediments appear to be the most important in releasing sediment-N to waters. Several facets of the N cycle in waters and sediments require further elucidation. Research needs are outlined.

INDEX TERMS: Reviews, Aquatic productivity, Sediment-water interfaces, Nitrogen cycle, Eutrophication, Environmental effects, Cycling nutrient, Nitrification, Denitrification, Nitrogen fixation, Water quality, Ecosystems, Algae, Bacteria, M1

AMIC-7755

"CARBON CYCLE IN SEDIMENT-WATER SYSTEMS", Kerr, P. C., Brockway, D. L., Paris, D. F., Craven, S. E., Journal of Environmental Quality, Vol. 2, No. 1, January/March 1973, pp 46-52.

This paper reviews literature relevant to the extent and rate of carbon exchange between sediment and water and discusses the general implication of the role of carbon in regulating biological activity. Several conclusions are drawn from the review. The extent of adsorption of organics to clay minerals in natural aquatic ecosystems is not known. Sorption, desorption, sedimentation, and aerobic and anaerobic activity are affected by physical factors such as depth and mixing. Certain data indicate that organisms cannot utilize organic material sorbed to clay minerals; other data indicate that growth of certain bacteria and yeast is stimulated by the addition of clay minerals. Although the exact substrate(s) is not known, aerobic and anaerobic decomposition of organic materials occurs in and on sediments. Aerobic decomposition seems to result in three different reactions affecting sediment-water carbon exchange: (1) Methane gas is produced and released from sediments. (2) Organic acids produced by anaerobes can serve as carbon sources for aerobes as well as aiding in solubilization of carbonates and affecting sorptive processes. (3) Carbon dioxide produced by anaerobes may be combined in some manner and remain in the sediments. The fact that most deep sediments retain organic carbon indicates that sediments may be sinks for organics. Possibly sediments serve as organic carbon sinks simply because the rate of sedimentation exceeds the rate of decomposition.

INDEX TERMS: Reviews, Carbon cycle, Aquatic environment, Sediment-water interfaces, Aquatic microorganisms, Carbon dioxide, Sinks, Ecosystems, Nutrient interchange.

AMIC-7754

"PESTICIDE-SEDIMENT-WATER INTERACTIONS", Pionke, H. B., Chesters, G., Journal of Environmental Quality, Vol. 2, No. 1, January/March 1973, pp 29-45.

Pesticide-sediment-water interactions occurring within a watershed and the associated aquatic system are reviewed regarding their impact on the distribution and persistence of pesticides in recipient lakes. Pesticidal persistence on the watershed is discussed initially because the aquatic residue hazard depends largely on the persistence of soil-applied pesticides. Mechanisms of transport from field to aquatic system are reviewed for those compounds not degraded rapidly to nontoxic derivatives. Pesticide transport through the atmosphere, ground water, and surface runoff is traced with particular emphasis on application-associated losses and transport effect on initial pesticide distribution and concentration in the aquatic system. Field and plot studies evaluating pesticide losses in runoff are summarized. Within the aquatic system, limnological, sediment and water characteristics potentially alter the distribution of adsorbed pesticide between water and associated sediment within the lake. Specifically, the effects of pH, lake stratification, characteristics and content of sediment organic matter and clay, and salinity are evaluated. This review concludes with a discussion of literature on pesticide persistence determined in simulated or natural aquatic systems and the interactions between aquatic vegetation, sediment and water which affect pesticide distribution.

INDEX TERMS: Watersheds (divides), Reviews, Sediments, Watersheds (basins), Pesticide kinetics, Aquatic environment, Water quality, Groundwater movement, Persistence, Pesticide residues, Surface runoff, Adsorption, Degradation (decomposition), Soil contamination, Path of pollutants, Pesticide drift, Herbicides, Insecticides, Environmental effects, Sediment transport, Fate of pollutants, Metabolites.

AMIC-7762

"PHYSICO-CHEMICAL LIMNOLOGY AND PERIPHYTON IN A WARM-WATER STREAM RECEIVING WASTEWATER TREATMENT PLANT EFFLUENT", Brigham, A. R., Larimore, R. W., University of Illinois, Water Resources Center, Urbana, Illinois, WRC Research Report No. 59, Contract No. DI-14-31-0001-3513, September 1972, 83 pp. NTIS Report No. PB-213 501.

Physical, chemical and biological parameters were monitored at five stations in the Asa Creek-Kaskaskia River system, Moultrie County, Illinois, from 12 September 1969 through 7 September 1970 to characterize these streams as a periphyton habitat. December 1970 to determine the effect of the effluent from the Sullivan wastewater treatment plant on assimilation of dissolved organic matter by the periphyton community. The results of 34 parameters measured biweekly revealed that there was no gross evidence of any differences between the creek and river sampling sites as determined by these measurements. Only nitrate-nitrogen, ammonia-nitrogen, and phosphorus (all forms) concentrations were directly attributable to the effluent in Asa Creek, the receiving stream. Of eight parameters measured during the periphyton accrual study, four were found to be significantly different among stations. These included standing crop (biomass), organic content, and productivities (biomass and caloric value). Intrastation correlations among these parameters revealed that the discharge of effluent into Asa Creek coupled with Asa Creek's low stream order not only resulted in a wide flux of physico-chemical conditions, but also had a varied effect on the periphyton. Greater stability in the Kaskaskia River, a higher order stream, was reflected in more predictable levels of physico-chemical parameters and in more stable periphyton communities which developed there. Planktonic and periphytic bacterial chemo-organotrophy, with acetate as the substrate, were measured and evaluated through enzyme kinetics analysis procedures. Bacterial uptake kinetics experiments demonstrated that

2. BIOLOGICAL METHODS

AMIC-7762 (Continued)

Card 2/2

the periphyton, at stations influenced by the wastewater treatment plant effluent, assimilated two to three times more dissolved organic matter than at stations not influenced by the effluent. The influence of the treatment plant was not as apparent for assimilation by planktonic bacteria. This reinforced the premise that the attached community was the most sensitive to subtle changes in the aquatic environment.

INDEX TERMS: Periphyton, Water pollution effects, Bioindicators, Nutrients, Absorption, Bacteria, Organic matter, Waste water (pollution), Sewage effluents, Kinetics, Water quality, Correlation analysis, Regression analysis, Asa Creek Kaskaskia River.

AMIC-7765

"PHYSIOLOGY AND CYTOLOGICAL CHEMISTRY OF BLUE-GREEN ALGAE", Wolk, C. P., Bacteriological Reviews, Vol. 37, No. 1, March 1973, pp 32-101.

That information which is pertinent to the study of the developmental phenomena of blue-green algae has been expanded to encompass that which is known of their physiology and cytological chemistry. This review paper covers the latter two areas of interest.

INDEX TERMS: Plant physiology, Cyanophyta, Algae, Chotosynthesis, Respiration, Plant morphology, Photosynthesis, Biological properties, Nitrogen fixation, Genetics, Plant pigments, Proteins, Carbohydrates, Lipids, Metabolism, Algal toxins, Nutrient requirements, Nitrogen compounds, Algal growth, Biochemical properties, Cyanophages, Ultrastructure, Biosynthesis, Substrate utilization, Synchronous cultures, Pure cultures, Culturing techniques, Electron transport.

AMIC-7764

"FLOW OF MICROBIAALLY FIXED NITROGEN IN A MODEL ECOSYSTEM", Visser, S. A., Witkamp, M., Dahlman, R. C., Plant and Soil, Vol. 38, No. 1, February 1973, pp 1-8.

Transfer of atmospheric nitrogen through microbial fixers, a green plant, decomposer microflora, water and soil was measured in model ecosystems. The systems were maintained under controlled conditions in a 50-ml respirometer flask and consisted of 10 g of kaolinite, 10 ml of water, 60 duckweed leaves (*Lemna minor*), and a mixed microflora or pure *Azotobacter chroococcum*. The role of the *Azotobacter* in fixation was assessed by comparing the nitrogen flow in systems with nitrogen fixers only and those with both nitrogen fixers and decomposers. Analog computer simulations were used to compare N-15 transfer from the atmosphere with net changes of all nitrogen in all compartments. Results showed that *Azotobacter* and the mixed flora with *Azotobacter* are about equally capable of fixing atmospheric nitrogen. During subsequent transfer of the nitrogen there was a distinct differentiation between movement of the newly fixed nitrogen and the nitrogen that was already present in tissues introduced in the beginning of the experiment. Pathways and transfer coefficients of both N-14 and N-15 were different in the presence of the different microbial populations. Turnover was more complex and in general slower in the presence of a mixed population than with pure *Azotobacter*. Denitrification losses upon acidification were negligible for N-14 but appreciable for N-15.

INDEX TERMS: Nitrogen fixation, *Azotobacter*, Nitrogen fixing bacteria, Path of pollutants, Nitrification, Ecosystems, Mass spectrometry, Computer models, Cycling nutrients, Fate of pollutants, Culturing techniques.

AMIC-7783

"A MATHEMATICAL MODEL OF THE NUTRIENT DYNAMICS OF PHYTOPLANKTON IN A NITRATE-LIMITED ENVIRONMENT", Grenney, W. J., Rella, D. A., Curl, H. C., Jr., Biotechnology and Bioengineering, Vol. 15, No. 2, March 1973, pp 331-358.

A three-compartment mathematical model is presented that represents a phytoplankton population capable of storing nitrogen in a nitrate-limiting environment. Growth rates are represented by saturation kinetics based on the concentrations in intracellular nutrient pools. Nutrient flow through a biological system is described using three forms of intracellular nitrogen (inorganic-nitrogen, organic intermediates, and protein). The three-compartment model was developed as part of a larger model to investigate mechanisms associated with nutrient limitation and recycling. The model demonstrated the changes which may occur in the nitrogenous constituents of a phytoplankton population with time and environmental conditions. The model also demonstrates three phenomena which have been observed in field and laboratory experiments but which are not represented by the customary Monod model: (1) uptake rates may significantly exceed net growth rates, (2) high growth rates may be encountered at very low environmental nitrate concentrations, and (3) the ratio of internal nitrogen to population size may change significantly during a study period. It is suggested that the amount of nitrogen in storage may be used as an indicator of the physiological state of a monospecific population. The one-compartment Monod model was shown to be inadequate to accurately represent population growth in chemostat experiments when intracellular storage is a significant factor.

INDEX TERMS: Phytoplankton, Mathematical models, Nitrates, Cycling nutrients, Deficient elements, Computer models, Absorption, Growth rates, Proteins, Nitrogen, Storage, Kinetics, Monod model, Chemostat.

2. BIOLOGICAL METHODS

AMIC-7859

"EFFECTS OF PESTICIDES IN WATER", U. S. Environmental Protection Agency, Washington, D.C., EPA Report to the States (No Date), 145 pp.

This document was prepared to fulfill the requirement of the newly amended Federal Water Pollution Control Act. The scientific information contained in this document consists of current knowledge of the effects on health and welfare of the presence of pesticides in waters. The areas covered are: (1) behavior of pesticides in the environment, (2) lethality, (3) persistence and biological accumulation, and (4) residues.

INDEX TERMS: Water pollution effects, Pesticide kinetics, Persistence, Pesticide toxicity, Pesticide residues, Aquatic life, Bioassay, Lethal limit, Heavy metals, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Freshwater fish, Path of pollutants, Metal organic pesticides, Aquatic bacteria, Aquatic plants, Marine fish, Plant tissues, Triazine pesticides, Insecticides, Herbicides, Fungicides, Carbamate pesticides, Urea pesticides, Arsenicals (pesticides), Phenolic pesticides, Piscicides, Marine algae, Aquatic algae, Marine plants, Food chains, Bioaccumulation, Metabolites, Animal tissues.

AMIC-7915

"PHYTOPLANKTON ALGAE: NUTRIENT CONCENTRATIONS AND GROWTH", Holmes, P., Kelly, M. G., Hornberger, G. M., O'Brien, W. J., Science, Vol. 180, No. 4092, June 1973, pp 1298-1300.

Critiques of and a rebuttal to an article concerned with nutrients and growth of phytoplankton are presented. Some of the more pertinent points made include: (1) Growth yield depends on the concentration of a limiting nutrient and not necessarily on how fast growth can occur. (2) Considering Monod kinetics, nutrient addition will increase both growth rate and final biomass. Phytoplankton growth kinetics should be considered in terms of both standing crop and productivity, nutrient uptake or growth rate. (3) The Liebig thought of nutrient limitation in terms of enhanced yield and experiments which demonstrate only an enhancement of phytoplankton yield without showing a change in population growth rate are not always valid in determining a real limiting factor in the natural system.

INDEX TERMS: Phytoplankton, Growth rates, Primary productivity, Nutrient requirements, limiting factors, Growth kinetics.

AMIC-7893

"BEHAVIOR OF THE GOLDFISH AS AN EARLY WARNING SYSTEM FOR THE PRESENCE OF POLLUTANTS IN WATER", Salzinger, K., Fairhurst, S. P., Freimark, S. J., Wolkoff, F. D., Journal of Environmental Systems, Vol. 3, No. 1, Spring 1973, pp 27-40.

This paper has a twofold purpose. First, it reviews the literature on the effects of pollutants on fish, particularly goldfish, in terms of lethal dosage and behavioral changes. Second, it presents the results of an experiment showing the effects of two very low concentrations of mercury on the behavior of goldfish. Twelve goldfish were conditioned to form different behavior patterns to obtain food (three fish to each pattern). After stabilization of these patterns, one fish from each pattern was placed in mercury polluted water at a concentration of 0.01 ppm, one in water polluted at 0.006 ppm, and the third in unpolluted water. All four fish placed in the more highly polluted water showed the largest drop in response rate. All but one of the fish placed in the lower-concentration polluted water showed greater decrease in response than those in the unpolluted water. The results suggest that the goldfish might be a potential pollution monitor.

INDEX TERMS: Pollutant identification, Bioindicators, Fish behavior, Water pollution, Mercury, Lethal limit, Water pollution effects, Toxicity, Reviews, Hydrogen ion concentration, Salinity, Water temperature, Pesticides, Heavy metals, Alkali metals, Goldfish, *Carassius auratus*, Biomonitoring.

AMIC-7922

"STANDARD DISPERSANT EFFECTIVENESS AND TOXICITY TESTS", McCarthy, L. T., Jr., Wilder, I., Dorrier, J. S., U. S. Environmental Protection Agency, Edison Water Quality Research Laboratory, Edison, New Jersey, Report No. EPA-R2-73-201, May 1973, 66 pp.

A brief history of the development of the Standard EPA Dispersant Effectiveness and Toxicity tests is outlined. The standard tests are presented and discussed. An analysis of variance is performed on the data developed by three independent laboratories in order to determine the reproducibility of standard test procedures. In the standard effectiveness test, oil is applied to the water surface in a cylindrical tank. Dispersant is applied in a fine stream and then mixing energy is supplied by a pressurized water stream. The tank contents are recirculated after which samples are withdrawn for extraction and spectrophotometric analysis. The standard toxicity test involves exposing three species (*Pimephales promelas*, *Fundulus heteroclitus*, and *Artemia salina*) to dispersant and oil/dispersant mixtures. From these tests a curve relating organism survival to material concentrations is developed to determine median tolerance limits. Separate discussion sections include the statistical analyses of 'testing the test' results for reproducibility and the rationale for selecting the test procedures as presented.

INDEX TERMS: Testing procedures, Toxicity, Laboratory tests, Methodology, Bioassay, Fish, Brine shrimp, Statistical methods, Freshwater, Sea water, Lethal limit, Oil dispersants, Standard tests, Reproducibility, Median tolerance limit, Data interpretation.

2. BIOLOGICAL METHODS

AMIC-7929

"A RELATIONSHIP BETWEEN HETEROTROPHIC UTILIZATION OF ORGANIC ACIDS AND BACTERIAL POPULATIONS IN WEST BLUE LAKE, MANITOBA, Robinson, G. G. C., Hendzel, L. L., Gillespie, D. C., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 264-269.

The relationship between the concentration of nine organic acid substrates (lactic, pyruvic, fumaric, malic, acetic, succinic, glycolic, citric, and formic) and their velocities of uptake have been investigated in West Blue Lake, Manitoba. Maximum uptake velocities were ranked and compared with bacterial plate counts on minimal media supplemented with single organic acids. Water samples from a 5-m depth were screened through a 153-micron Nitex screen to remove most of the zooplankton. Subsamples were placed in an appropriate number of sterile 25-ml bottles and inoculated with the C-14-labeled organic acid substrates. All bottles were incubated in the lake for a 12-hr period at a depth of 5 m. After incubation the samples were filtered through 0.45-micron cellulose acetate filters each of which was washed with sterile water and placed into scintillation vials containing Bray's fluor. Radioactivity was determined in a scintillation counter and calculations were made to determine bacterial numbers in relation to each organic acid. For pyruvic, fumaric, malic, acetic, glycolic, and citric acids an excellent correlation (r equals 0.98) existed between plate counts and acid uptake indicating that for these substrates maximum velocities of uptake are indeed indicative of actual bacterial populations.

INDEX TERMS: Organic acids, Aquatic bacteria, Absorption, Organic compounds, Water sampling, Cultures, Substrate utilization, Heterotrophic nutrition, Heterotrophic bacteria, Bacterial populations, West Blue Lake, Data interpretation, Plate counts.

AMIC-7931

"ANNUAL PRODUCTION OF A STREAM MAYFLY POPULATION: A COMPARISON OF METHODS", Waters, T. F., Crawford, G. W., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 286-296.

The annual production of the mayfly *Ephemerella subvaria* McDunnough in a small central Minnesota stream, Luxemburg Creek, was estimated by four methods: a removal-summation method, the instantaneous growth method, the Allen curve, and the Hynes method. Basic data on standing crop and growth rates were obtained from a series of bottom samples covering the life cycle of the mayfly. The life history of *E. subvaria* was clear and simple, and the data were particularly amenable to production estimation by all four methods. The first three yielded estimates of annual production that generally agreed, ranging from 26.4 to 28.9 g/sq m. The Hynes method yielded an estimate 15.2 to 26.1 percent higher, or 33.3 g/sq m. Cohort turnover ratios for the first three methods ranged from 4.2 to 4.6 (not calculable for the Hynes method); the annual turnover ratio for the first three methods ranged from 5.8 to 6.3 and was 7.2 for the Hynes method. (Reprinted from Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 286-296. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Mayflies, Standing crops, Secondary productivity, Animal growth, Methodology, Growth rates, Bottom sampling, Aquatic insects, Annual, Life history studies, Annual turnover, Comparative studies, Removal summation method, Instantaneous growth method, Allen curve method, Hynes method, Method evaluation, Data interpretation, *Ephemerella subvaria*.

AMIC-7932

"ESTIMATION OF MORTALITY COEFFICIENTS FROM FIELD SAMPLES OF ZOOPLANKTON", Fager, E. W., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 297-301.

Point estimates of mortality of zooplankton in the field, based on relative numbers of individuals of different developmental stages observed in samples, require either a knowledge of the initial input of young or assumptions about constancy of input and constancy of mortality over adjacent stages. As the initial input is rarely known and the assumptions of constancy are probably often violated, the resulting uncertainty should be made evident in the estimates. This can be done by reporting the ranges of values of the mortality coefficients that would be consistent with the observed relative numbers of individuals. Methods of calculating these ranges are given. (Reprinted from Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 297-301. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Zooplankton, On-site data collections, Estimating, Computer programs, Animal populations, Mathematical studies, Mortality coefficients, Population dynamics.

AMIC-7935

"AN EVALUATION OF LIQUID SCINTILLATION COUNTING TECHNIQUES FOR USE IN AQUATIC PRIMARY PRODUCTION STUDIES", Pugh, P. R., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 310-319.

Methods evaluated for the liquid scintillation counting of samples from aquatic primary production studies include the counting of intact filters and cells in a toluene fluor, solubilization and counting of membrane filters and cells in various reagents, and counting of a suspension of cells mixed with the fluor. A 1:1 Triton X-100:toluene fluor was very effective for the suspension of cells and gave high counting efficiencies. Up to 5 ml of sample could be mixed with the fluor, but this was considered inadequate for most primary production studies. The filter standardization method for the counting of intact filters was investigated further and found to be applicable over a wide range of conditions but only accurate when the weight of algae on the filters was small (less than 1 mg). Direct solubilization of the filters and cells in a naphthalene-dioxane or 2-methoxyethanol-toluene fluor were the simplest, most accurate, and economical methods for primary production studies; the latter dissolved both wet and dry cellulose nitrate membrane filters and gave excellent replicate counting. (Reprinted from Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 310-319. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Evaluation, Primary productivity, Methodology, Radioactivity techniques, Aquatic environment, Liquid scintillation, Scintillation counting, Membrane filters, Accuracy, Reagents.

2. BIOLOGICAL METHODS

AMIC-7936

"MEMBRANE FILTER RETENTION-A SOURCE OF ERROR IN THE C-14 METHOD OF MEASURING PRIMARY PRODUCTION", McMahon, J. W., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 319-324.

The relationship between volume of water filtered and apparent specific activity of phytoplankton in which the latter decreases (cpm C-14/ml) with increasing volume filtered, previously attributed to cellular damage to phytoplankton during vacuum filtration, is now considered mainly due to retention of unfixed radiotracer on the membrane filter. The retention capacity for C-14 by the filter, expressed as radioactivity per milliliter filtered, is maximum for small sample volumes (less than or equal to 1 ml), decreasing to a constant value when sample volumes are larger than 100 ml. This is attributed partially to adsorption in the filter and probable retention of C-14 bound to unknown substances in the water or on the filter which are eluted or exchanged by passage of volumes of water of 100 ml or greater. This "washing" effect permits almost all of the C-14 not fixed in organisms to pass through the filter. (Reprinted from Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 319-324. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Primary productivity, Methodology, Water analysis, Radioactivity techniques Retention, Measurement, Phytoplankton, Volume, Carbon radioisotopes, Absorption, Chemical analysis, Membrane filters, Error sources, Liquid scintillation, Scintillation counting, C-14, *Asterionella formosa*, Maskinonge Lake, Grenadier Pond.

AMIC-7937

"THE REDUCTION OF COPPER TOXICITY IN A MARINE COPEPOD BY SEDIMENT EXTRACT", Lewis, A. G., Whitfield, P., Ramnarine, A., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 324-326.

Seawater extracts of marine sediments from two areas were added to copper-enriched seawater in which the prefeeding stages (egg, NI, NII) of *Euchaeta japonica* (Copepoda: Calanoida) were maintained. Sediment samples were collected with an Ekman and a Shipek sampler. A quantity of the sediment was extracted by allowing the sediment to stand in cold, membrane-filtered seawater. The extract was filtered, stored, diluted to 2 percent, and CuCl₂ and the prefeeding copepod stages were added. Survival through the prefeeding stages was used as an indication of the effects of the sediment extracts. 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.

INDEX TERMS: Copper, Toxicity, Copepods, Attenuation, Bottom sediments, Water pollution effects, Growth stages, *Euchaeta japonica*, Survival.

AMIC-7938

"SUGAR-COATED DAPHNIA: A PRESERVATION TECHNIQUE FOR CLADOCERA", Haney, J. F., Hall, D. J., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 331-333.

A simple preservation technique is described which utilizes sucrose to prevent carapace distortion and loss of broodpouch contents due to ballooning in *Daphnia*. Zooplankton samples collected from Little Mill Lake by vertical tows of a 75-micron-mesh plankton net through 9 m were transferred to a 75-micron Nitex screen glued to the bottom of an acrylic cylinder, immersed in carbonated water, washed into sample bottles containing appropriate concentrations of sucrose and 4 percent formalin. Carapace distortion and loss of eggs by preserved specimens were prevented by adding 40 g/liter sucrose to 4 percent formalin. Differences in size and species composition may influence the threshold sugar concentration at which ballooning is prevented.

INDEX TERMS: *Daphnia*, Methodology, Sample preservation, Sucrose, Zooplankton, Invertebrates, Macroinvertebrates, *Daphnia pulex*, *Daphnia galeata*.

AMIC-7939

"QUANTITATIVE SAMPLING OF LIVE ZOOPLANKTON WITH A FILTER-PUMP SYSTEM", Icanberry, J. W., Richardson, R. W., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 333-335.

A conventional plankton net was inadequate for study of the survival of zooplankton passing through the cooling water systems of thermal power plants. A filter collection system was designed which allows survivals of 90-95 percent by reducing water velocities and turbulence within the collection chamber. The filter-pump system consisted of a specially designed filter connected to a Labawco type P general purpose centrifugal pump driven by an electric motor. Comparisons of fishing abilities did not show any significant differences between a filter pump and a plankton net.

INDEX TERMS: Zooplankton, Equipment, Efficiencies, Plankton nets, Methodology, Construction, Water sampling, Filtration, Mortality, Filter-pump system, Quantitative sampling, Performance evaluation, Survival.

2. BIOLOGICAL METHODS

AMIC-7948

"IDENTIFICATION OF THE LIMITING NUTRIENT AND SPECIFIC GROWTH RATE", Sykes, R. M., Journal Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 888-895.

The simplest mathematical theory of continuous microbial cultures, that for the chemostat, contains the corollary that a given growth medium may contain more than one limiting nutrient. If it does, in chemostat cultures each nutrient is limiting in a different, nonoverlapping dilution rate range, and in batch cultures each nutrient limits in different growth stages. It is possible to derive from the differential equations describing the microbial culture both the conditions permitting multiple limiting nutrients and the boundaries of each nutrient's range of limitation. These deductions are a consequence of defining the limiting nutrient as the nutrient that controls the organism's specific growth rate. Deductions can be derived for any model of microbial culture.

INDEX TERMS: Cultures, Mathematical models, Growth rates, Microorganisms, Limiting factors, Essential nutrients, Theoretical analysis, Kinetics, Nutrient requirements, Chemostat, Batch cultures, Continuous cultures, Culture media, Monod model.

AMIC-7958

"UPTAKE OF MERCURY BY CAGED RAINBOW TROUT (*SALMO GAIARDNERI*) IN THE SOUTH SASKATCHEWAN RIVER", Uthe, J. F., Atton, F. M., Royer, L. M., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 5, May 1973, pp 643-650.

Rainbow trout were held in cages in the South Saskatchewan River to assess mercury uptake following curtailment of mercury discharges to the river. Six fish were taken from the cages at random at 2-week intervals and pooled homogenate samples were taken from the livers, kidneys, and headless, dressed carcasses. The total mercury content of samples was determined by flameless atomic absorption spectroscopy. There was a rapid uptake of mercury by the fish 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 exists within this river system. Analyses showed that the bulk of mercury present in the fish carcasses was present as methylmercury. It was concluded that caged fish are good monitors of mercury pollution. The studies also showed that the cessation of mercury discharge into a river does not lead to elimination of mercury uptake in fish.

INDEX TERMS: Mercury, Absorption, Rainbow trout, Water pollution effects, On-site tests, Biomonitoring, Methylmercury, Liver, Kidneys, Sample preservation.

AMIC-7953

"EFFECTS OF LOGGING ON GROWTH OF JUVENILE COHO SALMON", Iwanaga, P. M., Hall, J. D., Oregon State University, Department of Fisheries and Wildlife, Corvallis, Oregon, Report No. EPA-R3-73-006, April 1973, 35 pp.

The objective of this research was to study the effects of increased water temperature characteristic of clearcut watersheds of Pacific coastal streams upon the growth rate of juvenile coho salmon. The natural temperature fluctuations of the stream were used in the study of growth of underyearling fish held in aquariums and fed at various consumption levels. Juvenile coho experiencing the cooler temperature of the control stream demonstrated generally better growth rates than did those that experienced the warmer temperatures of the clearcut stream. The reduced maintenance requirements in the control experiment indicated a reduced basal metabolic demand, which allowed for a greater portion of the food consumed to be utilized for growth. This was particularly true at low levels of consumption. Growth rates of juvenile coho salmon in the wild state were found to be slightly higher in the clearcut stream as compared to the unlogged stream. This difference from the experimental results may have been due to a change in availability and abundance of food. There was a marked decrease in the cutthroat trout population in the clearcut stream, which may have reduced competition for the coho salmon. There was no apparent influence of infestation by 'salmon poisoning' fluke on the condition of the juvenile coho in the clearcut stream.

INDEX TERMS: Water pollution effects, Thermal stress, Coho salmon, Juvenile fish, Bioassay, Lumbering, Watersheds (basins), Water temperature, Growth rates, Animal growth, Animal parasites, Trematodes, Laboratory tests, Animal metabolism, Needle Branch, Flynn Creek, *Oncorhynchus kisutch*, *Nanophyetus salmincola*, Food consumption, Deer Creek.

AMIC-7961

"A SIMPLE METHOD FOR RECORDING FISH HEART AND OPERCULUM BEATS WITHOUT THE USE OF IMPLANTED ELECTRODES, Rommel, S. A., Jr., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 5, May 1973, pp 693-694.

A method is described by which heart and opercular beats can be recorded from gently restrained, freely-swimming fish without implanting electrodes. The fish were restrained in soft plastic mesh cages so that the long axis of the body was usually aligned in one direction. Electrodes, consisting of carbon rods with leads to a polygraph, were fastened to either end of the cage. Electronic filtering was used to eliminate low frequency swimming movements and high frequency electrical noises. Atlantic salmon and American eel were used in the tests. The method was usable in waters with resistivities between 4000 ohm-cm and 400 ohm-cm. Best results were obtained in water of about 1000 ohm-cm. Excellent agreement was obtained between the water electrode recording and implanted electrode recordings. The method can minimize fish handling in some physiological experiments.

INDEX TERMS: Electrodes, Fish physiology, Methodology, Fish, Atlantic salmon, Heart rate, Opercular beats, Electrocardiograms, *Anguilla rostrata*, American eel, *Salmo salar*.

2. BIOLOGICAL METHODS

AMIC-7963

"SOME SHORT-TERM INDICATORS OF SUBLETHAL EFFECTS OF COPPER ON BROOK TROUT, *SALVELINUS FONTINALIS*", Drummond, R. A., Spoor, W. A., Olson, G. F., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 5, May 1973, pp 698-701.

Laboratory tests were conducted to evaluate changes in cough frequency, locomotor activity, and feeding behavior as possible short-term indicators of the long-term effects of copper on brook trout. The trout were studied in plastic electrode chambers that allowed free movement in continuously flowing water. The electrodes measured respiratory and other movements, which were recorded on a polygraph. The effect of copper on coughing was measured by comparing cough frequency during a 24-hour exposure to that during the preceding 24-hour period. The effect on locomotor activity was measured during the first 2 hours of exposure and compared with activity the day before the test and with that of controls. Feeding behavior was monitored at 2 and 24 hours after exposure began and any departure from normal aggressive feeding patterns was recorded. Changes occurred in all three activities at copper concentrations near 9.5 micrograms/l. Each response thus showed promise as a short-term indicator of the concentration range at which chronic exposure might have no permanent effect. Cough frequency was the best of the three for showing stress according to the copper concentration, but the change developed more slowly than in locomotor activity.

INDEX TERMS: Copper, Toxicity, Brook trout, Fish behavior, Bioindicators, Laboratory tests, Water pollution effects, Monitoring, Lethal limit, Food habits, Bioassay, Pollutant effects, Cough frequency, Locomotor activity, *Salvelinus fontinalis*.

AMIC-7965

"A COMPARISON OF LIQUID SCINTILLATION AND GEIGER-MULLER ESTIMATES OF PRIMARY PRODUCTIVITY IN AN IN SITU EXPERIMENT", Ward, F. J., Nakanishi, M., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 5, May 1973, pp 708-711.

For an in situ experiment conducted in Shiozu Bay, Lake Biwa, Japan, primary productivity estimates from liquid scintillation radioactivity counts of wet algae were generally higher than those from Geiger-Muller radioactivity counts of desiccated algae. Values at 0 m were similar, the G-M estimate at 0.5 m was 10 percent higher, but from 3 to 13 m the liquid scintillation values ranged from 11 to 33 percent higher than G-M estimates. The 20-m estimates were low and similar. Differences were caused primarily by C-14 losses during desiccation prior to G-M counting. Increasing loss rates between 0.5 and 3.0 m may have been caused by decreasing light intensity. On the basis of surface area, the estimate from liquid scintillation data was 27 percent greater than that obtained from G-M data. The results indicated that previously recommended methods for sample preparation and radioactivity determinations may cause primary productivity estimates from in situ data to be significantly in error.

INDEX TERMS: Primary productivity, Radioactivity techniques, On-site tests, Methodology, Liquid scintillation, Geiger-Muller estimates, Comparative studies, Method evaluation, C-14, Sample preparation.

AMIC-7979

"SOME EFFECTS OF EVAPORATION SUPPRESSION ON RESERVOIR ECOLOGY", Silvey, J. K. G., Sharp, H. B., Dickson, K. L., et al., Journal American Water Works Association, Vol. 65, No. 4, April 1973, pp 260-268.

St Studies were made in Lake Hefner, an Oklahoma City water supply reservoir, to determine the effects of hexadecanol on biological, chemical, and physical aspects of water quality. Hexadecanol is a chemical applied to suppress evaporation. Samples were taken twice a week from five stations during summer months and analyzed for bacteria, algae, phosphates, and nitrates. Chemical and physical analyses for hardness, temperature, specific conductance, pH, carbonates, bicarbonates, sulfates, chlorides, DO, CO₂, iron, color and turbidity were performed weekly. During winter months, monthly samples were analyzed in a like manner. The study was conducted over a 5-year period. The application of hexadecanol apparently had no detectable deleterious effect on chemical water quality. Some stimulation in the population of certain bacterial organisms could be seen, but only when a composite was made of all data from each station. A slight correlation could also be made between laboratory studies and the organisms shown to be stimulated in the reservoir. But since other conditions may have had an effect, it was not possible to conclude that population increases were due entirely to hexadecanol. There was no apparent difference in bottom fauna between periods of coverage and non-coverage. It was concluded that hexadecanol in the concentrations used had no detectable effect on the ecology of the reservoir.

INDEX TERMS: Aquatic algae, Aquatic insects, Reservoirs, Evaporation control, Hexadecanol, Water quality, Aquatic bacteria, Annelids, Benthos, Aquatic fungi, Freshwater fish, Monomolecular films.

AMIC-8040

"ECOLOGY OF TWO RELATED SPECIES OF CADDIS FLY LARVAE IN THE ORGANIC SUBSTRATES OF A WOODLAND STREAM", Mackay, R. J., Kaiff, J., Ecology, Vol. 54, No. 3, Late Spring 1973, pp 499-511.

Two species of *Pycnopsyche* larvae inhabiting allochthonous organic materials in West Creek are contemporaneous and similar in size. Field studies and laboratory experiments show that about 90 percent of *P. gentilis* larvae live in fallen leaves, which they use as food and for case materials; the remaining 10 percent occur in detritus with *P. luculenta*. *P. luculenta* can utilize leaves or woody materials; 50 percent of the population is in detritus, and 50 percent is in more leafy habitats, but not far from detritus. The distribution of each species from September through March depends on the amount of preferred habitat space available. Larvae in leafy habitats are washed downstream during the spring thaw by habitat displacement. In 1971, two-thirds of the *P. gentilis* population and nearly half the *P. luculenta* population were displaced. The subsequent shortage of leafy habitat space and crowding of remaining larvae may result in competitive interaction and predation by grackles. In the laboratory, both species feed preferentially on leaves that decay quickly, especially on leaves infected with fungi. Dry weights of leaf tissue ingested per larva in 24 hours frequently exceed 50 percent of the dry body weight of the larva. *P. luculenta* ingests less leaf material if twigs are available. The niche size of *P. gentilis* is smaller than that of *P. luculenta*. There is some niche overlap, but it apparently does not normally result in harmful competition between the species.

INDEX TERMS: Caddisflies, Larvae, Organic matter, Ecology, Aquatic habitats, On-site tests, Laboratory tests, Detritus, Leaves, Natural streams, Animal populations, Niches, Woodland stream, Substrate utilization, Food sources.

2. BIOLOGICAL METHODS

AMIC-8068

"THE GEOGRAPHIC DISTRIBUTION OF FRESHWATER HIRUDINOIDEA IN CANADA", Davies, R. W., Canadian Journal of Zoology, Vol. 51, No. 5, May 1973, pp 531-545.

The distribution for each species of freshwater leech (Hirudinoidea) is described and discussed on a province or territory basis. The hosts for those species recorded as temporary parasites are listed. One hundred and eight new species records are listed including 28 records new to the province or territory. *Percymooresis lateralis* is recorded in Canada for the first time, and the first record of freshwater leeches in the Yukon made.

INDEX TERMS: Systematics, Aquatic animals, Canada, Annelids, Speciation, Spatial distribution, Animal groupings, Leeches, Macroinvertebrates, Hirudinea.

AMIC-8080

"AVOIDANCE OF PESTICIDES BY GRASS SHRIMP (*PALAEMONETES PUGIO*)", Hansen, D. J., Schimmel, S. C., Keltner, J. M., Jr., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 3, March 1973, pp 129-133.

The capacity of the euryhaline grass shrimp, *Palaemonetes pugio*, to avoid water polluted by DDT, endrin, Dursban, malathion, Sevin, or 2,4-D was evaluated. Grass shrimp were sieved from ponds and acclimated for at least 5 days in the laboratory at 20 percent salinity and 20 C. Avoidance was tested by allowing the shrimp to move from a holding area into one of two sections, one with pesticide polluted water and the other with unpolluted water. Light was excluded during experiments. It was assumed, and corroborated in preliminary tests, that in the absence of pollutants the shrimp would enter the two areas with equal frequency. Chi-square tests were used to analyze the results. The shrimp avoided 1.0 and 10.0 ppm concentrations of the herbicide 2,4-D but did not avoid any of the five insecticides. Given a choice between two concentrations of 2,4-D, they chose the lower concentration. The data suggest that shrimp may be extremely vulnerable to pesticide pollution because they are very sensitive to pesticides and are unlikely to avoid water polluted by them.

INDEX TERMS: DDT, Endrin, 2,4-D, Bioassay, Animal behavior, Pesticide toxicity, Water pollution effects, Crustaceans, Chlorinated hydrocarbon pesticides, Phosphothioate pesticides, Carbamate pesticides, Dursban, Malathion, Sevin, Avoidance, *Palaemonetes pugio*, Grass shrimp, Macroinvertebrates, Median tolerance limit.

AMIC-8071

"TRENDS IN METHODOLOGY FOR EVALUATION OF EFFECTS OF POLLUTANTS ON MARINE ORGANISMS AND ECOSYSTEMS", Waldichuk, M., CRC-Critical Reviews in Environmental Control, Vol. 3, No. 2, February 1973, pp 167-211.

The literature related to biological and chemical methodology for evaluating the effects of pollutants on marine organisms is reviewed. Research findings are considered from the very pragmatic point of view and the review is an extension of the presentation on the subject made earlier. In this case, it does not cover in depth broader considerations of physiological and biochemical studies on the effects of pollutants on marine organisms, from which there is an ever-increasing literature. Also, much of the microbiological research on marine pollution has been largely unreviewed.

INDEX TERMS: On-site investigations, Analytical techniques, Methodology, Evaluation, Water pollution effects, Ecosystems, Reviews, Pollutant identification, Bioassay, Laboratory tests, Marine fish, Cold-water fish, Animal physiology, Primary productivity, Secondary productivity, Laboratory equipment, Instrumentation, Growth stages, Marine algae, Marine bacteria, Crustaceans, Mollusks, Marine animals, Invertebrates, Toxicity, Lethal limit, Animal behavior, Pollutant effects, Marine environment, Macroinvertebrates, Bioaccumulation, Data interpretation, Median tolerance limit.

AMIC-8089

"A SENSITIVE MECHANIZED DETERMINATION OF ATP PLUS ADP", Loos, J. A., van Doorn, R. C. H., Roos, D., Analytical Biochemistry, Vol. 53, No. 1, May 1973, pp 309-312.

A method for the mechanized determination of ATP plus ADP using a cyclic enzymatic system which was previously described has been improved to increase the sensitivity to 6 nm. The improved system differs in the way in which the conversion of ATP into ADP is measured and is based on the consumption of NADH. In the earlier system it was necessary to free the enzyme mixture by filtration. It has been found now that all the commercially purified enzymes can be substituted by 'adolase paste' without changing the sensitivity or reproducibility. The new method yielded less than 5 percent difference with erythrocyte lysates when quenching of the fluorometric signal by haemoglobin was taken into account. With leukocytes, less than 10 percent difference was found. ATP added to these lysates was recovered quantitatively. This indicates that the determination is specific for ATP plus ADP in lysates of human erythrocytes and leukocytes.

INDEX TERMS: Pollutant identification, Biochemistry, Methodology, ATP, ADP, Enzymatic tests, Sensitivity, Sample preparation, Blood, Biological samples.

2. BIOLOGICAL METHODS

AMIC-8103

"FINAL REPORT ON DRIFT STATION BIOLOGY: ZOOPLANKTON TAXONOMY AND SORTING PROGRAMS", Fernandez, H. R., University of Southern California, Department of Biological Sciences, Los Angeles, California, Final Report, Contract No. N00014-67-A-0269-0013, January 1973, 45 pp. NTIS Report No. AD 756 661.

The taxonomic studies of Arctic zooplankton conducted as part of the activities of the UCC Arctic Project are summarized. The purposes of such studies were to (1) identify the marine fauna of the area; (2) produce taxonomic guides which would enable biologists to readily identify Arctic zooplankton; and (3) study the biology of some of the organisms, to form the basis for biochemical and physiological investigations. This report also includes a list of the stations and the organisms identified. (See also: AMIC-8107 and AMIC-8314)

INDEX TERMS: Zooplankton, Systematics, Classification, Ecological distribution, Arctic Ocean, Crustaceans, Invertebrates, Sampling, Annelids, Mollusks, Marine animals, Taxonomic guides, Vertical distribution, Sample preservation, Chaetognaths, Tunicates, Nemertean, Macroinvertebrates, Ctenophora, Coelenterates.

AMIC-8104 (Continued)

Card 2/2

INDEX TERMS: Eutrophication, Water quality, Nutrients, Primary productivity, Phytoplankton, Water quality control, Hydrography, Epilimnion, Phosphorus, Nitrogen, Chemical properties, Cyanophyta, Pyrrophyta, Hypolimnion, Finger Lakes.

AMIC-8104

"EUTROPHICATION AS A PROBLEM IN THE FINGER LAKES", Oglesby, R. T., Cornell University, Water Resources and Marine Sciences Center, Ithaca, New York, Technical Report No. 53, Contract Nos. 14-01-0001-1400, 1852, 14-31-0001-3032, 3232, and 3532, October 1972, 23 pp. NTIS Report No. PB-214 772.

Water quality and related parameters have been established for four of the Finger Lakes and reinforced for a fifth. This information suggests possibilities for water quality management directed at control of phytoplankton production. It also indicates what additional information is needed in order to develop a more refined management model. This project began with a review of the literature concerned with the Finger Lakes and a detailed mapping of land use patterns in their drainage basins and major sub-basins. A program of stream sampling was begun with samples being taken under different climatological and hydrological regimes in an attempt to see if ready correlations between nitrogen and phosphorus and land use could be obtained. In late 1970 emphasis shifted to the lakes themselves and a regular limnological sampling program was initiated and carried out from 1971 to the present. Emphasis was placed on primary plant nutrients and on phytoplankton standing crop, but other standard limnological measurements have been made throughout the course of the surveys. The classic pattern of nutrient variation with fluctuation of primary production in lakes is an inverse relationship with nutrients decreasing as the growth activity of phytoplankton increases. Two striking features of the nutrient-phytoplankton relationship are apparent from the data: (1) the similarity of variation in epilimnetic and hypolimnetic nutrients and (2) the seemingly greater dependence of phytoplankton on soluble phosphorus than on saline nitrogen.

AMIC-8106

"MICROBIAL FORMATION OF POTENTIALLY HAZARDOUS ORGANO-METAL COMPOUNDS IN WATER", Alexander, M., Cornell University, Water Resources and Marine Sciences Center, Ithaca, New York, Report No. 47, Contract No. 14-31-0001-3532, October 1972, 17 pp. NTIS Report No. PB-214 698.

Species of *Candida*, *Gliocladium* and *Penicillium* from polluted waters were found to produce trimethylarsine gas from several arsenic sources. The pH of the solution and phosphate ions had a marked effect on the biosynthesis of this volatile arsenic compound. A strain of *Penicillium* which produced dimethylselenide from inorganic selenium compounds was isolated from raw sewage. Sulfate and methionine enhanced growth of the fungus and its production of dimethylselenide in media containing selenite. In solutions containing selenate, methionine inhibited dimethylselenide formation while stimulating proliferation of the fungus. Dimethylselenide was also generated from inorganic selenide. Alkylation did not appear to be a significant mechanism of selenium detoxication by this organism. Dimethyltelluride was also produced by the organism from several tellurium compounds, but this product was synthesized only in the presence of both tellurium and selenium. The yields of dimethylselenide and dimethyltelluride varied with the relative concentrations of selenium and tellurium in the medium.

INDEX TERMS: Microbial degradation, Water pollution sources, Aquatic fungi, Metabolism, Water pollution effects, Plant growth, Organometallics, *Candida humicola*, *Gliocladium roseum*, *Penicillium*, Biosynthesis, Biotransformation, Trimethylarsine, Substrate utilization, Dimethylselenide, Dimethyltelluride, Sewage fungi.

2. BIOLOGICAL METHODS

AMIC-8107

"TAXONOMIC GUIDES TO ARCTIC ZOOPLANKTON (V): PELAGIC POLYCHAETES OF THE CENTRAL ARCTIC BASIN", Yingst, D. R., University of Southern California, Department of Biological Sciences, Los Angeles, California, Technical Report No. 1, Contract No. N00014-671A1026910013, October 1972, 49 pp. NTIS Report No. AD756659.

'Taxonomic Guides to Arctic Zooplankton (V)' is one in a series of six practical taxonomic guides to zooplankton prepared to meet the needs of non-taxonomists involved with Arctic fauna. The work is based upon results of research by investigators associated with the USC Arctic Project and its precursors since 1952. This compilation presents a detailed consideration of the different adult pelagic polychaetes found in the central Arctic Ocean. Emphasis has been placed on the familial level as information on the group is still inadequate to justify construction of generalized keys to species. Provided also are a discussion of basic polychaete morphology and terminology used in the guide, illustrations, dichotomous keys, and hints on methodology for handling preserved specimens. Selected references pertaining to polychaetes in general, as well as those concerning specific polychaetes in the guide, are also included. (See also: AMIC-8103 and AMIC-8314)

INDEX TERMS: Zooplankton, Arctic Ocean, Annelids, Systematics, Classification, Larvae, Polychaetes, Pelagic animals, Taxonomic guides, Animal morphology, Sample preservation, Macroinvertebrates.

AMIC-8120

"APPARATUS FOR SEMI-CONTINUOUS CULTURE OF DAPHNIA", Harvey, A. M., Laboratory Practice, Vol. 22, No. 2, February 1973, pp 114-115.

An apparatus for culturing *Daphnia*, which employs some advantage of the chemostat is described. Two-litre culture vessels with a 14 mm bottom port are used. A delicate agitator is used involving moist, sterile air bubbling through a sintered glass disc into an inverted funnel inside the culture vessel. This provides satisfactory mixing and alleviates localization of metabolic wastes and oxygen deficiency. The vessel is autoclaved at 15 pounds per square inch for 15 minutes, and then joined aseptically to sterile food and air lines in a controlled temperature room at 20 C. A suspension of 150,000 cells per ml of *Chlorella vulgaris* is pumped into the culture vessel to a volume of 1200 ml. Sterile, clonal *Daphnia pulex* are introduced and the agitation system activated. The culture is allowed to increase and equilibrate for six days, and the pump is switched on again to give the desired dilution rate. Although this apparatus necessarily falls short of a true chemostat in some respects of its design, it represents a much more satisfactory method than previous ones used for culturing *Daphnia*. The main advantages are of constancy in the environment, simplicity of control, and physiological uniformity. The methods used here to minimize particular problems presented by *Daphnia* could easily be modified to allow the culture of other aquatic invertebrates in a similar system.

INDEX TERMS: *Daphnia*, Sampling, Zooplankton, Laboratory equipment, Crustaceans, Chemostat, Culturing vessels, Culturing techniques, Macroinvertebrates.

AMIC-8166

"SYNERGISTIC BIO-EFFECTS OF OIL AND IRRADIATION IN AN AQUATIC ORGANISM, *TARICHA GRANULOSA*", Lappenbusch, W. L., Ward, J. M., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 2, February 1973, pp 75-79.

A study was conducted to determine lethal toxicity of oil and the possible synergistic effects of oil on the radiosensitivity of the rough-skinned newt (*Taricha granulosa*). After acclimatization at 10 C to simulate winter conditions, newts were initially placed in 4000 ml of water containing 0, 0.5, 1.0, 2.5, 5, 10, 20, or 50 percent by volume regular non-detergent motor oil. After determining oil toxicity levels, additional newts were classified in four groups prior to irradiation. One group was unexposed to either oil or irradiation, a second was irradiated only, a third was continuously exposed to 0.5 percent oil but not irradiated, and a fourth continuously exposed to 0.5 percent oil and irradiated. The newts then absorbed 0, 1000, 2500, 5000, or 10,000 rads of x-rays. Their behavior, physical appearance and activity, and mortality were observed. Several dead newts of each group were necropsied and their tissues were examined. Oil toxicity was found to be acute, not chronic, at concentrations of 2.5 percent and higher. Newts subjected to 1,000, 2,500, 5,000, and 10,000 rads had mean survival times of 141, 117, 85 and 54 days. For those subjected to 0.5 oil and radiation these survival time were lowered to 98, 75, 53, and 29 days. It was concluded that exposure to oil increases the radiosensitivity of this newt synergistically.

INDEX TERMS: Oil, Irradiation, Water pollution effects, Toxicity, Radioactivity effects, Lethal limit, Synergistic effects, Rough-skinned newt, Histopathology, Necropsy, Animal tissues.

AMIC-8169

"TOXICITY OF METHYL MERCURY FOR STEELHEAD TROUT SPERM", McIntyre, J. D., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 2, February 1973, pp 98-99.

A test was performed to determine the concentrations of methylmercuric chloride that would reduce the viability of sperm from the steelhead trout. Sperm obtained from five fish was combined, and 0.1-ml aliquots were removed and inoculated into test tubes containing mercury concentrations of 1 g/l to 10 mg/l. The samples were maintained at 11 C. The sperm was left in solution 30 minutes and then combined with 100 steelhead eggs from a single female. Percentage of fertilization was determined on the 17th day. Reduced fertilization of eggs indicated that concentrations of mercury greater than or equal to 1 ppm reduced sperm viability. At concentrations greater than 1 ppm the reductions increased sharply.

INDEX TERMS: Toxicity, Mercury, Rainbow trout, Viability, Water pollution effects, Reproduction, Bioassay, Cold-water fish, Cytological studies, Sperm, Methylmercury, Steelhead trout, *Salmo gairdneri*, Methylmercuric chloride, Cell physiology.

2. BIOLOGICAL METHODS

AMIC-8170

"CADMIUM TOXICITY AND ACCUMULATION IN SOUTHERN NAIAD", Cearley, J. E., Coleman, R. L., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 2, February 1973, pp 100-101.

An investigation was undertaken to determine the effects of three different levels of cadmium on the uptake and accumulation of this metal by the southern naiad, a waterweed. A static bioassay was conducted over a 21-day period using duplicate exposure chambers for each exposure level. The plants were acclimated for 2 weeks and the roots removed before placement in the containers. Plants were exposed to different Cd levels for 0, 11, and 21 days. After exposure, the plant tissues were rinsed, dried for 24 hrs at 100 C, and ashed for 24 hours. Metal determinations were made by spectrophotometry. The exposed plants showed reductions of chlorophyll, turgor and stolon development not seen in controls. Toxic reactions and Cd accumulation by the plants increased as the exposure levels increased, which suggested that (a) Cd accumulation, ca. 1000 fold, was a direct function of the exposure level, and (b) the detoxifying mechanism was over-taxed at a more rapid rate at the higher levels resulting in an earlier impairment of physiological function. It is evident that this common aquatic plant is capable of introducing potentially toxic quantities of cadmium into the food chain of higher organisms, e.g. sunfish and waterfowl.

INDEX TERMS: Cadmium, Toxicity, Bioassay, Water pollution effects, Absorption, Food chains, Path of pollutants, Southern naiad, Bioaccumulation, *Najas guadalupensis*.

AMIC-8215

"BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURE IN A GREAT PLAINS STREAM RECEIVING FEEDLOT RUNOFF", Prophet, C. W., Edwards, N. L., Water Resources Bulletin, Vol. 9, No. 3, June 1973, pp 583-589.

The effect of feedlot runoff on the environmental quality of the Cottonwood River in east central Kansas was evaluated by analysis of community structure of benthic macroinvertebrates using the species diversity index, (d'). The benthic fauna along the study reach was dominated by mayflies, caddisflies, midges, riffle beetles, and the pelecypod, *Sphaerium*. Sixty-five taxa were identified during the study; the benthic fauna was most abundant during the 1968-69 segment of the study. However, the mean species diversity index per station indicated the river was subject to moderate environmental stress, and species diversity indices of those stations immediately downstream from feedlots were significantly lower than the species diversity index at the control station. There was a significant increase in species diversity indices during the 1970-71 segment of the study, following the closing of two feedlots. The results indicate periodic feedlot runoff had a continuing adverse effect on the environmental quality of the river, but recovery was rapid as the organic load on the river was reduced.

INDEX TERMS: Feed lots, Benthic fauna, Biological communities, Water quality, Mollusks, Oligochaetes, Gastropods, Biomass, Clams, Aquatic insects, Annelids, Species diversity index, Feedlot runoff, Macroinvertebrates, Data interpretation, Letches, Turbellaria.

AMIC-8213

"INORGANIC NITROGEN REMOVAL FROM WASTEWATER: EFFECT ON PHYTOPLANKTON GROWTH IN COASTAL MARINE WATERS", Goldman, J. C., Tenore, K. R., Stanley, H. I., Science, Vol. 180, No. 4089, June 1, 1973, pp 955-956.

Algal bioassays were used to demonstrate the high efficiency of a combined tertiary wastewater treatment and marine aquaculture system in removing inorganic nitrogen, and to show that the coastal waters off Woods Hole, Massachusetts, are limited in nitrogen for marine phytoplankton growth. When nutrients were removed from secondarily treated domestic wastewater through assimilation by phytoplankton in an outdoor growth pond, the pond effluents, in varying dilutions with seawater, could not support more phytoplankton growth than the seawater alone. However, when nitrogen was added back to the mixtures of pond effluent and seawater, the phytoplankton growth response was similar to that with a mixture of wastewater and seawater. This is similar to the findings of other researchers, and suggests that nitrogen may be the key growth-limiting nutrient in many coastal marine waters. The combined tertiary treatment-marine aquaculture system appears to be an effective means of removing nitrogen from secondarily treated wastewater and controlling eutrophication of coastal marine waters.

INDEX TERMS: Nitrogen, Waste water treatment, Phytoplankton, Growth rates, Bioassay, Marine algae, Tertiary treatment, Nutrient removal, Sea water, Nutrient requirements, Pollutant removal, Algal growth potential.

AMIC-8273

"EPOXIDATION AND FATE OF (C-14)ALDRIN IN INSECTICIDE-RESISTANT AND SUSCEPTIBLE POPULATIONS OF MOSQUITOFISH (*GAMBUSIA AFFINIS*)", Wells, M. R., Ludke, J. L., Yarbrough, J. D., Journal of Agricultural and Food Chemistry, Vol. 21, No. 3, May/June 1973, pp 428-429.

One susceptible and two resistant populations of mosquitofish (*Gambusia affinis*) were treated with (C-14)aldriin to determine differences in aldriin epoxidation between susceptible and resistant mosquitofish brains and livers. Three groups of nine fish from each population were tested in 5 ppb of C-14 aldriin. The aldriin was shown by assay to contain 2.5 percent dieldrin. Three fish were removed from each group after 4-8 hr exposure, washed carefully, and tissue samples were extracted and homogenized. After protein determination, samples were extracted three times with hexane and twice for recovery of lipid-bound material in the brain with 3:1 chloroform-methanol. Thin-layer chromatography samples were prepared from the remaining aqueous portion of the samples and were counted using a scintillation spectrometer. Resistant mosquitofish converted aldriin to dieldrin and/or water-soluble material at a greater rate than susceptible mosquitofish. These data would tend to support rate of detoxification as a possible mechanism of resistance to aldriin in the mosquitofish.

INDEX TERMS: Aldrin, Animal metabolism, Fish populations, Bioassay, Path of pollutants, Water pollution effects, Pesticide toxicity, Chlorinated hydrocarbon pesticides, Insecticides, Chemical analysis, Mosquitofish, *Gambusia affinis*, Fate of pollutants, Detoxification, Epoxidation, Thin layer chromatography, Animal tissues.

2. BIOLOGICAL METHODS

AMIC-8283

"UPTAKE AND ACCUMULATION OF DDT AND PCB BY EPHEMERA DANICA (EPHEMEROPTERA) IN CONTINUOUS-FLOW SYSTEMS", Sodergren, A., Svensson, B.J., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 6, June 1973, pp 345-350.

The kinetics of uptake and accumulation of DDT and PCB by mayflies was examined in a continuous-flow systems. Fifty *Ephemera danica* nymphs were used as test organisms and were introduced to the continuous-flow system immediately after collection from a Swedish stream. DDT and PCB were dissolved in ethanol and added to the systems. Five nymphs were then withdrawn each day for residue analysis. During the nine days of the experiment the animals received no food so that uptake was strictly via the gills and integument. Gas chromatography was used for residue analysis. Uptake and accumulation of both substances followed a similar pattern. After 4-5 days exposure an apparent constant level was established, indicating equilibrium between uptake and excretion of the substances. The accumulation of residues as a function of the concentration in the water showed a similar pattern. A kinetic equation of the first order is proposed as a model for uptake.

INDEX TERMS: DDT, Polychlorinated biphenyls, Absorption, Mayflies, Pesticide kinetics, Laboratory tests, Pesticide residues, Mathematical models, *Ephemera danica*, Bioaccumulation, Continuous flow system, Nymphs.

AMIC-8314

"TAXONOMIC GUIDES TO ARCTIC ZOOPLANKTON (VI): APPENDICULARIANS OF THE CENTRAL ARCTIC, MYSIDS OF THE ARCTIC OCEAN AND CONFLUENT SEAS, FIELD GUIDE TO ARCTIC ZOOPLANKTONIC CRUSTACEANS OSTRACODS OF THE CENTRAL ARCTIC", Leung, Y.-m., University of Southern California, Department of Biological Sciences, Los Angeles, California, Technical Report No. 2, Contract No. N00014-67-A-0269-0013, October 1972, 48 pp. NTIS Report No. AD-756 660.

"Taxonomic Guides to Arctic Zooplankton (VI)" is the last in the series of practical taxonomic guides to zooplankton prepared by the USC Arctic Project to meet the needs of non-taxonomists involved with Arctic fauna. Material presented in this guide is based upon results of research by investigators associated with this Project and its precursors since 1952. This compilation is composed of information on the five species of ostracods and five species of appendicularians found amongst central Arctic zooplankton; mysids from the central Arctic and peripheral seas; and a general guide to Arctic zooplanktonic crustaceans. Each guide contains dichotomous keys and complementary illustrations, special notes on individual species, and selected references to literature pertaining to the included groups. (See also: AMIC-8103 and AMIC-8107)

INDEX TERMS: Zooplankton, Arctic Ocean, Crustaceans, Invertebrates, On-site data collections, Benthic fauna, Appendicularians, Taxonomic guides, Macroinvertebrates.

AMIC-8284

"MOLYBDENUM TOXICITY: ABNORMAL CELLULAR DIVISION OF TERATOGENIC APPEARANCE IN EUGLENA GRACILIS", Colmano, G., Bulletin of Environmental Contamination and Toxicology, Vol. 9, No. 6, June 1973, pp 361-364.

Molybdenum is shown to be involved in the mechanism of cellular division that produces monsters in *Euglena*. *Euglena* cells were first grown in a medium containing 5.44 ppm molybdenum. These cells divided by normal fission and had a normal growth rate. When the molybdenum concentration was accidentally increased 20-fold, abnormal clusters of three to nine actively moving cells attached to each other at one end appeared. In further experiments, it was found that these abnormal forms, accompanied by blue coloration of the culture medium, appeared only with high molybdenum concentrations. Change in concentration of other components affected only the growth rate. It was concluded that molybdenum may be considered toxic and may be an inhibitor of cellular fission with resultant nuclear and chromosomal polyploidy and abnormal mitoses. It was hypothesized that a similar toxicity of molybdenum may activate the uncontrolled growth patterns observed in some neoplastic growths.

INDEX TERMS: Molybdenum, Toxicity, Cytological studies, Cultures, *Euglena gracilis*, Teratogenicity.

AMIC-8315

"ECOLOGICAL EFFECTS OF OFFSHORE DREDGING AND BEACH NOURISHMENT: A REVIEW", Thompson, J. R., University of Southern Mississippi, Hattiesburg, Mississippi, Miscellaneous Paper No. 1-73, January 1973, 39 p. NTIS Report No. AD-756 366.

A review of ecological effects of offshore dredging is presented, based on literature review and personal contacts, to provide a framework for determination of need for further knowledge. In general, little concrete effort aimed specifically at the determination of effects of offshore dredging was uncovered, although basic ecological works that are generally applicable are available. Much additional research of basic, but practical, orientation is needed to approach full understanding. The report shows that the beach may be divided into three zones on the basis of moisture and biota found, and describes the possible effects on these biota resulting from offshore dredging and deposition of sediments on a beach. Background descriptive material and impacts on both offshore dredged areas and nourished beaches, and suggestions for further research follow. A selected bibliography is included.

INDEX TERMS: Dredging, Sediments, Ecosystems, Environmental effects, Coastal engineering, Bibliographies, Reviews, Benthic flora, Bottom fish, Biota, Turbidity, Suspended solids, Benthic fauna, Zoning, Beach nourishment, Marine environment.

2. BIOLOGICAL METHODS

AMIC-8316

"EFFECT OF THERMAL SHOCK ON VULNERABILITY TO PREDATION IN JUVENILE SALMONIDS. II. A DOSE RESPONSE BY RAINBOW TROUT TO THREE SHOCK TEMPERATURES", Coutant, C. C., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington, Report No. UC-48, Contract No. AT (45-1)-1830, November 1972, 12 pp. NTIS Report No. BNWL-1519.

Juvenile rainbow trout (*Salmo gairdneri*) were found to be more vulnerable to predation following thermal shock, dependent on the thermal dose (temperature and duration) received. The fish were exposed to temperatures of 26, 28, and 30 C for periods from 0.5 to 100 minutes. Control fish were exposed to unheated water. Control and shocked fish were then reunited at the acclimation temperature and offered to adult rainbow trout predators. The predators were allowed a maximum of 15 minutes to remove about 50 percent of the prey and the remaining test and control fish were counted. A chi-square analysis was used on the results. At 30 C exposure, an identifiable effect in vulnerability of the shocked fish occurred after only 0.55 min exposure. At 28 C, an exposure of about 2 min was needed to increase vulnerability. The 26 C exposure temperature, included significantly different predation rates after 64 min but not after 16 or 32 min.

INDEX TERMS: Thermal pollution, Predation, Thermal stress, Chinook salmon, Rainbow trout, Laboratory tests, Water temperature, Lethal limit, Juvenile fish, Bioassay, Thermal shock.

AMIC-8320 (Continued)

Card 2/2

INDEX TERMS: Nematodes, Aquatic animals, Invertebrates, Biological communities, Ecosystems, Dominant organisms, Water quality, Physicochemical properties.

AMIC-8320

"NEMATODE COMMUNITY STRUCTURE. A TOOL FOR EVALUATING WATER RESOURCE ENVIRONMENTS", Ferris, V. R., Ferris, J. M., Callahan, C. A., Purdue University, Water Resources Research Center, Lafayette, Indiana, Technical Report No. 30, Contract No. DI-14-31-0001-3514, November 1972, 40 pp. NTIS Report No. PB-214-477.

This study indicates that analysis of benthic nematode community structure can be a useful tool for evaluating disturbance to aquatic habitats. Sufficient information for analysis can be obtained from data on a few of the dominant species, thus simplifying procedures. Nematodes were quantitatively sampled at intervals from 16 sites along two streams near West Lafayette, Indiana. Both streams flow through farmland and some forested areas, and one also flows through a growing housing development. Of 156 species of nematodes identified, 74 species were considered to be benthic inhabitants. Numbers of each species present at each sampling date at each site were obtained. Data for physico-chemical parameters were also collected at each of the 16 sites at biweekly intervals. These data included values for nitrate, nitrite, dissolved oxygen, carbon dioxide, pH, total hardness, phosphates, and water temperature. Organic matter and relative quantities of particles of different sizes were determined for the substrate at each site. When analyzed by a 3-dimensional community ordination technique, similar clusters were obtained whether data from all species were used, data from only 74 benthic species, 17 dominant benthic species, or only nine dominant species. Good reproducibility of results between years was clearly indicated in all analyses. Clustering was closely related to buildup of several nematode species in different trophic groups, which in turn could be related to certain substrate characteristics and an increase in nitrite nitrogen.

AMIC-8321

"NITROGEN METABOLISM IN THE SEA", Columbia University, Lamont-Doherty Geological Observatory, Palisades, New York, Technical Progress Report No. COO-3222-02, Contract No. AT(11-1)3222, October 31, 1972, 249 pp.

A combination of daily measurement of standing stocks and rates derived from N-15 uptake experiments was used in determining rates of nitrogen flux during the initial stages of the annual increase in productivity at a station off Bermuda. The nitrogen flux during the first stage of the annual nitrogen cycle was chosen for examination. Samples were collected daily for a period of three weeks. Standing stock measurements of all particulate nitrogen from 0.45 - 10,000 microns were made on samples collected with water bottles and plankton nets. Measurements of dissolved inorganic nitrogen, other nutrients, salinity, and temperature were made on samples taken with water bottles equipped with reversing thermometers. Three preliminary experiments were done with N-15-labeled phytoplankton to measure the rate of nitrogen transfer from primary producers to herbivores. A program was initiated to collect and maintain zooplankton cultures for continuation of N-15 tracer studies under laboratory conditions. It was concluded that both methods should be used to understand the nitrogen flux in an ecosystem. The standing stock method is at the lower limits of its sensitivity when production and changes in standing stock are small. The N-15 method may be used more successfully under such conditions.

INDEX TERMS: Radioactivity techniques, Nitrogen, Phytoplankton, Zooplankton, Metabolism, Sea water, Primary productivity, Water quality, Sampling, Systematics, Nets, Sieves, N-15.

3. MICROBIOLOGICAL METHODS

AMIC-7458

"MICROBIOLOGY IN THE AEROBIC TREATMENT OF FARM WASTE", Grainger, J. M., Process Biochemistry, Vol. 8, No. 3, March 1973, pp 28-30.

Procedures are reviewed for the enumeration and isolation of heterotrophic microorganisms of aerobic systems for treatment of farm slurry. The paper is intended as an introduction to the subject and is based largely on accepted microbiological practice. Areas of consideration are microscopical procedures and isolation methods including handling of samples, dilution and homogenization, media composition, inoculation methods, and temperature and period of incubation.

INDEX TERMS: Farm wastes, Waste treatment, Isolation, Microbial degradation, Methodology, Aerobic treatment, Protozoa, Enumeration, Heterotrophic microorganisms, Culture media.

AMIC-7679

"FIXATION OF ATMOSPHERIC NITROGEN BY AZOTOBACTER SP., AND OTHER HETEROTROPHIC OLIGONITROPHILOUS BACTERIA IN THE ILAWA LAKES", Niewolak, S., Acta Hydrobiologica, Cracow, Vol. 14, No. 3, 1972, pp 287-305.

Investigations were carried out on the distribution of bacteria fixing atmospheric nitrogen in water, bottom sediments, and netplankton of the Ilawa Lakes in the annual cycle, as well as on the intensity of fixing atmospheric nitrogen in pure cultures of bacteria isolated from the Lake Jeziorak. Considerable differences were noted in the development of the corresponding bacteria, according to the degree of pollution or mineralization of the water, the season of the year, and the type of the bottom. The greatest quantities of bacteria fixing atmospheric nitrogen occurred in the netplankton and in the bottom sediments of the Ilawa Lakes; a spring-summer maximum was distinguished in their occurrence in water and bottom sediments in May or June, and an autumn maximum in September and November. *Azotobacter beijerinckii* No 2 and 18 fixed in pure cultures the greatest quantity of atmospheric nitrogen - up to 15.9 mg/100 ml of the medium and 15.28 mg N/g of glucose. The yield of strains of the genus *Aeromonas*, *Vibrio*, *Achromobacter*, *Flavobacterium*, and *Corynebacterium* lay within the range typical of oligonitrophilous bacteria.

INDEX TERMS: Nitrogen fixing bacteria, Aquatic bacteria, Nitrogen fixation, *Azotobacter*, Bottom sediments, Hypolimnion, Water quality, Spatial distribution, Temporal distribution, Heterotrophic bacteria, Fate of pollutants, Pure cultures, Mineralization, Seasonal variation, Substrate utilization, Lake Jeziorak Maly, Lake Jeziorak.

AMIC-7645

"THE MECHANISMS OF NITROGEN ASSIMILATION IN PSEUDOMONADS", Brown, C. M., Macdonald-Brown, D. S., Stanley, S. O., Antonie van Leeuwenhoek, Vol. 39, No. 1, 1973, pp 89-98.

Pseudomonas aeruginosa, *Ps. fluorescens* and 3 marine psychrophilic pseudomonads were grown in chemostat cultures with nitrate ammonia or glutamate as nitrogen source. In cultures grown on nitrate (either carbon- or nitrogen-limited) and in ammonia nitrogen-limited cultures ammonia was assimilated via the glutamine synthetase/L-glutamine: 2-oxoglutarate aminotransferase (GS/GOGAT) pathway. With an excess of ammonia in the culture however ammonia was assimilated via glutamate dehydrogenase (GDH), and glutamine synthetase (GS) was either present only at low levels or absent. Two distinct GDH activities were detected in all 5 bacteria, one specific to NAD and one to NADP. The presence of these activities was determined by the environment in which cells were grown. These activities showed differences with respect to substrate affinity (Km values) for ammonia, incubation temperature and to a lesser extent pH and may involve separate GDH isoenzymes. GS from the marine bacterium PL sub 1 had a very high affinity for ammonia (Km of 0.3 mM) but a low affinity for glutamate (Km of 19 mM).

INDEX TERMS: Nitrogen, Aerobic bacteria, Cultures, Enzymes, Nitrates, Nutrient requirements, Deficient elements, Environmental effects, Assimilation, Pseudomonads, Substrate utilization, Enzymatic activity.

AMIC-7905

"POLIOVIRUS IN A WATER SUPPLY", Vander Velde, T. L., Mack, W. N., Journal American Water Works Association, Vol. 65, No. 5, May 1973, pp 345-348.

This is a two-part paper concerning the isolation of poliovirus from well water in Monroe County, Michigan. The first article considers construction of the well, geological features of the area, and the operation from which water samples were taken. The second article discusses laboratory and research techniques involved in the isolation of the poliovirus. A 5-gallon sample was taken from the well and divided into two equal volumes. Fifty ml of water were removed from each sample and 10 ml were used to seed five tubes of lauryl sulfate double-strength broth to detect coliforms. Two samples were concentrated on the ultracentrifuge and tested for virus on green, African-monkey kidney-cell cultures. A virus was isolated and identified as poliovirus 2. *E. coli* was recovered from the concentrated samples. The tests indicated that viruses are viable and can survive where bacteria do not. In this case, there was little evidence of contamination and it required a great deal of concentration of the samples before the coli organisms and the virus were detected.

INDEX TERMS: Isolation, Water pollution sources, Water supply, Drainage wells, Waste water (pollution), Potable water, Sewerage, Methodology, Environmental effects, *E. coli*, Bioindicators, Pollutant identification, Poliovirus, Culture media.

3. MICROBIOLOGICAL METHODS

AMIC-7941

"BACTERIAL CONTENT OF PARTICULATE MATTER IN OFFSHORE SURFACE WATERS", Jannasch, H. W., Limnology and Oceanography, Vol. 18, No. 2, March 1973, pp 340-342.

During a cruise in the Sargasso Sea, flakelike particles swirling up with the surface wave's motion were encountered. These particles showed intense iridescence and it required more than an hour at a speed of 11-12 knots to sail out of them. Because the particles would disintegrate with only slight disturbance of the water, they were very difficult to sample. Methods were devised to obtain small samples of small size particles. Subsamples were shaken vigorously, streaked on agar plates, membrane filtered and incubated on the same agar medium at 22 plus or minus 1 C for 4 days. The data taken from these cultures indicated the absence of attached bacteria and made it appear unlikely that the particulate material was inhibitory to bacterial growth or attachment. This was interpreted as an indication that the particles were of relatively recent origin and in a labile state.

INDEX TERMS: Sea water, Organic matter, Marine bacteria, Surface waters, Carbon, C Cultures, Filtration, Water sampling, Methodology, Sargasso Sea, Particulate matter, Heterotrophic bacteria, Culturing techniques, Sample preparation.

AMIC-7952

"ATP POOLS IN PURE AND MIXED CULTURES", Kao, I. C., Chiu, S. Y., Fan, L. T., Erickson, L. E., Journal of Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 926-931.

E. coli and *Pseudomonas aeruginosa* were grown in a mixed culture for about 9 hr at 30°C with glucose as an energy source. The same organisms were also grown separately in the same medium. After recovery, washing and drying, the glucose concentration was determined by the glucostat method and ATP concentration by use of a biometer. The sample was prepared for ATP measurement by mixing one ml of culture broth with one ml butanol for 10 sec to lyse the cells. Eight ml of octanol was added, the sample was vigorously shaken for 10 sec and centrifuged at 3000 rpm for 3 min. Butanol was partitioned into the top octanol layer and ATP into the bottom aqueous layer. The extracted ATP (0.01 ml) was then injected into a 10cm tube containing luciferin and luciferase. The resultant light flash was converted into an electrical signal and then a decimal count representing the concentration of ATP in the sample. The fact that the ATP concentration in the cells from the mixed culture was appreciably smaller than that in the pure cultures indicated that the species in the mixed culture interact. The fact that cell yields in mixed cultures were far smaller than those in pure cultures also indicated the existence of such interaction.

INDEX TERMS: *E. coli*, Methodology, Monitoring, Activated sludge, Sludge treatment, Efficiencies, Adenosine triphosphate, *Pseudomonas aeruginosa*, Firefly luminescence, Culture media, Luciferin-luciferase method, Mixed cultures, Pure cultures, Species interaction, Bacterial physiology.

AMIC-7977

"VIRUSES IN METROPOLITAN WATERS: CONCENTRATION BY POLYELECTROLYTES, FREEZE CONCENTRATION, AND ULTRAFILTRATION", Rubenstein, S. H., Fenters, J., Orbach, H., Shuber, N., Reed, J., Molloy, E., Journal American Water Works Association, Vol. 65, No. 3, March 1973, pp 200-202.

A collaborative study was conducted to compare viral concentration methodologies and to elicit data related to the viral status of Lake Michigan. One laboratory employed a concentration method utilizing an insoluble cross-linked polyelectrolyte of isobutylene maleic anhydride (IMA). The second laboratory used a method of freeze-concentration and ultrafiltration. In both cases, experimental model systems, seeded with poliovirus and echovirus, were operated in the laboratory and actual samples from Lake Michigan filtration plants and the Chicago River were tested. The recovery and concentration of viruses were shown to be practical, simple, and efficient with either method. Both allow for the processing of large volumes of water with minimum manipulation and a high degree of certainty of viral recovery. In the testing of actual samples, no viral agents were detected in Lake Michigan samples and only one echovirus isolate was yielded by Chicago River samples.

INDEX TERMS: Viruses, Methodology, Lake Michigan, Concentration, Freeze concentration, Polyelectrolytes, Ultrafiltration, Natural waters, Recovery, Sample preparation, Culture media, Plaque assay, Collaborative studies, Coxsackie B4 virus, Echo 6 virus, Poliovirus 1-Sabin.

AMIC-8096

"INFLUENCE OF SULFITE ON GROWTH, SLIME, AND FLUORESCENT PIGMENT FORMATION BY *PSEUDOMONAS AERUGINOSA*", Palumbo, S. A., Canadian Journal of Microbiology, Vol. 19, No. 4, April 1973, pp 505-511.

Substitution of sulfite for sulfate in the defined pyocyanine medium of Frank and DeMoss 1959 allowed formation of fluorescent pigments and slime by *Pseudomonas aeruginosa* NRRL B-4014. This formation of fluorescent pigments was both pH and iron dependent. The unadjusted medium (pH 8.25) containing sulfite and Fe (3 plus) allowed both growth and fluorescent pigment formation. Growth and fluorescent pigment formation were observed from a pH of 9.0 down to a pH of 7.5. At pH 7.5, the concentration of HSO₃ (minus) is 0.0006 M, and this ion appears to be the active agent in inhibiting growth below pH 7.5. When the medium was adjusted to pH 7.0, neither fluorescent pigment formation nor growth was observed. The acid used for pH adjustment did not influence the minimum pH for growth. In the presence of small amounts of iron (ca. 1.0 microM Fe (3 plus)), the organism shifted from a blue to a yellow-green fluorescent pigment. Cultural conditions such as temperature and nutrients which supported growth also supported slime formation as well as fluorescent pigment formation.

INDEX TERMS: Cultures, Pigments, Growth rates, Water pollution effects, Sulfur compounds, Iron, Slime, Incubation, Hydrogen ion concentration, *Pseudomonas aeruginosa*, Sulfites, Bacterial physiology, Fluorescent pigments.

3. MICROBIOLOGICAL METHODS

AMIC-8109

"A REPORT ON BACTERIAL POLLUTION AFFECTING SHELLFISH HARVESTING IN NEWPORT RIVER, NORTH CAROLINA", U. S. Environmental Protection Agency, Surveillance and Analysis Division, Athens, Georgia, EPA Report, April 1972, 43 pp. NTIS Report No. PB-215 291.

An intensive bacteriological monitoring program has been conducted in shellfish harvesting areas of the Newport River in North Carolina. Levels of bacterial indicators in the river's estuary and tributaries are reported and where possible, sources of the indicators are identified. Two treatment plants were major domestic waste sources but it was determined that if they operated continuously at the same efficiency as during the study they did not pose an immediate threat to shellfish growing areas. Other sources of contamination identified were wildlife, agricultural runoff, and septic tanks. In those areas of the River classified for shellfishing (SA), each station monitored was in violation of the established criteria of the USPHS standard (median total coliform not to exceed 70/100 ml and not more than 10 percent exceed an MPN of 230/100 ml).

INDEX TERMS: Water pollution effects, Water quality standards, Water analysis, Water pollution sources, Shellfish, *Shellfish farming, Tributaries, Domestic wastes, Waste disposal, Coliforms, Treatment facilities, Estuaries, Waste water treatment, E. coli, Chlorination, Newport River, Fecal coliforms, Fecal pollution, Fecal streptococci.

AMIC-8151

"MICROMETHOD SYSTEM FOR IDENTIFICATION OF ANAEROBIC BACTERIA", Starr, S. E., Thompson, P. S., Dowell, V. R., Jr., Balows, A., Applied Microbiology, Vol. 25, No. 5, May 1973, pp 713-717.

A micromethod multitest system was compared with conventional tests for identification of anaerobic bacteria. The micromethod system includes tests for neutral red and nitrate reduction; H₂S, urease, and indole production; hydrolysis of gelatin and esculin; and fermentation of glucose, mannose, fructose, galactose, mannitol, lactose, sucrose, maltose, salicin, glycerol, xylose, arabinose, and starch. All procedures were conducted in an anaerobic glove box. A total of 104 cultures, including 18 reference strains and 86 diagnostic cultures, were examined. Ninety-one percent of the total tests performed with the two systems were in agreement. Greater than 90 percent agreement between the two systems was obtained with 12 of the 17 differential tests compared. The tests for nitrate reduction and H₂S production gave the poorest agreement, 77.8 and 80.8 percent, respectively. Only 66 percent of the 86 diagnostic cultures could be presumptively identified with the micromethod system supplemented only with microscopy and colonial characteristics. However, when appropriate supplementary tests and gas-liquid chromatography were used with the micromethod system, 85 percent of the 86 strains could be identified. When Ehrlich reagent, instead of Kovac reagent, was used with the micromethod to test for indole, the agreement in identification was raised to 93 percent.

INDEX TERMS: Anaerobic bacteria, Pollutant identification, Methodology, Chemical reactions, Reduction (chemical), Micromethod system, Method evaluation, Comparative tests, Culture media, Substrate utilization, Biochemical tests, Bacterial physiology.

AMIC-8158

"EFFECT OF DYES ON BACTERIAL GROWTH", Fung, D. Y. C., Miller, R. D., Applied Microbiology, Vol. 25, No. 5, May 1973, pp 793-799.

A rapid screening procedure was used to test the effect of 42 different dyes on the growth of 30 bacteria on solid media. Stock solutions of each dye were incorporated into a tryptic soy agar at final dilutions of 1:1000, 1:10,000, and 1:100,000 before sterilization of the media at 121 C for 15 minutes. A multipoint inoculation device was used to transfer broth culture of the test organisms onto the agar surface. The agar plates were inverted for incubation at 37 C for 24 and 48 hr. They were observed under incandescent as well as ultraviolet light and growth was recorded as positive or negative after 24- and 48-hr periods. The results indicated that many readily available dyes might have potential application for selective isolation of specific bacterial groups as well as value in differentiating between closely related bacterial taxa. Separation of *Enterobacter* from *Escherichia*, *Salmonella* from *Shigella*, and *Staphylococcus* from *Micrococcus* by selected dyes was also evaluated.

INDEX TERMS: Dyes, Growth rates, Analytical techniques, Aerobic bacteria, Pollutant identification, Bioindicators, Cultures, Separation techniques, Pollutant effects, Bacterial physiology, Gram-positive bacteria, Gram-negative bacteria.

AMIC-8160

"METABOLISM OF NITRILOTRIACETATE BY CELLS OF *PSEUDOMONAS* SPECIES", Tiedje, J. M., Mason, B. B., Warren, C. B., Malec, E. J., Applied Microbiology, Vol. 25, No. 5, May 1973, pp 811-816.

A *Pseudomonas* species was isolated from soil which could degrade nitrilotriacetate (NTA) to CO₂, H₂O, NH₃, and cellular constituents without the accumulation of significant quantities of intermediates either in the presence or absence of several inhibitors. After extensive gas chromatography analysis, small quantities of aspartate, glycine, and aconitate were the only detectable compounds to accumulate during NTA degradation, and these compounds were not excreted from the cells. Manometric studies indicated that iminodiacetate, glycine, and glyoxylyate are possible intermediates, whereas N-methyliminodiacetate, sarcosine, and acetate are not. The data are consistent with an oxidative cleavage of the C-N bond of NTA as the initial degradation step. The finding that NTA is readily oxidized to inorganic products and that no intermediates accumulated under a variety of conditions indicates that environmental concern for hazardous intermediates in NTA degradation seems unwarranted.

INDEX TERMS: Nitrilotriacetic acid, *Pseudomonas*, Pollutant identification, Metabolism, Microbial degradation, Soil bacteria, Surfactants, Aerobic bacteria, Detergents, Fate of pollutants, Degradation products, Substrate utilization, Scintillation counting.

3. MICROBIOLOGICAL METHODS

AMIC-8162

"INTERACTING EFFECTS OF PH, TEMPERATURE, AND SALT CONCENTRATION ON GROWTH AND SURVIVAL OF *VIBRIO PARAHAEMOLYTICUS*", Beauchat, L. R., Applied Microbiology, Vol. 25, No. 5, May 1973, pp 844-846.

Thermal resistance and minimal pH and temperature conditions for growth of *Vibrio parahaemolyticus* in artificial media containing 3 and 7 percent sodium chloride were studied. Growth was observed at pH 4.8 and at 5 C. To study thermal resistance a 0.3-ml portion of a 24-h culture was dispensed into tubes containing 19.7 ml of Trypticase soy broth with 3 percent NaCl which had been tempered at 53 plus or minus 0.2 C (128 F) in a water bath. Heating menstria had been adjusted to pH values ranging from 5.0 to 8.0 in 0.5-unit increments. Samples were withdrawn, and dilutions were made immediately by using a 3 percent NaCl in water diluent before plating in TSA with 3 percent NaCl tempered at 45 C. Recovery was at 37 C, and counts were made after 24 h of incubation. Extensive growth at 5 C was not observed at the pH values examined; no growth was observed at 2 C. Growth at 5 and 9 C was only at an alkaline pH. There was a tendency for growth at lower pH's as the incubation temperature was increased, regardless of NaCl concentration. With the exception of strain 4750, *V. parahaemolyticus* was demonstrated to grow at lower pH values in the TSB with 3 percent NaCl at pH 4.8 when incubation was at 30 C, the lowest pH tolerance observed in the study. The six strains were least sensitive to heat at pH 7.0 and most sensitive at pH 5.0.

INDEX TERMS: Growth rates, Hydrogen ion concentration, Temperature, Sodium chloride, Environmental effects, Heat resistance, Salt tolerance, Enteric bacteria, Pathogenic bacteria, Survival, *Vibrio parahaemolyticus*, Chemical concentration.

AMIC-8174

"SURVIVAL OF *SALMONELLA TYPHIMURIUM* IN ANIMAL MANURE DISPOSAL IN A MODEL OXIDATION DITCH", Will, L. A., Diesch, S. L., Pomeroy, B. S., American Journal of Public Health, Vol. 63, No. 4, April 1973, pp 322-326.

A laboratory model oxidation ditch was constructed to evaluate potential health effects of pathogens in cattle manure. The studies were conducted in a 1:10 scale model with pH, DO, temperature, and total solids regulated to simulate a field unit at summer (20 C) and winter (2 C) temperatures. Liquid manure obtained from a field ditch was placed in the laboratory ditch. Stock cultures of biologically and serologically pure *Salmonella typhimurium* were grown on tryptic soy agar and seeded into the ditch. Various cultural methods were used in measuring survival and differentiation was accomplished both biochemically and serologically. At summer temperatures *S. typhimurium* survived for 17 days post-seeding and at winter conditions for 47 days. The data indicated that survival was of greatest duration in the sludge portion of settling chambers. Attempts were made during the tests to use fluorescent antibody methods for measurement but these were not as successful as anticipated. Retrieval of fluorescent organisms from the enrichment phase media was more successful than sampling directly from the oxidation ditch manure.

INDEX TERMS: Pollutant identification, Farm wastes, Oxidation lagoons, Model studies, Waste disposal, Public health, Biochemistry, Survival, *Salmonella typhimurium*, Fluorescent antibody techniques, Biochemical tests, Feces.

AMIC-8191

"COLIFORMS, FECAL COLIFORMS, AND FECAL STREPTOCOCCI AS INDICATORS OF WATER POLLUTION", Cohen, J., Shvual, H. I., Water, Air, and Soil Pollution, Vol. 2, No. 1, March 1973, pp 85-95.

The presence and survival of coliforms, fecal coliforms, and fecal streptococci were studied under various ecological conditions (sewage treatment plants, heavily polluted rivers, a lake and other drinking water sources) and their relative importance as pollution indicators, especially of viral pollution, was examined for each type of water system examined. Grab samples were taken with sterile containers, filtered, and the bacteria were cultured. Coliform bacteria were cultured on m-Endo media (Difco) and counted after 24 hr incubation at 35 C. Fecal coliforms were incubated on M-FC broth (Difco) for 24 hr in a water bath at 44.5 C. Fecal streptococci were incubated for 4 hr at 35 C followed by 44 hr at 44.5 C to eliminate the growth of atypical microcolonies. In all cases the fecal streptococci were generally more resistant to the natural water environment and to purification processes than the other indicator organisms and, at points distant from the original source of pollution were often the only indicators of the fecal nature of the pollution. In two of the systems studied the survival of the fecal streptococci paralleled the survival of enteric viruses better than the coliforms. The fecal streptococci may thus in certain cases provide a better estimate of the probable virus content in lightly contaminated water than the other two indicators.

INDEX TERMS: Coliforms, Bioindicators, Viruses, Water pollution, Sewage treatment, Treatment facilities, Potable water, Lakes, Rivers, Chlorination, Efficiencies, Enteric bacteria, Fecal coliforms, Fecal streptococci, Fecal pollution.

AMIC-8207

"METHYLMERCURY: BACTERIAL DEGRADATION IN LAKE SEDIMENTS", Spangler, W. J., Spigarelli, J. L., Rose, J. M., Miller, H. M., Science, Vol. 180, No. 4082, April 13, 1973, pp 192-193.

Long-term incubation studies were carried out on the biomethylation of mercury in sediments taken from the delta area of the St. Clair River, Michigan. Various combinations of growth media and gaseous atmospheres were used in an effort to identify organisms or groups of organisms capable of methylating Hg. During the first 50 days of a long-term period of incubation of lake sediments with inorganic mercury (Hg (2 plus)), low concentrations of methylmercury were observed to build up. Upon continued incubation there was a rapid decrease in amount of methylmercury in the system and a concomitant evolution of volatile inorganic mercury (Hg). Transfer of the mixed culture to growth media containing methylmercury resulted in the degradation of methylmercury and the volatilization of Hg. Four bacterial isolates were obtained from the mixed culture which, in pure culture, rapidly degraded methylmercury to methane and Hg. The presence of methane in head space gases was confirmed by flame ionization gas chromatography, and the presence of Hg in head space gases was confirmed by mass spectrometry.

INDEX TERMS: Microbial degradation, Lake sediments, Aquatic bacteria, Mercury, Pseudomonas, Methylation, Methylmercury, Fate of pollutants, Pure cultures, Volatilization, St. Clair River, Mixed cultures, Degradation products, Substrate utilization.

3. MICROBIOLOGICAL METHODS

AMIC-8248

"FATTY ACID COMPOSITIONS OF PARACOLON: ARIZONA, CITROBACTER, AND PROVIDENCIA", Machtiger, N. A., O'Leary, W. M., Journal of Bacteriology, Vol. 114, No. 1, April 1973, pp 80-85.

The fatty acid compositions of stationary-phase cultures of *Arizona* *arizonae*, *Citrobacter freundii*, *Providencia alcalifaciens*, *Providencia stuartii*, and *Providencia* sp. were studied. All organisms were grown in chemically defined media. Stationary-phase cells were harvested by centrifugation at 8200 times g for 20 min at 5 C, washed once in distilled water, and recentrifuged. The cell pastes were lyophilized, weighed and growth was measured turbidimetrically at 600 nm. Total cellular fatty acids were extracted from dry cells, methylated, and analyzed by dual-column, dual flame ionization gas chromatography. The major fatty acids of *A. arizonae*, *C. freundii*, and *Providencia* were 16:0, 16:1, 17:cyclopropane, and 19:cyclopropane. The fatty acid compositions of the two strains of *A. arizonae* examined were similar to each other, but the three strains of *C. freundii* differed from one another in their fatty acid compositions. In both *A. arizonae* and *C. freundii*, the relative quantities of saturated, unsaturated, and cyclopropane fatty acids were similar to those which have been found in stationary-phase cultures of other members of the Enterobacteriaceae. The three strains of *Providencia* also differed from one another in their fatty acid compositions. In all three strains the total quantity of unsaturated fatty acids was larger and that of the cyclopropane fatty acids was smaller than those found in stationary-phase cultures of other enteric bacteria.

INDEX TERMS: Enteric bacteria, Coliforms, *Arizona arizonae*, *Citrobacter freundii*, *Providencia alcalifaciens*, *Providencia stuartii*, Fatty acids, Chemical composition.

AMIC-8250

"METHANOL METABOLISM IN PSEUDOMONAS C", Stieglitz, B., Mateles, R. I., Journal of Bacteriology, Vol. 114, No. 1, April 1973, pp 390-398.

Cell suspensions of pseudomonas C, a bacterium capable of growth on methanol as sole carbon source, were able to oxidize methanol, formaldehyde, and formate, although the rates of oxidation for the latter two compounds were much slower. The latter compounds also could not serve as sole carbon sources. Through the use of labeled compounds, it was shown that in the presence of methanol, formaldehyde, formate, and bicarbonate were incorporated into trichloroacetic acid-precipitable material. Hexose phosphate synthetase activity was found, indicating the assimilation of methanol via an allulose pathway. No hydroxypyruvate reductase activity was found, nor was any complex membrane structure observed. Such a combination of characteristics has been observed in an obligate methylotroph (*Pseudomonas* W1), but pseudomonas C can utilize a variety of non-methyl substrates.

INDEX TERMS: Metabolism, Pseudomonas, Radioactivity techniques, Nutrient requirements, Assay, Enzymes, Carbon radioisotopes, Methanol, Substrate utilization, Fate of pollutants, Bacterial physiology, Pseudomonads, Methanol dehydrogenase, Enzymatic activity, C-14, Assimilation.

AMIC-8272

"METABOLISM OF ENDOTHAIR BY AQUATIC MICROORGANISMS", Sikka, H. C., Saxena, J., Journal of Agricultural and Food Chemistry, Vol. 21, No 3, May/June 1973, pp 402-406.

(C-14)Endothall (7-oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid) labeled in the oxabicyclo ring was readily degraded by microorganisms in lake water and hydrosol through a pathway involving splitting of the ring. An *Arthrobacter* species isolated from hydrosol by the enrichment method was able to utilize endothall as the sole source of carbon and energy for its growth. The C-14 from endothall was incorporated into cellular amino acids, proteins, nucleic acids, and lipids and was also released as C-14O2. After short-term incubation of the *Arthrobacter* with (C-14)endothall, C-14 was incorporated into citric, aspartic, and glutamic acids and some unidentified compounds. (C-14)Glutamic acid accounted for a large proportion of the total C-14 incorporated into the alcohol-soluble cell fraction. Treatment with 0.02 M monofluoroacetate caused a severalfold accumulation of (C-14)citric acid, but only partially inhibited the incorporation of C-14 into glutamic acid. It appears, therefore, that the C-14 from C-14-ring-labeled endothall is incorporated into glutamic acid via the tricarboxylic acid cycle and an alternate, unknown pathway.

INDEX TERMS: Aquatic microorganisms, Metabolism, Microbial degradation, Aquatic environment, Cultures, Lakes, Hydrosols (soils), Aquatic bacteria, Bottom sediments, Fate of pollutants, Endothall, *Arthrobacter*, Substrate utilization, Biological magnification, Assimilation, Degradation products.

AMIC-8290

"PERSISTENCE OF VIRUS AND BACTERIA IN SEAWATER", Won, W. D., Ross, H., Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 99, No. EE3, June 1973, pp 205-211.

At a temperature of 38 F - 40 F bacterial survivals (*Escherichia coli*) were significantly enhanced in seawater deliberately 'polluted' with small concentrations of organic materials (25 ppm - 500 ppm) including peptone, heart infusion, casamino acid, yeast extract, trypticase soy, and human feces. In a warmer environmental temperature the survival enhancing property of these substances became growth promoting resulting in a 40-fold population increase followed with a marked increase in microbial persistence lasting at least 18 weeks. These substances were also capable of stabilizing cell and colony morphology. The same phenomenon was not observed in parallel experiments with Echo 6 virus. In this instance, cold temperature per se appeared more effective in enhancing survival time. Inactivation rate was gradual and the virus persisted for 14 weeks at 38 F - 40 F, contrasted sharply with an 8-day persistence at an environmental temperature of 72 F.

INDEX TERMS: Sea water, Persistence, *E. coli*, Environmental effects, Enteric bacteria, Survival, Echo 6 virus, Culture media, Enrichment, Enterovirus, Cell morphology.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-7942

"WPCF PROJECT REPORT: A STATE CERTIFICATION PROGRAM GUIDE", Guy, L. L., Jr., Burke, G. W., Jr., Brinck, C. W., Journal Water Pollution Control Federation, Vol. 45, No. 5, May 1973, pp 787-808.

A study was conducted by WPCF, supported by an EPA grant, of state programs for certification of operations personnel in wastewater facilities. Six states were visited and the others polled for facts and opinions on key issues. The project report included the findings and conclusions of the study and recommended actions for federal and state agencies. A 'State Certification Program Guide' is presented that attempts to describe the elements of an effective state program. The states are encouraged to coordinate their efforts, and particular attention is directed toward (a) adequate autonomy and budget, (b) separate certification from training, (c) broader coverage of personnel and facilities, (d) development of a sound classification system, (e) separate certification for industrial waste facilities, and (f) easier reciprocity among state programs.

INDEX TERMS: Waste water treatment, Administration, Personnel, Training, Operations, Classification, Education, Regulation, Water quality control, Water pollution control, Certification programs, Examination, Certification renewals, Certification criteria.

AMIC-8200

"SOME PROBLEMS ASSOCIATED WITH THE ANALYSIS OF MULTIRESPONSE DATA", Box, G. E. P., Hunter, W. G., MacGregor, J. F., Erjavec, J., Technometrics, Vol. 15, No. 1, February 1973, pp 33-51.

Experience has shown that unless special care is exercised in analyzing multiresponse data serious mistakes can be made. In this paper some problems associated with fitting multiresponse models are identified and discussed. In particular, three kinds of dependencies are considered: dependence among the errors, linear dependencies among the expected values of the responses, and linear dependencies in the data. Since ignoring such dependencies can lead to difficulties, a method is described for detecting and handling them. The concepts involved are illustrated with a chemical example.

INDEX TERMS: Statistical methods, Chemical analysis, Estimating, Kinetics, Mathematical models, Data interpretation, Multiresponse data, Linear dependencies, Nonlinear models, Multivariate analysis, Errors.

AMIC-8026

"COLLABORATIVE STUDY OF THE NONAQUEOUS COPPER COLORIMETRIC AND SILVER TITRIMETRIC METHODS FOR THE DETERMINATION OF MALATHION IN TECHNICAL GRADE MALATHION AND IN MALATHION FORMULATION", Wayne, R. S., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 3, May 1973, pp 579-585.

The nonaqueous copper colorimetric and the silver titrimetric methods for the determination of malathion were studied collaboratively. The study involved wettable powders, emulsifiable concentrates, dusts, and the technical grade product. The mean of all of the results indicates that both procedures will give comparable values for each sample type used in the study. Agreement between replicates in individual laboratories was excellent. Agreement between laboratories was satisfactory; coefficients of variation ranged from 1.3 to 4.8 percent for the samples studied. The 2 methods offer improved reliability and ease of operation when compared to the official first action colorimetric method, 6.265-6.269. The methods have been adopted as official first action.

INDEX TERMS: Methodology, Chemical analysis, Reliability, Collaborative studies, Method evaluation, Comparative tests, Standard methods, Coefficient of variation, Interlaboratory tests.

AMIC-8201

"ERRORS OF MEASUREMENT, PRECISION, ACCURACY AND THE STATISTICAL COMPARISON OF MEASURING INSTRUMENTS", Grubbs, F. E., Technometrics, Vol. 15, No. 1, February 1973, pp 53-66.

A very important and yet widely misunderstood concept or problem in science and technology is that of precision and accuracy of measurement. It is therefore necessary to define the terms precision and accuracy (or imprecision and inaccuracy) clearly and analytically if possible. Also, we need to establish and develop appropriate statistical tests of significance for these measures, since generally a relatively small number of measurements will be made or taken in most investigations. In this paper a discussion is given of some of the pertinent literature for estimating variances in errors of measurement, or the 'imprecisions' of measurement, when two or three instruments are used to take the same observations on a series of items or characteristics. Also, present techniques for comparing the imprecision of measurement of one instrument with that of a second instrument through the use of statistical tests of significance are reviewed, as well as procedures for detecting the significance of the difference in biases or levels of measurement of two instruments. Finally, we indicate methods of extending present theory to the case of three measuring instruments, for which rather sensitive statistical test of significance are developed for dealing with the precision and accuracy problem. An example for the three instrument case is given to illustrate the suggested methodology of analysis.

INDEX TERMS: Instrumentation, Measurement, Statistical methods, Laboratory equipment, Research equipment, Methodology, Accuracy, Precision, Errors.

5. INSTRUMENT DEVELOPMENT

AMIC-6952

"REAL-TIME INTERACTIVE INSTRUMENTATION", Jones, D. O., Purdue University, Lafayette, Indiana, Dissertation Abstracts No. 73-6142, 1970, 167 pp. (Complete report not available from AMIC.)

The work presented in this thesis considers the critical experimental design parameters elucidated by a software-oriented study and describes the translation to hardware-oriented instrumentation. The hardware device was evaluated experimentally in the laboratory and the capabilities compared to the software-generated experimentation. Results indicate the essentially identical analytical performance is achieved at greatly reduced complexity of operation and expense. In addition, the hardware-oriented instrumentation provides the capability for greater measurement rates.

INDEX TERMS: Instrumentation, Digital computers, Data processing, Optimization, Automatic control, Laboratory tests, Testing procedures, Laboratory equipment, Real-time computers, Interactive computer systems, Stationary electrode polarography, Data interpretation, On-line computers.

AMIC-7462

"A METHOD FOR HIGH SPEED BCD-TO-BINARY CONVERSION", Beougher, L. C., Computer Design, Vol. 12, No. 3, March 1973, pp 53-59.

The BCD-to-binary design proposed as a high speed coded number converter can translate an 8-digit BCD number into a 27-bit binary number in 60 ns. The method is sufficiently fast to complete the process within one computer memory cycle of any available digital computer. High speed conversion of the number provides assurance that the input data to the computer will be in binary form at any time computer instructions request it. The design architecture was implemented using Schottky-clamped TTL integrated circuits. A less costly configuration can be obtained by using standard TTL integrated circuits such as the 74181 arithmetic logic unit and 74182 carry-look-ahead generator but results in a sacrifice of conversion speed. When standard TTL logic circuits are used, the converter can be expected to convert an 8-digit BCD number into a 27-bit binary number in approximately 150 ns, which is sufficiently fast for many applications and provides a saving of initial component costs.

INDEX TERMS: Methodology, Digital computers, BCD to binary conversions, Conversion systems, Computer memory, Converters.

AMIC-7461

"HIGH SPEED A-D CONVERTERS IN A MEMORY TEST SYSTEM", Connolly, J. J., Rosenbaum, M., Computer Design, Vol. 12, No. 2, February 1973, pp 86, 88, 89.

A low repetition rate digital sampling system is described in which a buffer storage unit provides a reduction in data rate so that digital samples may be processed and analyzed by an on-line computer. This computer may be either a special-purpose digital processor, or a general-purpose device wherein digital data sample analysis is accomplished by means of a software program. A block diagram is given of the memory data gathering system using an A-D converter. This system will take five samples of the sense amplifier output at 50-ns intervals, convert the analog value of each sample to a 6-bit digital number, and place these numbers in five storage buffers. The converter has a sampling rate capability of up to 20 million samples/s, accuracy of plus or minus 0.8 percent FS plus or minus 1/2 LSB, and is TTL compatible. A 4-bit delay code defines the 100-ns multiple that must elapse after acceptance of an external convert command before actual sampling of the sense amplifier output signal begins.

INDEX TERMS: Data transmission, Data processing, Digital computers, Automation, Instrumentation, Mechanical equipment, Automatic control, Analog to digital converters, Digital sampling systems, On-line computers, Buffer memory systems, Data gathering systems, Computer memory.

AMIC-7465

"BOOST A/D RATES WITH STAGGERED OPERATION", Baluta, H., Electronic Design, Vol. 21, No. 4, February 15, 1973, pp 54-57.

The operation of two interleaved a/d converters is discussed in order to clarify the details of interface circuit requirements versus the number of converters used. Conversion speed is doubled by the interconnection of two converters; however, external timing constraints limit the attainable speeds.

INDEX TERMS: Design criteria, Rates, Interfaces, Timing, Design standards, Velocity, Digital to analog converters, Conversion speed, Timing constraints.

5. INSTRUMENT DEVELOPMENT

AMIC-7895

"AT-STREAM-VELOCITY PUMPING SEDIMENT SAMPLING SYSTEM", Bennett, J. P., Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol. 99, No. HY6, June 1973, pp 873-887.

The sampling system collects water-sediment samples at local stream velocity from any point in an open-channel flow. The system used a flow-through Pitot tube as a combination velocity sensor and sampler nozzle. The main advantage of the sampling system over existing suspended-sediment samplers such as the US-P series samplers is that a sample of any desired volume can be collected without changing the position of the sampler nozzle. To compare the performance of the system with that of other samplers, suspended-sediment samples were collected from a flat-bed flow using the system, a US DH-48 sampler modified for point sampling, and a siphon sampler. On the basis of these samples, at the 99 percent confidence level, the relative percent difference between the concentrations of the samples from the system and the siphon sampler was between -5.45 and 4.45 and the relative percent difference between the concentrations of the samples from the system and from the US DH-48 was between -0.54 and 7.78.

INDEX TERMS: Open channel flow, On-site data collections, Sediment-water interfaces, Calibrations, Construction, Operation and maintenance, Bottom sampling, Instrumentation, Sediment transport, Hydraulics, On-site investigations, Methodology, Equipment, Sediment sampling system, Automatic samplers, Suspended sediments, Performance evaluation, Accuracy.

AMIC-7987

"VOLTAMMETRIC STUDY OF THE HYDROGEN ION/HYDROGEN COUPLE IN ACETONITRILE/WATER MIXTURES", Lanning, J. A., Chambers, J. Q., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1010-1016.

A voltammetric study at polished platinum electrodes of perchloric acid in acetonitrile/water mixtures is reported. The half-wave potentials of the proton reduction wave (ferrocene scale) and the viscosity of acetonitrile/water mixtures indicate that acetonitrile structures water in the 0.80 to 0.95 mol fraction of water region. The proton is most difficult to reduce ($E_{1/2}$ most negative) at 0.85 mol fraction of water. Acetonitrile proved to be a poor solvent for the generation of dry protons. Chemical reactions occur in $H^+(plus)/H_2/CH_3CN$ mixtures which depend on the nature of the generation technique employed. Solvent effects on the cyclic voltammograms of p-hydrobenzoquinone in acetonitrile-water mixtures were used to aid in the identification of product reduction waves. The wave assigned to the reduction of protonated benzoquinone was independent of solvent composition, in marked contrast to the reduction of solvated protons. (Reprinted from Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1010-1016. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Electrochemistry, Aqueous solutions, Chemical reactions, Chemical analysis, Solvents, Perchloric acid, Voltammetry, Nonaqueous solutions, Platinum electrodes, Mixtures, Acetonitrile, Reproducibility, p-Benzohydroquinone, Proton diffusion coefficients.

AMIC-7988

"SODIUM TUNGSTEN BRONZE AS A POTENTIOMETRIC INDICATING ELECTRODE FOR DISSOLVED OXYGEN IN AQUEOUS SOLUTION", Hahn, P. B., Wechter, M. A., Johnson, D. C., Voigt, A. F., Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1016-1021.

Sodium tungsten bronzes, nonstoichiometric compounds, $NaxWO_3$, with 0.5 less than x less than 0.9, were found to respond potentiometrically to dissolved oxygen in basic solutions. A Nernstian response, with a slope of approximately 120 mV per decade, was exhibited in the concentration range 0.2-8 ppm. Oxygen analyses were made in this range with precision and accuracy approaching plus or minus 5 percent. The large slope and other observations place serious doubt on customary oxygen redox reactions as possible mechanisms. An absorption mechanism is proposed which involves the displacement of adsorbed hydroxide ions by molecular oxygen. (Reprinted from Analytical Chemistry, Vol. 45, No. 7, June 1973, pp 1016-1021. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Dissolved oxygen, Aqueous solutions, Pollutant identification, Indicators, Chemical analysis, Chemical reactions, Inorganic compounds, Hydrogen ion concentration, Temperature, Iron, Copper, Mercury, Cations, Sodium tungsten bronze electrodes, Potentiometry, Precision, Accuracy, Ionic interference, EDTA, Chemical interference, Reproducibility.

AMIC-8035

"ESTIMATION THEORY APPLICATIONS TO DESIGN OF WATER QUALITY MONITORING SYSTEMS", Moore, S. F., Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol. 99, No. HY5, May 1973, pp 815-831.

A quantitative methodology, utilizing Kalman filtering techniques, is developed for designing water quality monitoring systems. A basis is established for: (1) improvement of current practices of specification and enforcement of water quality standards; and (2) evaluating the economic trade-off between temporal and spatial frequency of sampling. Monitoring systems are characterized by spatial and temporal frequency of sampling and the variables to be measured. Utilizing a dynamic model of the aquatic environment and estimates of the uncertainty in model error and measurement error, a best sampling program is selected from a set of feasible sampling programs by sequentially minimizing a specified measurement system cost function. An optimal solution is not guaranteed. The power of the technique is based on the unique combination of model and data obtained from filtering techniques. The major shortcomings are: (1) the need for a model of the systems and (2) high computer costs.

INDEX TERMS: Methodology, Monitoring, Water quality, Design, Stochastic processes, Aquatic environment, Mathematical models, Water sampling, Model studies, Filtration, Monitoring systems, Kalman filtering methods, Sampling frequency, Estimation theory, Variance, Computer costs.

5. INSTRUMENT DEVELOPMENT

AMIC-8167

"OIL SPILL SURVEILLANCE SYSTEM STUDY", Mohr, D., McCormack, K., Brewster, G., Fournier, G., Texas Instruments Incorporated, Dallas, Texas, Report No. EPA-R2-73-215, Contract No. 68-01-0150, May 1973, 215 pp.

Test studies of active and passive infrared sensor systems were conducted to determine the ability of these systems to detect petroleum oil on the water's surface. Since there are temperature, as well as emissivity differences between oil and water, it was expected that these systems might have applications for real time detection, alarm, monitoring, and recording of oil spilled or discharged in waters. The active system emits a wide-band IR pulse and receives reflections at two narrow spectral bands. Its operation is based on differences in the reflectance of oil and water at these narrow spectral bands. The passive system receives IR radiation in the 8- to 14-micron spectral region. The test results indicate that both sensor systems have distinct advantages in oil spill surveillance applications. The active sensor provides absolute oil spill detection, for ranges to 300 feet that is not affected by the time of day, weather, or water surface conditions. The passive sensor makes possible oil volume determination, areal coverage, and probable oil detection for ranges to 1000 feet. Since both evaluated sensor systems have distinct and equally important features, a combination active and passive sensor system would provide the best surveillance for oil spill applications. Two combination system designs are described in this report.

INDEX TERMS: Oil spills, Remote sensing, Pollutant identification, Water pollution sources, Monitoring, Optical properties, Infrared sensors, Surveillance, Infrared imagery.

AMIC-8194

"FIELD CALIBRATION AND EVALUATION OF A NUCLEAR SEDIMENT GAGE", Welch, N. H., Allen, P. B., Water Resources Research, Vol. 9, No. 1, February 1973, pp 154-158.

Nuclear sediment gage readings were compared to stream cross-sectional sediment concentrations for several storm events over a 3-year period. Calibration curves, developed by least-squares analysis, are presented for individual and combined storm events. Correlation coefficients for individual or combined storm events ranged from -0.86 to -0.99, and all were significant at the 1 percent level. Standard errors of estimate ranged from plus or minus 172 to plus or minus 1884 ppm. Sediment concentrations predicted with the calibration curves developed in this study were accurate enough for most applications. Although the particular nuclear gage used in this study is probably unsatisfactory for general use, the principle of monitoring sediment concentrations by nuclear techniques appears sound and feasible.

INDEX TERMS: Calibrations, On-site investigations, Monitoring, Evaluation, Instrumentation, On-site tests, On-site data collections, Sediments, Least squares method, Radioactivity techniques, Nuclear sediment gage, Suspended sediments, Correlation coefficients, Standard errors, Accuracy, Half-life.

AMIC-8204

"A RUGGED SILVER-SILVER CHLORIDE ELECTRODE FOR FIELD USE", Conti, U., Corwin, R. F., The Review of Scientific Instruments, Vol. 44, No. 6, June 1973, pp 708-711.

A rugged silver-silver chloride electrode has been developed and used successfully in a variety of field applications. The electrode housing is made of 2.54 cm o.d. clear acrylic plastic rod. The filling solution is 2.7 M potassium chloride saturated with silver chloride, and contact with the external medium is made through a porous ceramic rod. Results of laboratory and field tests measuring the response of the electrode to chemical, thermal, mechanical, and electrical disturbances are presented. The electrode has provided reliable service when subjected to severe mechanical abuse during both offshore and onshore use.

INDEX TERMS: On-site data collections, Electrochemistry, Resistivity, Salinity, Reliability, Temperature, Design, On board analysis, Marine environment, Silver/silver chloride electrode, Electrochemical behavior, Ion selective electrodes, Shipboard measurements, Mechanical shock.

AMIC-8208

"ENZYME ELECTRODES", Gough, D. A., Andrade, J. D., Science, Vol. 180, No. 4084, April 27, 1973, pp 380-384.

The development of biochemical-specific electrode systems is discussed; some of the foreseeable problems that might be associated with their use are presented; and the essential literature is reviewed. It was determined that the clinical determinations of certain metabolites and soluble enzymes by means of enzyme electrodes are quite feasible. Such devices may be made highly specific by the use of appropriate enzymes and a high degree of accuracy can be obtained. Instantaneous and continuous determinations can be made from physiological fluids, and undesirable physiologic responses can theoretically be minimized, thus making long-term clinical monitoring a possibility. Enzyme electrodes may also have a useful lifetime and meet other practical requirements.

INDEX TERMS: Monitoring, Methodology, Pollutant identification, Chemical reactions, Properties, Electrochemistry, Enzymes, Amino acids, Ureas, Metabolites, Potentiometry, Immobilized enzyme electrodes, Electrochemical behavior, Glucose, Response time.

5. INSTRUMENT DEVELOPMENT

AMIC-8214

"POLARIZATION: A KEY TO AN AIRBORNE OPTICAL SYSTEM FOR THE DETECTION OF OIL ON WATER", Millard, J. P., Arvesen, J. C., *Science*, Vol. 180, No. 4091, June 1973, pp 1170-1171.

The detection of oil slicks can be improved by utilizing polarization techniques. Good contrast was obtained in a study of oil slicks by viewing a specific polarization component. Skylight polarization, which varies with the position of the sun in the sky, influences the contrast of oil on water. Good contrast is most consistently obtained by viewing in azimuth directions toward or away from the sun. Contrast is enhanced by imaging selected polarization components and by taking the difference between orthogonal polarization components.

INDEX TERMS: Oil spills, Aerial photography, Remote sensing, Water pollution, Pollutant identification, Oil pollution, Reflectance, Optical properties, On-site data collections, Cameras, Thin films, Photogrammetry, Aerial surveillance, Skylight polarization, Optical systems, Polarization, Azimuths.

AMIC-8237

"ION-SELECTIVE CARBON-PASTE ELECTRODES FOR HALIDES AND SILVER (I) IONS", Mesaric, S., Dahmen, E. A. M. F., *Analytica Chimica Acta*, Vol. 64, No. 3, May 1973, pp 431-438.

The behavior of a simple type of ion-selective electrode for halogens and silver has been studied. The electrode consists of a plastic body filled with carbon paste, the surface of which can be easily renewed. The paste composition is based on carbon-mujol (5: 1, w/v) or carbon-paraffin was (3: 1, w/v) containing a prepared mixture of silver halide-silver sulphide (1-30 percent). The electrodes have low ohmic resistance and show a rapid Nernstian response (within 2-5 mV) for halide and silver ions down to 0.05 mM chloride, 0.01 mM bromide and 0.5 microM iodide with the respective electrodes. Ions forming very stable complexes with halide or silver and those having strong oxidizing or reducing action interfere.

INDEX TERMS: Halides, Cations, Aqueous solutions, Fabrication, Silver iodide, Measurement, Silver, Ion selective electrodes, Carbon paste electrodes, Potentiometric titration, Silver chloride, Silver bromide, Potentiometry, Chemical interference, Detection limits.

AMIC-8235

"A POTASSIUM-SELECTIVE SILICONE-RUBBER MEMBRANE ELECTRODE BASED ON A NEUTRAL CARRIER", Pick, J., Toth, K., Pungor, E., *Analytica Chimica Acta*, Vol. 64, No. 3, May 1973, pp 477-480.

A new potassium-selective silicone-rubber membrane electrode based on the neutral carrier valinomycin has been developed. The electrode selectivity for most alkali and alkaline earth metal cations is comparable to that of the conventional liquid membrane electrodes. Over a period of 65 h no drift in e.m.f. was observed. The response time usually is less than 3 s.

INDEX TERMS: Selectivity, Cations, Aqueous solutions, Alkali metals, Alkaline earth metals, Ion selective electrodes, Membrane electrodes, Potassium electrodes, Ligands, Valinomycin, Electrochemical behavior, Electromotive force, Response time, Reproducibility, Ionic interference.

AMIC-8238

"THE CALIBRATION AND RESPONSE OF ION-SELECTIVE ELECTRODES AT LOW CONCENTRATIONS OF PRIMARY IONS", Bailey, P. L., Pungor, E., *Analytica Chimica Acta*, Vol. 64, No. 3, May 1973, pp 423-430.

The responses of silicone-rubber based ion-selective membrane electrodes (iodide and silver ion-selective electrodes) to low concentrations of primary ions have been studied in various unbuffered media. In particular, the failure region of the electrodes was studied. Reproducible and accurately known concentrations of ions (0.1-0.0007 mM) were prepared by electrolytic generation. A necessary and integral part of the work was to measure the current efficiency for the generation of the ions in the different media. Such efficiencies were measured coulometrically. Results obtained from the calibration of the iodide-ion selective electrode in various media are presented, and results with the silver and copper ion-selective electrodes are briefly discussed. The advantages of the electrolytic generation technique are discussed.

INDEX TERMS: Calibrations, Methodology, Electrolytes, Electrochemical behavior, Ion selective electrodes, Copper electrodes, Silver electrode, Iodide electrodes, Unbuffered media, Reproducibility, Accuracy, Electrolytic generation technique, Current efficiencies.

5. INSTRUMENT DEVELOPMENT

AMIC-8239

"RECENT RESULTS ON THE DYNAMIC RESPONSE OF PRECIPITATE-BASED ION-SELECTIVE ELECTRODES", Toth, K., Pungor, E., *Analytica Chimica Acta*, Vol. 64, No. 3, May 1973, pp 417-421.

The e.m.f. vs. time curves of the precipitate-based ion-selective electrodes (copper(II)-selective electrode) have been interpreted mathematically on the basis of the desolvation of ions at the electrode surface. A new method has been suggested for the characterization of ion-selective electrodes by the half-life time of the first-order desolvation reaction.

INDEX TERMS: Mathematical studies, Chemical reactions, Methodology, Desolvation, Ion selective electrodes, Electrochemical behavior, Data interpretation, Copper electrodes, Response time, Characterization, Half-life, Electromotive force.

AMIC-8318

"REMOTE SENSING STUDY OF THERMAL DISCHARGES TO LAKE MICHIGAN, WISCONSIN, ILLINOIS, INDIANA, MICHIGAN", U. S. Environmental Protection Agency, National Field Investigations Center, Denver, Colorado, Presented at the Fourth Session of the Lake Michigan Enforcement Conference, September 1972, 36 pp. NTIS Report No. PB-214 503.

An aerial reconnaissance study was conducted along the shoreline of Lake Michigan including 13 electric power generating facilities, 10 of which were operating at the time of the flight. Thermal data were recorded on an infrared line scanner (IRLS) with a temperature resolution of 0.1 C. The instrument recorded only surface water temperature. Recorded data were on 5-inch film in the form of a thermal map. Nine of the operating power stations were found to be violating the recommended 3 F maximum temperature increase at a distance of 1000 feet from the discharge point. Six were violating the 3 F recommendation even at 2000 feet. However, none of the discharges caused surface temperature to exceed the maximum allowable for September of 80 F. Overlapping thermal plumes were also recorded, which was in violation of recommendations.

INDEX TERMS: Remote sensing, Thermal pollution, Lake Michigan, Electric powerplants, Water pollution sources, Industrial wastes, Water temperature, Mapping, Infrared radiation, Photogrammetry, Michigan, Illinois, Indiana, Wisconsin, Water pollution, Surface waters, Aerial surveillance, Infrared imagery, Line scanning, Lake Winnebago, Muskegon Lake, Fox River.

AMIC-8280

"AN ON-SITE HYDROLOGIC DATA RECORDING SYSTEM", Chadwick, D. G., *Water Resources Bulletin*, Vol. 9, No. 2, April 1973, pp 328-337.

A system is described which has the capability to operate unattended for long periods of time, reliably sensing and digitizing hydrologic data at predetermined intervals for data transmission or storage as the case requires. Little power is needed for system operation in the standby mode. Batteries supply what energy is required for operation, so it can be used in places located remotely from a 60 Hz power source. A description is given of methods used to sense and digitize data taken from a precipitation gage, temperature probe, wind direction, indicator, wind mill sensor, and water level sensor. The system is periodically actuated by an extremely accurate solid-state crystal clock. The record is made on an 8-channel battery operated paper-tape punch. The system has flexibility for measuring many other parameters. The overall system has an indefinitely long life, it being primarily determined by the ultimate wear-out of the paper tape punch which of course is replaceable. Other elements are essentially nonwearing and should last indefinitely. About 25 dollars worth of batteries will power the system up to 2 years depending on the amount of data to be recorded.

INDEX TERMS: Hydrologic data, Automatic control, Instrumentation, On-site data collections, Data storage and retrieval, Recording systems, Sensors.

AMIC-8324

"CHEMICAL COMPOSITION OF OCEAN USING A DIRECT MEASURING OCEANOGRAPHIC ELECTROCHEMICAL PROBE", Kaplan, I. R., Ben-Yaakov, S., University of California, Department of Geology, Los Angeles, California, Report No. UCLA-34P-178X3, Contract No. AT(04-3)-34, 1972, 156 pp.

These studies were primarily concerned with the investigation of carbonate saturation in the ocean by the application of an in situ probe. The method involved the construction of an electrochemical measurement system which was used to depths of 4,500 m. A glass electrode was allowed to reach equilibrium with a calcium carbonate suspension and the changes in pH were measured. This pH change could then be related to the degree of saturation of the carbonate in seawater. Studies also were undertaken to measure ionic diffusion from seawater to less dilute solutions. It was established that ionic complexing may extensively modify the fluxes of migrating ions. Theoretical studies were conducted on the effect of complexing on the apparent dissociation constants in the carbonate system. It was shown that these could change significantly in interstitial waters having approximately the same ionic strength of seawater, but a different composition. A study was also made of the CO₂-O₂ system in the North Eastern Pacific. Variations in CO₂ and O₂ were related to production and consumption rates and to mixing models of ocean currents.

INDEX TERMS: Sea water, Chemical analysis, Electrochemistry, Hydrogen ion concentration, Pacific Ocean, Mixing, Carbon dioxide, Dissolved oxygen, Saline water, On-site investigations, Aquatic productivity, Methodology, Electrochemical probe, Ionic diffusion, Carbonate saturation, Chemical composition, Glass electrodes.