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Reviews of Current Literature on Analytical Methodology and Quality Control

No. 17



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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.

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REVIEWS OF CURRENT LITERATURE ON
ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 17

By

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WASHINGTON, D.C. 20460



NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM
ANALYTICAL QUALITY CONTROL LABORATORY

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ANALYTICAL METHODOLOGY AND QUALITY CONTROL

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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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1. PHYSICAL AND CHEMICAL METHODS

AMIC-6684

"OXYGEN DEFICIENT CONDITIONS AND NITRATE REDUCTION IN THE EASTERN TROPICAL NORTH PACIFIC OCEAN", Cline, J. D., Richards, F. A., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 885-900.

The purpose of this investigation was to relate the distributions of dissolved oxygen and compounds of nitrogen and phosphorus in the oxygen-minimum zone of waters off Mexico and Central America to the effects of oxygen deficiencies on nitrate reduction, denitrification, and attendant microbiological processes occurring there. Chemical and physical observations included salinity, temperature, dissolved oxygen (Winkler and colorimetric), inorganic phosphate, nitrate, nitrite, nitrous oxide, ammonia, silicate, pH, alkalinity, total carbon dioxide, dissolved hydrogen sulfide, sulfite, thiosulfate, and soluble and particulate iron. On a second cruise, nitrate, nitrite, ammonia, phosphate, and silicate determinations were carried out on a Technicon AutoAnalyzer. Oxygen concentrations in the oxygen-minimum zone were commonly less than 1 microgram-atom/liter from below the pycnocline to depths of several hundred meters. In these nearly anoxic waters, nitrate appears to be reduced to nitrite and free nitrogen. Nitrate deficits, derived from material balance calculations, suggest that up to 13-14 microgram-atoms/liter (40-50 percent) of nitrate-nitrogen have been so reduced. Secondary nitrite concentrations rarely exceed 1.5 microgram-atoms/liter and are generally associated with oxygen concentrations of less than 2 microgram-atoms/liter. Ammonia concentrations appear to be slightly lower in the region of denitrification, probably because of bacterial assimilation. It is estimated that about 230×10 to the twelfth power grams of combined N are lost annually by denitrification.

INDEX TERMS: Dissolved oxygen, Nitrates, Nitrites, Reduction (chemical), Denitrification.

AMIC-6852

"SMITHSONIAN ADVISORY COMMITTEE REPORT ON STUDIES OF THE EFFECTS OF WASTE DISPOSAL IN THE NEW YORK BIGHT", Buzas, M. A., Carpenter, J. H., Ketchum, B. H., McHugh, J. H., Norton, V. J., O'Connor, D. J., Simon, J. L., Young, D. K., Smithsonian Institute, Oceanography and Limnology Program, Washington, D. C., Report, July 1972, 60 pp. NTIS Report No. AD 746 960.

Reports of studies by the U. S. Army Coastal Engineering Research Center on the effects of waste disposal in the New York Bight were reviewed by the Smithsonian Advisory Committee. The reviews point out shortcomings in the data which prevent drawing definite conclusions about the effects of waste disposal and suggest areas for further research which will overcome this deficiency. Recommendations are included regarding further research on this area and on dumping practices. The major recommendation on disposal is that acceptable alternatives should be sought but in the meantime more effective management and control must be instituted.

INDEX TERMS: Water pollution effects, Water pollution control, Water quality, Sludge disposal, Reviews, Heavy metals, Coliforms, Benthos, Zooplankton, Amphipoda, Fish, Sampling, Copepods, Turbidity, Suspended solids, New York Bight, Data interpretation

AMIC-6923

"WATER POLLUTION ASPECTS OF STREET SURFACE CONTAMINANTS", Sartor, J. D. Boyd, G. B., URS Research Company, San Mateo, California, Report No. EPA-R2-72-081, Contract No. 14-12-921, November 1972, 236 pp.

Materials which commonly reside on street surfaces have been found to contribute substantially to urban pollution when washed into receiving waters by storm runoff. In fact, runoff from street surfaces is similar in many respects to sanitary sewage. Calculations based on a hypothetical but typical U. S. city indicated that the runoff from the first hour of a moderate-to-heavy storm would contribute considerably more pollutional load than would the same city's sanitary sewage during the same period of time. This study provides a basis for evaluating the significance of this source of water pollution relative to other pollution sources and provides information for communities having a broad range of sizes, geographical locales, and public works practices. Information was developed for major land-use areas within the cities (such as residential, commercial and industrial). Runoff was analyzed for the following pollutants: BOD, COD, total and volatile solids, Kjeldahl nitrogen, nitrates, phosphates, and a range of pesticides and heavy metals.

INDEX TERMS: Water pollution sources, Urban runoff, Biochemical oxygen demand, Chemical oxygen demand, Nitrates, Phosphates, Pesticides, Heavy metals, Gas chromatography, Volatile solids, Characterization, Transport, Atomic absorption spectrophotometry.

AMIC-7031

"A SOLVENT EXTRACTION METHOD FOR THE DETERMINATION OF PHOSPHORUS-32 IN SEA WATER", Flynn, W. W., Meehan, W. R., Analytica Chimica Acta, Vol. 63, No. 2, February 1973, pp 483-488.

Seawater samples to be analyzed for Phosphorus-32 were collected in polyethylene bottles and treated with perchloric acid. The perchloric acid treatment converts all phosphorus to orthophosphate. The procedure involved adding a phosphorus carrier (potassium dihydrogenphosphate), and extracting P-32 as the phosphomolybdate from a solution of 0.66 M sulfuric acid with isobutyl acetate. A buffered ammonium solution stripped the carrier from the solvent and a precipitate (as magnesium ammonium phosphate) was used for counting. This method was unsatisfactory with demineralized water, but substitution of isoamyl alcohol gave 90-95 percent recovery of the carrier from solutions as high as 0.7 N in acid. Results were similar with seawater. Recoveries of phosphorus ranged from 16 percent to 100.8 percent. Addition of interfering ions (Ag, Al, As, Bi, Ca, Co, Cr (3 plus), Cs, Cu (2 plus), Fe (3 plus), F, Hg, I, La, Mg, Mn, Nb, Ni, Pb, Rb, Sb, Si, Sr, Sn, Te, Th, U, Y, Zn, Zr, acetate, ascorbic acid, borate, citrate, nitrate, oxalate, sulfate, and tartaric acid did not affect recovery. Study of radionuclides (Ac-228, As-76, Ba-133, Bi-207, Ca-45, Ce-144, Co-60, I-131, Mn-54, Mo-99, and Na-22) showed decontamination factors in excess of 1000 for most. The recovery of P-32 from samples of seawater spiked with a standard solution and stored for six weeks in polyethylene bottles under various conditions showed that the method was quantitative.

INDEX TERMS: Sea water, Separation techniques, Scintillation counting, P-32, Chemical recovery, Chemical interference, Sample preparation, Storage.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7137

"KRAFT EFFLUENT COLOR CHARACTERIZATION BEFORE AND AFTER STOICHIOMETRIC LIME TREATMENT", Swanson, J. W., Dugal, H. S., Buchanan, M. A., Dickey, E. A., The Institute of Paper Chemistry, Division of Natural Materials and Systems, Report No. EPA-R2-73-141, February 1973, 84 pp.

The objective of this project was the isolation of color components and characterization of dilute kraft waste liquors before and after stoichiometric lime treatment. Eight series of 24-hour composite samples of untreated decker wastes, lime-treated wastes containing color bodies not removed by lime treatment, and returned waste containing supernatant from sludge holding ponds and returned to the treatment process were collected for analysis. Samples were chemically analyzed for pH, color, Na, Ca, Cl, organic N, organic C, total solids, fixed solids, volatiles, and carbonates. Ultraviolet and visible spectra were also determined after variable storage times. Ion exchange resins, dialysis, sorption on carbon and synthetic resin, gel permeation chromatography, and paper chromatography were tested as means for isolating color bodies. Wastes were centrifuged and the colored solution freeze-dried to produce a powder which did not degrade and could be readily dissolved in water. The reconstituted samples were extracted for acid-soluble and acid-insoluble components which were analyzed by paper chromatography, color measurement, absorbance measurement, fraction of color bodies, and determination of molecular weights. Infrared spectroscopy data indicate that the acid-insoluble color bodies (high molecular weights) contain a high proportion of conjugated carbonyl groups where conjugation with an aromatic ring is probable. The acid-soluble fractions (low molecular weights) seem to contain nonconjugated carboxyl groups and may be associated with carbohydrate material. However, color bodies are found to be aromatic in nature (partially

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degraded lignin), possess a negative charge, and exist primarily as soluble sodium salts in aqueous solutions. The lime-treatment process was found to remove on an average about 86 percent of the color, 57 percent of the total organic carbon, and 17 percent of total sugars from the waste effluent during the period of approximately 15 months over which the samples were collected. No appreciable change in chloride content was noticed.

INDEX TERMS: Pulp wastes, Separation techniques, Color, Waste treatment, Characterization, Sample preparation.

AMIC-7186

"RECENT DEVELOPMENTS IN THE ANALYTICAL APPLICATION OF UV-PHOTOELECTRON SPECTROSCOPY", Betteridge, D., Baker, A. D., Bye, P., Hasanuddin, S. K., Kemp, N. R., Rees, D. I., Stevens, M. A., Thompson, M., Wright, B. J., Zeitschrift fur Analytische Chemie, Vol. 263, No. 4, March 1973, pp 286-290.

Preliminary results are reported from a number of new developments designed to make UV photoelectron spectroscopy analytically advantageous. A versatile photoelectron spectrometer with a simple sample inlet system has been constructed. This has been successfully linked to a G.L.C. and in this combination serves either to provide a spectrum of the sample or acts as a selective G.C. detector. Data processing has been improved with the aid of a computer program which enables the spectrum of a mixture to be resolved into its components. The system was tested with acetone, PC15, POC15, and HCl.

INDEX TERMS: Data processing, Computer programs, Laboratory equipment, Gas chromatography, Chlorides, UV-photoelectron spectroscopy, Sample inlet, GC-photoelectron spectroscopy, Acetone, Solvents, Organic solvents, Hydrochloric acid, Phosphorus pentachloride, Phosphorus oxychloride.

AMIC-7191

"PHYSICAL-CHEMICAL OCEANOGRAPHIC DATA FROM THE NORTH PACIFIC OCEAN AND BERING SEA, 1971", Ingraham, W. J., Jr., Fisk, D. M., Bartlett, C. J., Turner, S. E., National Marine Fisheries Service, Northwest Fisheries Center, Seattle, Washington, NMFS Data Report 75, NOAA 72012303, February 1973, 172 pp. NTIS Report No. COM-73-10192.

Temperature and salinity data were obtained in the North Pacific Ocean at 176 stations in 1971 during spring and autumn cruises of the RV George B. Kelez south of the Aleutian Islands, in the Bering Sea, and along the coasts of Washington and British Columbia. Values were obtained from STD traces at standard depths to 1,000 m (spring data) or 1,500 m (autumn data). Computations of density (σ_t), sound velocity, anomaly of specific volume, and dynamic height, which were performed by a shipboard PDP-8 computer, are also presented. The autumn data tabulations were obtained automatically through a new computer interface.

INDEX TERMS: Pacific Ocean, Water temperature, Depth, Salinity, Data processing, Bering Sea.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7213
 "NUTRIENT INVERSIONS IN THE SOUTHEASTERN TROPICAL PACIFIC OCEAN", Thomas, W. H.,
Fishery Bulletin, Vol. 70, No. 3, 1972, pp 929-932.

During a cruise of the Pacific Ocean in 1970, samples of seawater were collected at various depths in Nansen bottles for analysis of nitrates, nitrites, phosphates, and silicates. Plots of nutrient concentration versus depth showed that at a typical station nutrients such as nitrate and phosphate were high at the surface, at a minimum at about 100 m depth, and then increased at greater depths. Silicate followed this distribution to a lesser degree. These inversions occurred from lat 8 to 15 degrees S and were more pronounced in sections along long 126 degrees W and 119 degrees W than in sections farther east. The nutrient minimum was associated with water having a salinity maximum. It is suggested that such water may have acquired its characteristics in the mixed layer in areas to the south or southeast where the nutrients were depleted by phytoplankton, and had then sunk below high-nutrient and relatively fresh water carried westward from the Peru Current. However, the nutrients may also have been depleted in situ since the low-nutrient water contained a maximum amount of chlorophyll.

INDEX TERMS: Pacific Ocean, Nitrates, Phosphates, Nitrites, Silicates, Salinity, Depth, Phytoplankton, Nutrient Inversion.

AMIC-7229
 "CYCLING OF ELEMENTS OF ESTUARIES", Wolfe, D. A., Rice, T. R., Fishery Bulletin, Vol. 70, No. 3, 1972, pp 959-972.

Review and discussions are presented on the types of information needed to develop useful models for the cycling of contaminant metals (both radioactive and stable) in estuarine ecosystems. Basic requirements are knowledge of the major reservoirs of the metals, which in most cases are the sediment and water, the mechanisms and pathways of elemental transformation, rates of elemental turnover among reservoirs, and responses of these processes and reservoirs to environmental change. A conceptual systems model is presented as the preliminary phase in the development of dynamic mathematical models of elemental cycling.

INDEX TERMS: Model studies, Heavy metals, Estuaries, Marine animals, Biotransformation, Transport, Bioaccumulation.

AMIC-7235

"THE INFLUENCE OF LOG HANDLING ON WATER QUALITY", Schaumburg, F. D., Oregon State University, Corvallis, Oregon, Report No. EPA-R2-73-085, February 1973, 105 pp.

Because of the potential contribution of logging activities to pollution of rivers, lakes, and estuaries, studies were conducted to determine the leachates from Douglas fir, ponderosa pine, and hemlock logs, toxic effects of log storage, amount of bark loss, and other factors which may contribute to degradation of water quality. Studies were conducted both in laboratory tanks and on-site. Leaching studies were conducted with logs with and without the ends sealed and with and without bark. Tannin, lignin, and phenolic compounds were determined by the Pearl-Benson Index, COD by the Jerris method, BOD by Standard Methods, k-rates by manometer, and reducing sugars by procedures described by Somogyi and Hodge and Hofreites. Bioassays were run with chinook salmon and rainbow trout. Bark losses were determined photographically. Benthic samples were taken with a corer, frozen, and analyzed to determine bark distribution. Measurements including BOD, COD, FBI, solids and toxicity have shown that in most situations the contribution of soluble leachates to holding water is not a significant water pollution problem. The most significant problem associated with water storage appears to be the loss of bark from logs during dumping, raft transport and raft storage. Dislodged bark can float until it becomes water logged and sinks forming benthic deposits. Floating bark is aesthetically displeasing and could interfere with other beneficial uses of a lake, stream or estuary. Benthic deposits exert a small, but measurable oxygen demand and may influence the biology of the benthic zone. Implementation of corrective measures by the timber industry to reduce bark losses could make the water storage of logs a practice which is compatible with a high quality environment.

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INDEX TERMS: Biochemical oxygen demand, Chemical oxygen demand, Bark, Lumbering, Leaching, Toxicity, Water analysis, Pearl Benson Index, Total organic carbon, Reducing sugars, Tannins, Lignins, Volatile solids.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7288

"ACQUISITION AND REDUCTION OF GAS CHROMATOGRAPHIC DATA USING A COMPUTER", Greco, M., Marranci, G., Journal of Chromatography, Vol. 77, No. 1, March 14, 1973, pp 91-96.

This paper describes the installation of an IBM 1800 computer system for the on-line acquisition and reduction of data from twenty gas chromatographs. Gas chromatographs from various manufacturers that use both packed and capillary columns and thermal conductivity and flame ionization detection were interfaced to the computer. The gas chromatography computer system has been used for a wide range of applications, from routine analyses to research and development. The accuracy and repeatability of quantitative data and retention times are shown. Routine analyses were run on C1-C5 gases, alkylbenzenes, p-xylene oxidation products, n-paraffins, pyrolysis samples, H2, O2, N2, CO, CO2, aromatics, halogenated compounds from 1,2-dichloroethane, naphtha, and olefins. The computer installation required particular studies on the layout of signal cables from the gas chromatography laboratory, of electric cables and of pneumatic lines.

INDEX TERMS: Gas chromatography, Computers, Data reduction, Alkyl benzenes, Xylene, Paraffins, Dichloroethane, Naphtha, Olefins.

AMIC-7315

"MULTI-ELEMENT NEUTRON ACTIVATION ANALYSIS OF SEDIMENT USING A CALIFORNIUM-252 SOURCE", Hayes, D. W., Peterson, S. F., E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, South Carolina, Report No. Conf-720902--4, Contract No. AT(07-2)-1, September 11-13, 1972, 4 pp. NTIS Report No. DP-MS-72-38.

The application of a Cf-252 source to the neutron activation analysis of several elements in small (approximately 1.5 inch in diameter) cores was studied using high-resolution gamma ray spectroscopy and manual data reduction. A preliminary study of 4-inch segments of various ocean bottom cores by this method showed that Mn, Al, Ca, Na, Cl, and V were easily detected. Other elements found in some of the samples were Mg, Ti, Br, Dy, Ca, and I. Cores from the Atlantic Ocean were analyzed for the easily detectable elements, and on the basis of elemental content, were characterized as pelagic clay or pure sand. With a few modifications, the procedure could be used aboard a ship or on shore to obtain rapid elemental analysis of sediment cores using a Cf-252 source, Ge(Li) detector, multichannel analyzer, and manual data reduction. The procedure could also be used to analyze sediment cores from estuaries or tidal flats. The procedure could be improved by using a 4096 analyzer, and computerized data reduction, and by rotating the core during activation and counting. Procedures are discussed for eliminating interference and differences in irradiation and counting between standards and samples.

INDEX TERMS: Bottom sediments, Cores, Neutron activation analysis, Radioactivity techniques, Chemical analysis, Heavy metals, Alkali metals, Alkaline earth metals, Halogens, Pollutant identification, Aquatic soils, Atlantic Ocean, Soil analysis, Multielemental analysis, Californium-252, rare earth elements.

AMIC-7310

"IDENTIFICATION BY MEANS OF RETENTION PARAMETERS", Schomburg, G., Dielmann, G., Journal of Chromatographic Science, Vol. 11, No. 3, March 1973, pp 151-159.

Retention parameters, preferably Kovats indices, can be used to identify chromatographically separated components of mixtures, and in addition, chemical derivatives thereof. For reliable correlations of peaks, combined use of other mainly spectroscopic identification methods is necessary. There are two different methods of applying Kovats indices which are table matching and/or incremental predictions of I and delta I values. Identification by table matching is demonstrated with saturated and unsaturated hydrocarbons from C5 to C6 of a gasoline cut and C6 compounds. Identification by retention increments is demonstrated with 1-octene, 2-methylnonane, 3-methylnonane, hexyl-cyclopropane, methylbranched undecanes, and unsaturated and methylbranched cyclopropanes. The extended use of retention parameters was limited until recently because of a lack in data reproducibility due to column polarity and apparatus parameters. Proposals are made as to how these difficulties may be overcome and as to the corrections and standardizations which may be made in order to obtain precise data.

INDEX TERMS: Gas chromatography, Organic compounds, Kovats indices, Retention time, Retention volume.

AMIC-7345

"A RATIONAL SERIES OF SOLVENTS FOR USE IN INCREMENTAL GRADIENT ELUTION", Scott, R. P. W., Kucera, P., Analytical Chemistry, Vol. 45, No. 4, April 1973, pp 749-754.

A rational procedure for choosing a series of solvents for incremental gradient elution in liquid-solid chromatography is described and a practical series of solvents for gradient elution development is given. Examples are included of the use of the solvent system for separating mixtures containing solutes of widely diverse polarities together with the necessary operating conditions. The range of solvents given, commencing with heptane and ending with water, appears to cover a K' range, relative to heptane of 10,000. (Reprinted from Analytical Chemistry, Vol. 45, No. 4, April 1973, pp 749-754. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Solvents, Solvent extractions, Separation techniques, Polarity, Liquid-solid chromatography, Incremental gradient elution, Organic solvents, Polar solvents, Nonpolar solvents, Inorganic solvents.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7357

"COMPARISON OF SELECTIVE ION MONITORING AND REPETITIVE SCANNING DURING GAS CHROMATOGRAPHY-MASS SPECTROMETRY", Middleditch, B. S., Desiderio, D. M., Analytical Chemistry, Vol. 45, No. 4, April 1973, pp 806-808.

Because of the increasing applicability of repetitive scanning (RS) and selective ion monitoring (SIM) gas chromatography-mass spectrometry to biochemical problems, an investigation using cholestane as a test substance was carried out to determine the relative sensitivities, limitations and versatilities of the two methods. Three-microliter aliquots of cholestane stock solution diluted by a factor of 10 from 10 to 1,000,000 times were used for GC-MS to facilitate accuracy of injection volumes. The results indicate that, under similar conditions, the RS and SIM methods provide similar sensitivities. Under the optimum conditions for each method, SIM is capable of far greater sensitivity. The choice of technique to be used depends, to a great extent, on the availability of facilities for automated data handling. The SIM method is preferable for the detection and measurement of trace quantities.

INDEX TERMS: Laboratory tests, Methodology, Chemical analysis, Organic compounds, Selective ion monitoring, Repetitive scanning, Sensitivity, Versatility, GC-Mass spectrometry, Biochemical analysis, Method evaluation, Mass spectra, Cholestane, Accuracy, Trace levels.

AMIC-7374

"ADDITIONAL STUDIES FOR THE SPECTROPHOTOMETRIC MEASUREMENT OF IODINE IN WATER", Beckman Instruments, Incorporated, Advanced Technology Operations, Fullerton, California, Report Nos. NASA-CR-128585, FR-1116-101, Contract No. NAS 9-12769, August 31, 1972, 37 pp. NTIS Report No. N73-10172.

Previous work in Iodine Spectroscopy is briefly reviewed. Continued studies of the direct spectrophotometric determination of aqueous iodine complexed with potassium iodine show that free iodine is optimally determined at the isosbestic for these solutions. The effects on iodine determinations of turbidity and chemical substances (in trace amounts) is discussed and illustrated. At the levels tested, iodine measurements are not significantly altered by such substances. The main objective of the present work--a preliminary design for an on-line, automated iodine monitor with eventual capability of operating also as a controller--is analyzed and developed in detail with respect to optics, mechanics, and circuitry. The resulting design features a single beam colorimeter operating at two wavelengths (using a rotating filter wheel). A flow-through sample cell allows the instrument to operate continuously, except for momentary stop flow when measurements are made. The timed automatic cycling of the system may be interrupted whenever desired, for manual operation. An analog output signal permits controlling an iodine generator.

INDEX TERMS: Spectrophotometry, Iodine, Pollutant identification, Water analysis, Measurement, Instrumentation, Automatic control, Turbidity, Chemical analysis, Aqueous solutions, Electronics, Automation, Halogens, Iodine-iodide spectroscopy, Automated iodine monitoring system, Chemical interference, Isosbestic point.

AMIC-7367

"DRAFT ENVIRONMENTAL STATEMENT NEW HAVEN HARBOR, CONNECTICUT MAINTENANCE DREDGING", U. S. Army Corps of Engineers, New England Division, Waltham, Massachusetts, Report No. ELR-5798, November 15, 1972, 55pp. NTIS Report No. EIS-CT-72-5798-D.

A draft environmental statement is presented which covers administrative action related to the navigational maintenance project in New Haven Harbor, Connecticut. The project is concerned with dredging in the main channel of the Harbor from Long Island Sound to Tomlinson Bridge. A description is given of the action; the environmental impact and the alternatives to such action are discussed.

INDEX TERMS: Environmental effects, Dredging, Administration, Administrative decisions, Navigable waters, Alternate planning, Waste disposal, Judicial decisions, New Haven Harbor.

AMIC-7396

"ORGANIC LOADING OF PETENWELL RESERVOIR, WISCONSIN", Kluesener, J. W., Lee, G. F., Journal of Water Pollution Control Federation, Vol. 45, No. 2, February 1973, pp 269-282.

Studies were conducted on the Wisconsin River from Nekoosa, Wisconsin, to the Petenwell Reservoir to determine organic loading to and conditions in the Petenwell Reservoir specifically during the winter period of ice cover. Determinations made using 20 sampling sites include: flow, DO, BOD, nitrogen, phosphorus, photosynthesis, and sedimentary oxygen uptake. Stream profile studies were conducted at 3 sites. The river in this area had large excesses of biodegradable materials, chiefly from pulp and paper mills, compared to the oxygen available during the periods of late summer and winter ice cover. Reaeration and photosynthesis were not sufficient to overcome the oxygen deficit. Frequently, dissolved oxygen concentrations near zero were obtained in the Wisconsin River between Nekoosa and the Petenwell flowage. In the winter under ice cover, approximately 360,000 lb (163,000 kg) of BOD entered Petenwell flowage in excess of available oxygen. This resulted in large parts of the flowage having essentially zero dissolved oxygen. The primary source of oxygen-demanding materials was the organic matter dissolved and suspended in the water. The sludge deposits and natural lake sediments were estimated to have a minor effect on the oxygen concentrations in the water.

INDEX TERMS: Dissolved oxygen, Organic loading, Pulp wastes, Ice cover, Biochemical oxygen demand, Water pollution, Pulp and paper industry, Chemical analysis, Water analysis, Organic wastes, Water pollution effects, Water pollution sources, Petenwell Reservoir, Wisconsin River.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7404

"ESTIMATING INDUSTRIAL WATER POLLUTION IN SMALL REGIONS", Greenberg, M. R., Zimmerman, R., Journal Water Pollution Control Federation, Vol. 45, No. 3, March 1973, pp 462-469.

Estimating industrial water pollution requires information on present levels of pollution and behavioral factors likely to bring about changes in the future. A model covering 26 pollution parameters was calibrated from readily available data for 2,026 plants in the New York region. The simulations produced a microspatial scale view of industrial pollution potential. Attempts to improve the model by collecting regional industrial surveys and questionnaires proved unrewarding because data remained incomplete and inconsistent with respect to location and timing of samples. The potential impact of federal regulations and technological changes on industrial effluent generation will be influenced largely by the organizational structures governing the abatement program.

INDEX TERMS: Model studies, Industrial wastes, Water pollution, Estimating, Regional analysis, Pollutant identification, Surveys, Mathematical models, Mathematical studies, Pollutants, Data collections, Data interpretation.

AMIC-7408

"EFFECT OF CHLORINE ON FLOURESCENT DYES", Deaner, D. G., Journal Water Pollution Control Federation, Vol. 45, No. 3, March 1973, pp 507-514.

A study was conducted to determine the effect of chlorine on four widely used flourescent dyes: fluorescein, rhodamine B, rhodamine WT, and pontacyl pink B. All the tests were performed in the laboratory using batch samples contained in 1-1 glass bottles. Different dye concentrations were subjected to various chlorine residuals and fluorescence intensities were measured at selected time intervals. Analysis of the results provided the following conclusions: (1) Chlorine has little effect on the fluorescence of the dyes rhodamine B and rhodamine WT at chlorine residuals normally found in practice (2 to 9 mg/l). This conclusion reflects the long-term, steady-state condition when dye and chlorine are mixed instantaneously. In cases where the dye and chlorine are added in close proximity to each other, the loss of dye may vary from that predicted from data obtained in these experiments. (2) At high chlorine residuals, quenching of fluorescence was a result of the effects of chlorine as opposed to the effects of pH change. (3) Dissipation of chlorine residuals followed the equation $C = C_0 - kt$, with k varying between 0.001/min and 0.006/min.

INDEX TERMS: Fluorescent dye, Chlorine, Water pollution effects, Laboratory tests, Fluorometry, Dye concentrations, Halogens, Fluorescence, Gases, Tracers, Dissipation rates, Rhodamine WT, Organic dyes, Rhodamine B, Fluorescein, Pontacyl pink B, Chlorine residual.

AMIC-7406

"NUTRIENT RATIO VARIATION IN RESERVOIR SEDIMENTS", Hendricks, A. C., Silvey, J. K. G., Journal Water Pollution Control Federation, Vol. 45, No. 3, March 1973, pp 490-497.

Chemical analyses were performed on a number os sediment samples collected from two sections of Garza-Little Elm reservoir, near Dallas, Texas. These analyses consisted of ash-free weights, organic carbon, Kjeldahl nitrogen, phosphates, and nitrates. The results indicated that the area richest in nutrients was in deep water where a hypolimnion existed in the summer. Cove areas were about equal in enrichment whether or not marinas were located on them. Areas along the shores demonstrated least enrichment.

INDEX TERMS: Nutrients, Sediments, Variability, Reservoirs, Aquatic soils, Soil analysis, Chemical analysis, Carbon, Texas, Sampling, Phosphates, Bottom sediments, Nitrogen, Nitrates, Hypolimnion, Garza-Little Elm Reservoir, Organic carbon, Kjeldahl nitrogen, Heterotrophy, Enrichment, Sample preparation.

AMIC-7411

"A COLORIMETRIC TECHNIQUE SUGGESTED FOR CHEMICAL OXYGEN DEMAND DETERMINATION", Chaudhuri, N., Niyogi, S., De, A., Basu, A., Journal Water Pollution Control Federation, Vol. 45, No. 3, March 1973, pp 537-541.

The feasibility and consistency of colorimetric estimation of chemical oxygen demand were investigated using a sufficiently large number of chemicals under varying test conditions. Chemicals representing carbohydrates, fats, proteins, and metabolites that are commonly encountered in domestic and industrial wastewater were selected as test substances. A Hilger pattern biochemical absorptiometer (filter type) was used. The investigation revealed a very high degree of consistency between the colorimetric and chemical oxygen demand values, with a correlation coefficient of 0.99 or above in all tests. The method suggested for use consists of (a) selecting the optimum wave length, (b) determining the colorimetric absorbance on various substrates, and (c) preforming a linear regression to calibrate the technique.

INDEX TERMS: Chemical oxygen demand, Methodology, Colorimetry, Laboratory tests, Chemical analysis, Waste water (pollution), Industrial wastes, Domestic wastes, Chemical properties, Organic compounds, Substrates, Data interpretation, Correlation coefficients.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7412

"CHEMICAL OXYGEN DEMAND OF SOME NITROGENOUS HETEROCYCLIC COMPOUNDS", Chudoba, J., Dalesicky, J., Water Research, Vol. 7, No. 5, May 1973, pp 663-668.

Chemical oxygen demands of fourteen nitrogenous compounds were determined by the dichromate method. Only pyridine and its derivatives were resistant to oxidation. Heterocyclic compounds containing one atom of nitrogen in a molecule, e.g. quinoline, pyrrole, proline, and indole were 90-100 percent oxidized. Nitrogen is split off these compounds as NH_3 . Heterocyclic compounds containing two or more atoms of nitrogen in a molecule are also easily oxidized. However, only a part of the nitrogen is split off as NH_3 . On the basis of the results obtained it is possible to make the following generalization: nitrogen in amino groups is split off mostly as NH_3 ; quinoline, pyrrole, pyrrolidine, and indole nitrogen is split off as NH_3 ; from imidazole and pyrimidine rings, one atom of nitrogen is split off as NH_3 and one as N_2 ; from the purine configuration, two atoms of nitrogen are split off as NH_3 and two atoms as N_2 ; from isoxaloxazine, three atoms of nitrogen are split off as NH_3 and one as N_2 .

INDEX TERMS: Chemical oxygen demand, Oxidation, Chemical reactions, Nitrogen compounds, Nitrogen, Organic compounds, Ammonia, Chemical properties, Methodology, Heterocyclic hydrocarbons, Organic nitrogen compounds, Pyridine, Nicotinic acid, Nicotinamide, Quinoline, Pyrrole, L-proline, Indole, D L-Tryptophan, Imidazole, L-histidine, Adenine, Uric acid, Uracil, Riboflavin, Isoalloxazine.

AMIC-7417

"SPECTROPHOTOMETRIC METHOD FOR DETERMINATION OF OZONE IN AQUEOUS SOLUTIONS", Shechter, H., Water Research, Vol. 7, No. 5, May 1973, pp 729-739.

A sensitive spectrophotometric method for determination of ozone in small volumes of water was performed in order to meet the requirements of a kinetic study of virus and bacteria inactivation by ozone. The proposed method involves oxidation of a buffered iodine solution and spectrophotometric measurement of the triiodide ion liberated by ozone. Two procedures are used: one for low ozone concentration (0.01-0.30 ppm) and another for higher concentrations (0.30-2.0 ppm). In order to establish the precision of the proposed method, 6 parallel determinations were carried out, in a consecutive order, at different O_3 concentrations (0.05-0.33 ppm and 0.23-1.92 ppm). Reproducibility was found to be very high when the procedure used corresponds with the ozone level for which it was intended. The comparative results obtained from ozone determinations by spectrophotometry using neutral KI reagent or Mast reagent, and by the standard volumetric method showed the volumetric readings to be greater than those of spectrophotometry. Some applications of the method for a kinetic study of virus inactivation by ozone are presented and the optimal conditions for such applications have been established.

INDEX TERMS: Spectrophotometry, Ozone, Methodology, Kinetics, Aqueous solutions, Pollutant identification, Water analysis, Oxidation, Viruses, Volumetric analysis, Chemical analysis, Chemical reactions, Disinfection, Bacteria, Water temperature, Cultures, Inactivation, Reproducibility, Dissolved gases, Sensitivity, Mast reagent, Method evaluation, Stirring rate.

AMIC-7418

"DETERMINATION OF CARBOHYDRATE IN LAKE SEDIMENT BY A MODIFIED PHENOL-SULFURIC ACID METHOD", Liu, D., Wong, P. T. S., Dutka, B. J., Water Research, Vol. 7, No. 5, May 1973, pp 741-746.

A spectrophotometric method for the assay of carbohydrates in lake sediments and soil is described that is based on the measurement of color development in phenol-sulfuric acid at 485 nm. Sediment core samples were taken with a Benthos corer from Lake Erie and Lake Ontario, stored at 4 C and extruded within 48 h of collection. Samples (10 g) from each subsection (0-2, 5-7, 10-12, and 20-22 cm) were processed immediately for carbohydrate and dry weight determination. Dry weights were obtained by heating the sample overnight at 105 C. Distilled water and phenol solution were added to a 2-50 mg wet weight sample and thoroughly mixed. Concentrated H_2SO_4 was added to the mixture which was subsequently allowed to stand at room temperature for 10 minutes. It was centrifuged for another 10 minutes and carbohydrate determinations were made as stated above. Studies of the effects of phenol and carbohydrate on the method showed 100 mg phenol/sample and 0-100 micrograms carbohydrate gave the best results. This highly reproducible and sensitive assay technique requires only 20 minutes and as little as 2 mg wet weight of sample.

INDEX TERMS: Carbohydrates, Lake sediments, Chemical analysis, Spectrophotometry, Methodology, Sampling, Color reactions, Phenol-sulfuric acid method, Sample preparation, Reproducibility, Sensitivity.

AMIC-7421

"OIL POLLUTION SOURCE IDENTIFICATION", Lieberman, M., Esso Research and Engineering Company, Government Research Division, Florham Park, New Jersey, Report No. EPA-R2-73-102, Contract No. 68-01-0058, February 1973, 175pp.

A study was conducted to evaluate and develop a method for the identification of sources of oil pollution. The method is based on the comparison of certain stable chemical indices present in unweathered suspect oil pollution sources and the weathered pollution sample. Five different crude oils, two residual fuel oils (a No. 4 and a No. 5 oil) and one distillate fuel oil (a No. 2 oil) were subjected to simulated weathering in the laboratory. Samples were weathered for 10 and 21 days at 55 and 80 degrees F, under high and low salt water washing rates. "Weathered" and "unweathered" oil samples were analyzed by low voltage mass spectroscopy (polynuclear aromatics), high voltage mass spectroscopy (naphthenes), gas chromatography (n-paraffins), emission spectroscopy (nickel/vanadium), X-ray tot sulfur and Kjeldahl total nitrogen techniques. Several compound indices were found to be stable after laboratory simulated weathering and showed the ability to help discriminate between pairs of oils used in the study. Discriminant function analysis was used to select the best compound indices for distinguishing among the oils used in the study.

INDEX TERMS: Pollutant identification, Water pollution sources, Oil pollution, Oil spills, Laboratory tests, Methodology, Weathering, Environmental effects, Statistical methods, Oil fingerprinting, Discriminant function analysis, Aromatic hydrocarbons, Fuel oil, Petroleum residues, Oil characterization, Nigerian crude oil, Aliphatic hydrocarbons, Petroleum products, Chemical composition.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7424

"QUANTITATIVE INFRARED SPECTROPHOTOMETRY OF ORGANIC NITRATE ESTERS", Carignan, Y. P., Hickman, C. L., IV, Picatinny Arsenal, Dover, New Jersey, Technical Report No. PA-TR-4350, May 1972, 75 pp. NTIS Report No. AD 753 938.

A quantitative infrared analysis of the N double bond O asymmetric stretching vibration band for the nitrate esters, ethyl nitrate, amyl nitrate, ethylene glycol dinitrate, glycerol trinitrate, and cellulose nitrate (12.53 percent) is presented. Two solvents, spectrograde chloroform and tetrahydrofuran, were used in the preparation of the solutions. For the five nitrate esters studied, Beer's law for the absorbance of the N double bond O asymmetric stretching band was found to be generally obeyed. From a measure of the absorbance one could calculate the amount of a given nitrate ester present in solution. The band shape for cellulose nitrate was significantly broader and consequently measurement of the absorbance at the band maximum was not a true indication of the absorption intensity. A more realistic measurement would be the integrated intensity of the band.

INDEX TERMS: Nitrates, Organic compounds, Nitrogen compounds, Nitrate esters, Infrared spectrophotometry, Infrared spectra, Organic nitrogen compounds, Ethyl nitrate, Amyl nitrate, Ethylene glycol dinitrate, Glycerol trinitrate, Cellulose nitrate, Absorbance, Organic solvents, Chloroform, Tetrahydrofuran, Quantitative analysis.

AMIC-7432

"SPECTROPHOTOMETRIC INVESTIGATION OF PLUTONIUM (III) IONS IN AQUEOUS SOLUTIONS OF VARIOUS ACIDS", Halloff, E., FOA Reports, Vol. 6, No. 12, November 1972, pp 1-4. NTIS Report No. PB 213 539.

An investigation was conducted to determine whether and to what extent the absorption spectrum of plutonium (III) ions in aqueous solution is affected by different acids (anions). A concentration of 1.000-molal was kept constant during all experiments which utilized the following media: hydrochloric, nitric and perchloric acids. Hydroxylamine hydrochloride was added to the media to prevent the oxidation of plutonium (III) ions. The absorption spectrum was recorded between 200 and 1300 nm using a spectrophotometer. Molal absorptivity values at the major absorption peaks are given separately for each medium. An investigation was performed to test whether possible shifts in the wavelength of absorption maxima and discrepancies in the molal absorptivities caused by the different anions are significant. The concentration interval of plutonium (III) ions was 0.25-5.00 mg per gram of solution.

INDEX TERMS: Spectrophotometry, Chemical analysis, Aqueous solutions, Cations, Anions, Inorganic compounds, Pollutant identification, Inorganic acids, Plutonium, Absorption spectra, Transuranium elements, Molar absorptivity, Hydroxylamine hydrochloride, Hydrochloric acid, Nitric acid, Perchloric acid.

AMIC-7430

"CRUDE OIL BEHAVIOR ON ARCTIC WINTER ICE", McMinn, T. J., U. S. Coast Guard Headquarters, Washington, D. C. Report No. USCG-734108, September 1972, 53 pp. NTIS Report No. AD-754 261.

Oil spill behavior in an Arctic winter environment was investigated using several small controlled oil spills during January 1972 on the Bering Sea in Northwestern Alaska. To duplicate a real world spill as closely as possible, a Prudhoe Bay crude oil was used as the test oil. Investigated were oil spread rate on snow and ice, oil absorption into snow and ice surfaces, aging of oil on snow and ice surfaces, and effectiveness of various cleanup procedures. The experimental results on oil spreading rate validated the theoretical assumption that only gravity and inertia forces must be considered when predicting spread rate. This rate is independent of oil properties and is not affected by temperature. Absorption of oil into the snow or ice surface is minimal; the only substantial penetration was found where a physical surface indentation existed. The temperature differential between the oil upon spilling and the surface causes a melting and refreezing of the snow surface, blocking pore channels. The aging rate of oil on ice is decreased when compared to temperate climate aging. However, the winter aging rate is significant and should not be discounted. It has been determined that the density of crude oil will increase with time, eventually becoming more dense than sea ice (.901 gm/ml) and sea water (1.04 gm/ml). Artificial cleanup agents such as sorbents, dispersants, surface active agents, and burning agents are of little or no practical use in extreme temperature (cold) conditions found in the Arctic winter. Burning agents were found to increase the cleanup effort required due to the additional residue contributed by the agents themselves.

INDEX TERMS: Ice cover, Snow cover, On-site tests, Oil spills, Crude oil, Fate of pollutants.

AMIC-7434

PRELIMINARY REPORT, (RV THOMAS G) THOMPSON CRUISE 66", Campbell, S., Millar, R. M., Owens, T., University of Washington, Department of Oceanography, Seattle, Washington, Report Nos. PCR-66, Ref-M72-28, Contract No. N 00014-67-A-0103-0014, Grant No. NSF-GA-24875, May 1972, 9 pp. NTIS Report No. AD 754 843.

Cruise 66 of the Thomas G. Thompson was the sixth in a series of cruises to the oxygen deficient waters of the eastern tropical North Pacific Ocean. The major objectives of the cruise were to: (a) provide information on the variability of the transport of the products of denitrification out of the oxygen deficient region and determine the magnitude of the transport of these products by the California Undercurrent. (b) provide nitrate and nitrite data from a number of areas where such information was previously unavailable. (c) determine whether or not gaseous nitrogen is the main sink for the nitrate consumed during denitrification by the precise measurement of N/Ar and N-14/N-15 ratios, dissolved and particulate organic nitrogen, nitrate and nitrite. (d) estimate respiration rates by obtaining profiles of the activity of the respiratory electron transport system both as a function of depth and latitude. (e) determine the effects of pressure and temperature on the electron transport system, and (f) obtain depth profiles of chlorophyll in plankton. The methods employed for the analyses are briefly described. However, no data are included.

INDEX TERMS: Denitrification, Sea water, Nitrates, Chlorophyll, Respiration, Nitrites, Electron transport.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7440

"NEUTRON ACTIVATION ANALYSIS OF BOTTOM SEDIMENTS", Moore, R. V., Prophet, O. W., U. S. Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, Georgia, Report No. EPA-R2-73-009, March 1973, 20 pp.

Instrumental neutron activation analysis (INAA) was applied to bottom sediments obtained from 17 locations (small and large rivers, a canal, coastal waters, and a bay) within the United States to determine the applicability of INAA to water pollution studies. Irradiations of 30 seconds and 60 minutes, followed by three pulse-height analyses of gamma radiation, detected and measured up to 43 elements including most elements of interest. Decay times did not exceed seven days. Sample handling was minimal. Elements readily analyzed are Al, As, Au, Ba, Br, Cl, Co, Cr, Dy, Fe, K, La, Mg, Mn, Na, Sb, Sm, Th, Ti, and V. Elements that could be analyzed, but for which optimum conditions of analysis (length of irradiation, time of decay, time for counting, and type of detector) were not used, were Ag, Ca, Cd, Ce, Cs, Cu, Eu, Hf, Hg, I, Lu, Mo, Nd, Rb, Se, Sr, Te, U, W, Yb, and Zn. At least 30 elements can be determined in duplicate for about 120 dollars per sample with optimum laboratory utilization and number of samples.

INDEX TERMS: Chemical analysis, Soil analysis, Bottom sediments, Methodology, Pollutant identification, Aquatic soils, Rivers, Bays, Saline soil, Canals, Heavy metals, Alkali metals, Alkaline earth metals, Water pollution, Halogens, Instrumental neutron activation analysis, Rare earth elements, Coastal waters, Sample preparation.

AMIC-7442

"RUNOFF OF OILS FROM RURAL ROADS TREATED TO SUPPRESS DUST", Freestone, F. J., U. S. Environmental Protection Agency, Edison Water Quality Research Laboratory, Edison, New Jersey, Report No. EPA-R2-72-054, October 1972, 29 pp.

Two rural roads in Readington Township, Hunterdon County, New Jersey which have been treated with waste crankcase oils, were examined to determine whether the oil leaves the road and if so, the possible effects on surrounding land and water. The history of the oilings and the types and application rates were reviewed. Test roads were sampled to determine the concentration of oil vs. depth and to calculate the loss of oil to other areas via volatilization, runoff, biodegradation, adhesion to vehicles, and dust transport. Runoff studies were conducted in the laboratory with simulated rain on oiled road samples. Since waste crankcase oil contains up to 1 percent lead, samples of soil, plants, water and aquatic organisms (mayflies, stoneflies, crane flies, blackflies, caddisflies, and crayfish) surrounding the oil-treated roads were analyzed for lead concentration. Analyses indicated that roughly one percent of the total oil estimated to have been applied remains on the top inch of road surface material, that oil penetration below the top inch of road was minimal, and that lead was concentrated (approximately 200 mg/kg) in the top inch of road material. Laboratory weathering experiments indicate an estimated maximum weathering loss of oil from a road would be approximately 18 percent. Rain runoff studies on simulated rural road surfaces indicated two mechanisms by which oil is transported from the road: leaching of the oil by flotation, and flotation of oil-wet soil particles. The greatest oil transport is during the first few rains after oil application with continuous, low level leaching during each subsequent rain. Analysis of soil samples taken from a field subjected to runoff from an oiled road showed significantly higher

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lead content than soil taken from a field 150 feet from the road. Soil plant and water samples surrounding the roads contained lead concentrations which apparently resulted from the road oiling. No conclusions could be made regarding lead concentrations in aquatic organisms.

INDEX TERMS: Environmental effects, Oil pollution, Roads, Lead, Aquatic insects, Crayfish, Runoff, Road oiling, Crankcase oil, Transport, Mayflies, Blackflies.

AMIC-7482

"A SURVEY OF DISPERSION COEFFICIENTS FOR ESTIMATING POLLUTANT TRANSPORT", Keen, K., Grumman Aerospace Corporation, Bethpage, New York, Report No. RM-562, December 1972, 40 pp. NTIS Report No. AD-754 010.

A review is presented of a number of studies dealing with the diffusion and dispersion of pollutants in oceans, in rivers, and in estuaries. Details of the mathematical models are discussed. Experimental methods for measuring dispersion are also considered. These generally employ a tracer such as a dye or a radioactive material which is observed at certain distances. Although a number of attempts have been made, the author concludes that no reliable analytical method exists for defining the dispersion coefficient in estuaries.

INDEX TERMS: Methodology, Mathematical models, Measurement, Reviews, Pollutants, Oceans, Rivers, Estuaries, Dispersion coefficients.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7485

"PROGRESS REPORT OF RESIDUE STUDIES ON ORGANIC ARSENICALS USED FOR DITCHBANK WEED CONTROL", Salman, H. A., Bartley, T. R., Summers, A. D., Bureau of Reclamation, Denver Colorado, Report No. REC-ERC-72-37, November 1972, 8 pp. NTIS Report No. PB214-051.

Monosodium methanearsonate (MSMA) was applied to the ditchbanks of full and dewatered irrigation systems on the Rio Grande Project to control ditchbank weeds and to determine the MSMA residues in irrigation water. Information obtained was to provide support for the registration of organic arsenicals used for weed control along full and/or dewatered ditchbanks. Water samples were analyzed for total arsenic content after sulfuric-nitric acid digestion by the silver diethyldithiocarbamate method. Maximum arsenic concentrations found in the first water released through dewatered laterals were 0.54, 0.12, and 0.29 ppm, dropping below the mandatory U. S. Public Health Service Drinking Water Standards for arsenic within 10 minutes. Maximum arsenic concentrations in full systems following MSMA herbicide application to ditchbanks were 0.16, 0.17, and 0.86 ppm, but dropped rapidly after a period of time. Test results show that low levels of arsenic occur in irrigation water for short periods of time following ditchbank applications of MSMA. Theoretical calculations indicate that from 0.002 to 0.04 lb of arsenic per acre of treatment could reach the farmland during a 24-hour period using 6 inches of irrigation water.

INDEX TERMS: Water analysis, Irrigation canals, Weed control, Irrigation water, Monosodium methanearsonate, Sample preparation.

AMIC-7488

"THE STUDY OF THE PHOTODEGRADATION OF COMMERCIAL DYES", Porter, J. J., Clemson University, Department of Textiles, Clemson, South Carolina, Report No. EPA-R2-73-058, March 1973, 94 pp.

The stability of thirty-six different commercial dyes in water to visible and ultraviolet light from a carbon arc has been studied. The dyes were selected on the basis of their importance in the textile industry from six major classes: basic, acid, direct, vat, disperse and sulfur dyes. A comparison is made for two of the dyes between laboratory fading rates and fading rates in natural sunlight. Both dyes degraded at least 10 times more rapidly in artificial light than in sunlight. Some previously identified degradation products of Basic Green 4 were confirmed, and a mechanism of their formation was proposed. A significant difference in degradation rate was observed between water-soluble dyes and pigment dispersions. This study showed that most commercial colors are resistant to photodegradation and many weeks would be required to produce appreciable dye degradation in a natural aquatic environment.

INDEX TERMS: Kinetics, Gas chromatography, Mass spectrometry, Spectrophotometry, Photodegradation, Sample preparation, Chemical structure, Basic dyes, Direct dyes, Vat dyes, Acid dyes, Disperse dyes, Sulfur dyes.

AMIC-7492

"A SHORT SURVEY OF THE ENVIRONMENT AT THE DUMPING SITE FOR SANTA CRUZ HARBOR DREDGING", Arnal, R. E., California State University, Moss Landing Marine Laboratory, Fresno, California, Report No. CASUC-MLML-TP-72-06, Grant No. 2-35137, 1972, 18 pp. NTIS Report No. COM 73 10160.

A short survey was conducted of a small craft harbor in Santa Cruz by Moss Landing Marine Laboratories at the dumping site of dredge spoil prior to dumping. Some monitoring was also done at the dumping site during dredging operations. Dredging was performed with a pipe dredge that delivered the dredge spoil by means of a floating pipeline more than 3,000 feet long to the dumping site where the end of the pipe was always located near the bottom. Surface water current measurements were made at bi-weekly intervals for a full yearly cycle. A total of 60 samples were collected at the dredge site; 49 were processed by mechanical analysis for sedimentary characteristics. The percentage of organic content of the sediment was determined by the rapid potassium dichromate oxidation method (Allison, 1935). The survey of benthic fauna was conducted by sampling with a Peterson grab using a 25-foot inboard motor boat equipped with a hydraulic winch. Samples were preserved in 10 percent buffered formaldehyde, dyed with Rose Bengal, processed by sieving, sorted according to major groups, and the biomass calculated. The sediment at the dredge site has a very high organic content regardless of the size of the sediment particles. There was also a high biomass value at the disposal site and surrounding area.

INDEX TERMS: Benthic fauna, Dredging, Bottom sediments, Monitoring, Surveys, Bottom sampling, Organic matter, Biomass, Environmental effects, Soil analysis, Santa Cruz Harbor, Marine environment.

AMIC-7498

"ANNOTATED BIBLIOGRAPHY OF LAKE ONTARIO LIMNOLOGICAL AND RELATED STUDIES - VOL. III - PHYSICAL", Baldwin, J., Sweeney, R. A., State University College at Buffalo, Great Lakes Laboratory, Buffalo, New York, Report No. EPA-R3-73-028c, March 1973, 207 pp.

Four hundred thirty-nine (439) papers concerning physical 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, parameters, techniques and instrumentation. 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.

INDEX TERMS: Bibliographies, Documentation, Lake Ontario, Publications, Data collections, Physical properties, Instrumentation, Methodology, Physical limnology.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7506

"REMOVAL OF OIL FROM WATER SURFACES BY SORPTION ON UNSTRUCTURED FIBERS", Johnson, R. F., Manjrekar, T. G., Halligan, J. E., Environmental Science and Technology, Vol. 7, No. 5, May 1973, pp 439-443.

The capacity of unstructured fibers to remove crude oil from seawater was found to be related to the chemical composition and surface properties of the fibers as well as the concentration, specific gravity, and temperature of the crude oil. The sorption capabilities of cotton exceeded those observed for all of the other synthetic and natural fibers tested. The amount of oil sorbed increased as the denier of the fiber decreased for all of the materials tested. For the data available, the critical surface tension of the solid sorbent was also related to the amount of oil sorbed. Cyclic sorption/desorption studies indicated that a simple squeezing operation was sufficient to remove most of the oil sorbed on the fibers and that recycling was feasible.

INDEX TERMS: Sorption, Oil spills, Sea water, Methodology, Oil pollution, Fibers (plant), Physical properties, Oil removal, Crude oil, Unstructured fibers, Synthetic fibers, Natural fibers, Cleanup.

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INDEX TERMS: Nitrogen, Sulfur, Carbon, Phosphorus, Chemical analysis, Methodology, Aqueous solutions, Hydrogenation, Chemical reactions, Biological materials, Chemical composition, Sample preparation, Hydrides, Flame photometric gas chromatography, Precision, Electrolytic conductivity gas chromatography.

AMIC-7507

"DETERMINATION OF NITROGEN, SULFUR, PHOSPHORUS, AND CARBON IN SOLID BIOLOGICAL MATERIALS VIA HYDROGENATION AND ELEMENT-SELECTIVE DETECTION", Horton, A. D., Shults, W. D., Meyer, A. S., Matthews, D. R., Environmental Science and Technology, Vol. 7, No. 5, May 1973, pp 449-451.

A rapid method for the simultaneous determination of nitrogen (N), sulfur (S), and carbon (C), and for the separate determination of phosphorus (P), in solid biological field specimens has been developed. No pretreatment of the samples other than freeze- or oven-drying and grinding to less than 40 mesh is required. Samples are weighed into quartz boats and introduced into a Dohrmann pyrolyzer that contains a platinum catalyst through which hydrogen flows and serves as both reactant and carrier. The elements N, S, P, and C are reduced to their respective hydrides. The effluent from the pyrolyzer is split: one portion passes to a flame photometric detector which responds to H₂S, PH₃, and CH₄; the other portion passes to a Coulson electrolytic conductivity detector which responds to NH₃. The average coefficient of variation for triplicate determinations of forest floor litter, the most common field specimen, is 1.4 percent for C, 5.8 percent for N, and 5.5 percent for S. Analysis time, exclusive of weighing and purging, is 6-8 minutes per sample with an 8-hr load of 25 samples, including the necessary standards. This system of pyrolysis and catalytic hydrogenation will reduce P, S, N, and C in inorganic compounds also. Water solutions of sodium sulfate, sulfuric acid, phosphoric acid, copper sulfate, sodium nitrate, and potassium dihydrogen phosphate were injected into boats and the water was allowed to evaporate before inserting the boat into the hot zone of the pyrolyzer. The response of the detector to the elements was approximately the same as that for equal amounts of the organically based elements.

AMIC-7509

"MEASUREMENT OF EXCHANGEABLE INORGANIC PHOSPHATE IN LAKE SEDIMENTS", Li, W. C., Armstrong, D. E., Harris, R. F., Environmental Science and Technology, Vol. 7, No. 5, May 1973, pp 454-456.

The amounts of isotopically exchangeable inorganic phosphate in a range of Wisconsin lake sediments were measured in two contrasting (long- and short term) equilibration systems. The systems differed in equilibration times, oxidation reduction conditions, and the degree of agitation. Total sediment P was determined by Na₂CO₃ fusion, total organic P by the Mehta extraction procedure, and total inorganic P as the difference between total P and total inorganic P. Dissolved inorganic P in sediment extracts and in sediment-water equilibration systems was measured by the method of Murphy and Riley (1962). Levels of total exchangeable inorganic P were similar for the two systems, indicating that the simplified short-term equilibration method was suitable for routine measurements of exchangeable inorganic P. Differences between the two systems in the distribution of exchangeable P between the solid and solution phases were apparently related to differences in oxidation-reduction conditions. Exchangeable inorganic P ranged from 18-65 percent of the total inorganic P in the sediments investigated.

INDEX TERMS: Phosphates, Lake sediments, Methodology, Measurements, Pollutant identification, Sediment-water equilibration systems.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7511

"ULTRAPURITY IN TRACE ANALYSIS", Mitchell, J. W., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 492-500.

In this report an attempt is made to provide a current reference for analytical chemists, materials scientists, and others responsible for the preparation or practical characterization of ultrapure materials. A summary of procedures used in this laboratory for trace analysis and other recent advances in methods and techniques are presented, major obstacles to extending the limits for determining trace elements are discussed, and developments required in the future are treated.

INDEX TERMS: Analytical techniques, Trace elements, Reviews, Quality control, Chemical interference, Reagents, Ultrapure water, Blanks, Sample preparation, Detection limits.

AMIC-7514

"ANODIC STRIPPING VOLTAMMETRY AT A TUBULAR MERCURY-COVERED GRAPHITE ELECTRODE", Seitz, W. R., Jones, R., Klatt, L. N., Mason, W. D., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 840-844.

A procedure was developed for preparing a tubular mercury-covered graphite electrode (TMCGE) for doing anodic stripping voltammetry (ASV) in flowing system. The TMCGE was evaluated using thallium in the presence of .01 M EDTA to mask other metals. The effects of varying plating potential, plating time and flow rate on the TI stripping peak were as theoretically expected, and linear calibrations of TI peak height vs concentration were obtained over the ranges 2-10 times 10 to the minus 7 M, 2-10 times 10 to the minus 8 M, and 2-10 times 10 to the minus 9 M at plating times of 3, 8 and 30 minutes, respectively. The current at any point in the tubular electrode with a flowing system is proportional to one over the cube root of the distance from the upstream end of the tube. Since the upstream end of the TMCGE has the highest current density of any point in the tube, impurities accumulate in this region causing this part of the mercury surface to deteriorate more rapidly.

INDEX TERMS: Water analysis, Sea water, Calibrations, Anodic stripping voltammetry, Thallium, Masking, Chemical interference, Tubular mercury-covered graphite electrode.

AMIC-7513

"COPPER DETERMINATION IN WATER BY STANDARD ADDITION POTENTIOMETRY", Smith, M. J., Manahan, S. E., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 836-839.

Potentiometric techniques are described which are applicable to the analysis of tap water and natural waters for very low levels of copper. An Orion Model 94-29A solid-state cupric ion electrode was used in the analysis. Tap water samples were analyzed directly from the tap; natural water samples were first filtered, a complexing antioxidant buffer (CAB) was added, and the potential was allowed to equilibrate. The initial electrode potential and the potentials after each of 3 additions of standard Cu were recorded. The determination of copper in water samples using standard addition techniques with an ion selective electrode was facilitated through the use of CAB. With the method, copper in tap water has been determined at concentrations down to 9 ppb. Copper at a level of 9.0 ppb added to natural water samples containing between 3.3 and 46.8 ppb was analyzed with an average percent recovery of 102.9 percent and a relative standard deviation of 7.5 percent. Reagent purity is a major limiting factor in the analysis, and detailed directions are given for preparing the copper-free reagents required in the analysis.

INDEX TERMS: Copper, Potable water, Water analysis, Methodology, Chemical analysis, Natural waters, Standard addition potentiometry, Trace levels, Cupric ion electrode, Chemical recovery.

AMIC-7515

"DETERMINATION OF PHENOLS AND AROMATIC AMINES BY DIRECT TITRATION WITH BROMINE IN PROPYLENE CARBONATE", Krause, R. D., Kratochvil, B., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 844-848.

Propylene carbonate is used as a medium for bromine substitution reactions. A series of aromatic amines and phenols were determined with accuracies of about 1 percent and precisions of a few ppt. A base such as pyridine must be present to accept protons released in the substitutions. Advantages include rapidity of the reactions, solubility of reactants and products, and convenient standardization of bromine with solutions of bromide. The log formation constant of Br3(-) in propylene carbonate at zero ionic strength is 7.37.

INDEX TERMS: Volumetric analysis, Phenols, Bromine, Propylene carbonate, Aromatic amines, Stoichiometry, 2-Naphthol, p-Nitrophenol, Salicylic acid, Methyl salicylate, p-Cresol, Thymol, Resorcinol, Cresols, Aniline, p-Nitroaniline, Anthranilic acid, n-Phenylenediamine, p-Toluidine, p-Phenetidine.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7516

"SELECTIVE DETERMINATION OF COPPER (II) IN AQUEOUS MEDIA BY ENHANCEMENT OF FLASH-PHOTOLYTICALLY INITIATED RIBOFLAVIN CHEMILUMINESCENCE", Wehry, E. L., Varnes, A. W., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 848-851.

Copper(II) is determined in aqueous media (pH 6.0) by measuring its enhancement of riboflavin chemiluminescence in systems containing hydrogen peroxide and p-dioxane. The chemiluminescence is initiated by flash photolysis of the reaction system. The light source employed was a microsecond-duration xenon flashtube. Interfering ions are Co(II), Ag(I), Hg(I), and Hg(II); other common metal ions do not significantly interfere. The effects of other experimental parameters (anions, organic solvents, pH, buffer composition, initiating flash energy) are evaluated. The minimum detectable quantity of copper is 30 nanograms. The sensitivity and selectivity of light- and chemically-induced riboflavin chemiluminescence methods are compared; the light-induced system is concluded to be superior. The results suggest that flash photolysis, widely employed in mechanistic photochemistry, also has useful analytical potentialities.

INDEX TERMS: Copper, Aqueous solutions, Selectivity, Pollutant identification, Chemical analysis, Heavy metals, Cations, Anions, Alkali metals, Alkaline earth metals, Chemiluminescence, Riboflavin, Flash photolysis, Detection limits, Organic solvents, Photochemistry, Chemical interference, Sensitivity, Complexing agents, Precision, Buffers.

AMIC-7520

"GAS CHROMATOGRAPH PEAKS IDENTIFIED ON-LINE BY A NEW GRATING INFRARED SPECTROPHOTOMETER", Penzias, G. J., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 890-895.

A new, double-beam ratio recording grating infrared spectrophotometer that scans from 2.5 to 15 micrometers in 6 seconds has been developed. It is designed to identify eluting gas chromatograph fractions on-line for routine analysis. Heated sample and reference cells are integral with the spectrophotometer, which utilizes a rapid-response, room-temperature detector. The new instrument was used to record infrared spectra of eluting GC fractions of various samples including coatings, paints, polymers, and other organic compounds (polystyrene film, phenolic epoxy solvent, methyl ethyl ketone, ethanol, methyl isobutyl ketone, toluene, n-butanol, m-xylene, o-xylene, acetone, methanol, isoamyl acetate, p-tolualdehyde, aniline, and valeraldehyde). Components of unresolved GC peaks were identified by scanning several spectra during the elution of a single peak. Fractions as small as 0.02 microliter were identified (e.g., a 1 percent component of a 2-microliter sample injected into the gas chromatograph).

INDEX TERMS: Laboratory equipment, Automation, Organic compounds, Pollutant identification, GC-Infrared spectroscopy, Methyl ethyl ketone, Toluene, n-Butanol, m-Xylene, o-Xylene, Methanol, Isoamyl acetate, p-Tolualdehyde, Aniline, Valeraldehyde, Ethanol, Methyl isobutyl ketone.

AMIC-7524

"NEW PICOGRAM DETECTION SYSTEM BASED ON A MASS SPECTROMETER WITH AN EXTERNAL IONIZATION SOURCE AT ATMOSPHERIC PRESSURE", Horning, E. C., Horning, M. G., Carroll, D. I., Dzidic, I., Stillwell, R. N., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 936-943.

A novel mass spectrometer with an external ionization source can be used to detect picogram quantities of compounds of biological interest. The source contains a Ni-63 foil, and is at atmospheric pressure. Samples are introduced in a flowing gas stream in selected common solvents. Positive ions are formed by a complex series of ion molecule reactions. The ionization reaction for the sample may involve either proton transfer or charge transfer. Negative ions are formed by either resonance or dissociative capture of thermal electrons, or by ion-molecule interactions. In a favorable case (very little absorption on the reaction chamber walls), 5-10 picograms could be detected by single ion monitoring, and a scanned mass spectrum could be obtained with as little as 25 picograms. The potential uses include incorporation into LC-MS-COM and GC-MS-COM analytical systems. Cocaine, methadone, butabarbital, pentobarbital, phenobarbital, and secobarbital were analyzed in chloroform solvent, 2, 6, dimethyl-alpha-pyrone and testosterone were analyzed in benzene solvent, and phenobarbital, hydroxyphenobarbital, and dihydroxyphenobarbital were analyzed in rat urine extract.

INDEX TERMS: Pollutant identification, Urine, LC-mass spectrometry, GC-mass spectrometry, Detection limits, Cocaine, Methadone, Butabarbital, Pentobarbital, Phenobarbital, Secobarbital, 2,6 dimethyl-alpha-pyrone, Testosterone, Hydroxyphenobarbital, Dihydroxyphenobarbital.

AMIC-7525

"IMPROVED METHOD FOR CHARACTERIZING ENVIRONMENTAL HYDROCARBONS BY GAS CHROMATOGRAPHY", Zafiriou, O. C., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 952-956.

Routinely correlating environmental hydrocarbons from natural waters by gas chromatography requires optimal resolution and separation of weathering resistant components, operational simplicity, and good precision. Methods for comparing results from different columns must precede spectral libraries. A novel method of protecting columns from sample residues involves injecting solutions of oil rich samples into a capillary injection/splitter with disposable glass liner operated at 175 C; reproducible results are obtained without sample cleanup. Temperature programmed OV-101 support-coated open tubular columns and FID detection yield excellent characterization. Characteristic signal intensity ratios have long-term relative standard deviations of 1.8-4 percent, 0.7 percent has been achieved short term. Ratios from three columns were similar enough for comparison directly or with a standard. The performance attained is adequate to correlate artificially weathered oils with sources and to differentiate most of thirty oils found in a major port. Extensions and improvements of the method are discussed.

INDEX TERMS: Methodology, Pollutant identification, Water analysis, Oily water, Hydrocarbons, Flame ionization gas chromatography, Petroleum products, Crude oil, Environmental samples, Precision, Reproducibility, Oil characterization, Sample preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7529

"GAS CHROMATOGRAPHIC AND MASS SPECTROMETRIC STUDIES OF S-ALKYL DERIVATIVES OF N,N-DIALKYL DITHIOCARBAMATES", Onuska, F. I., Boos, W. R., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 967-971.

Flame ionization gas chromatography and gas chromatography-mass spectrometry (GC-MS) have been used to separate mixtures by S-alkylated N, N-dialkyl dithiocarbamates. The gas chromatographic retention data are tabulated. A non-polar liquid phase such as Apiezon L was found to be quite suitable for separation. The mass spectral data obtained from the peaks eluted from the gas chromatographic column provided fragmentation patterns of the respective S-methyl DTC, S-ethyl DTC, or S-n-propyl DTC depending on the alkylating agent. These derivatives are easily separated by GC. The electron impact-induced fragmentation of the majority of DTC derivatives is consistent with bond rupture directed by the presence of bivalent sulfur in these molecules. It is very difficult to draw a simple decomposition path using tandem GC-MS because N,N-dialkyl dithiocarbamates are thermally very unstable.

INDEX TERMS: Pollutant identification, Herbicides, Pesticides, Chemical analysis, Separation techniques, GC-Mass spectrometry, S-ethyl N N-dialkyl dithiocarbamates, Flame ionization gas chromatography, S-n-propyl N N-dialkyl dithiocarbamates.

AMIC-7534

"LIQUID-LIQUID EXTRACTION OF CADMIUM WITH HIGH-MOLECULAR-WEIGHT AMINES FROM IODIDE SOLUTIONS", McDonald, C. W., Moore, F. L., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 983-985.

The extraction behavior of cadmium from acidic and alkaline aqueous iodide solutions was studied using four classes of high-molecular-weight amines. The amines investigated were Primene JM-T, Primene 81-R, Amberlite LA-1 (N-dodecenyldiethylmethylamine), Alamine 336-S (tricaprylamine), and Aliquat 336-S (tricaprylmethylammonium chloride). These were dissolved in xylene and converted to iodide salts. Preliminary tests were conducted with aqueous solutions containing Cd-109 labelled cadmium chloride. With acid solutions, all amines except Primene JM-T extracted quantitatively. With alkaline solutions, only Aliquat 336-S extracted quantitatively with Primene 81-R showing very high extractability. Aliquat 336-S, therefore, was used in additional studies to determine the effect of pH, HI concentration, and concentration of extractant on cadmium extraction. Ammonium hydroxide, 5 percent ethylenediamine, and 0.1 M cysteine-1 M sodium hydroxide, each proved to be excellent extractants of cadmium from the Aliquat 336-S-I-xylene solutions. Further studies with solutions containing cadmium and mercury and extracted with Aliquat 336-S-I-xylene showed that the mercury and cadmium could be separated by stripping the cadmium with ammonium hydroxide or ethylenediamine and then stripping the mercury with alkaline cysteine.

INDEX TERMS: Separation techniques, Mercury, Cadmium, Aqueous solutions, Radioactivity techniques, Amines, Chemical recovery, Stripping.

AMIC-7535

"2,4,6-TRIPHENYLPYRYLIUM CHLORIDE] A NEW ORGANIC ANALYTICAL REAGENT FOR THE DETERMINATION OF CERTAIN ANIONS", Chadwick, T. C., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 985-986.

A simple synthesis of water-soluble 2,4,6-triphenylpyrylium chloride (TPC) has been devised and a study made of its behavior with a number of anions. Of two gravimetric procedures devised, the one which involves a determination of boric acid by conversion to tetrafluoroboric acid and subsequent precipitation has served to illustrate the utility of the new reagent, TPC. The other procedure involves a direct precipitation of perchlorate ion. TPC was found to give precipitates with iodide, thiocyanate, permanganate, dichromate, and ferrocyanide anions and also with the anionic chloro complexes of Zn(II), Sn(II), Pb(II), Cd(II), Pt(IV), and Au(III). Fluoride, bromide, iodate, chlorate, sulfate, and oxalate anions and the chloro complex of iron (III) failed to react with TPC under similar conditions. These experiments show that the reagent behaves very much like nitron and the tetraphenylarsonium, -phosphonium, and -stibonium chlorides. Perchlorate analyses were carried out using only a small (25 percent) excess of reagent to ensure complete precipitation. The precipitate was dried at 110 C without any apparent decomposition. Boron analyses were performed using a modification of the procedure of Lucchesi and DeFord (1957). It was found necessary to use a 60 percent excess of TPC solution to ensure quantitative precipitation. Washing with a saturated, ice-cold, acidified (0.2N HCl) solution of 2,4,6-triphenylpyrylium tetrafluoroborate yielded satisfactory results in all cases. Care must be taken when working with TPC to see that all solutions are acidified because its hydrolysis is fairly rapid above a pH of 4.

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INDEX TERMS: Anions, Chemical analysis, Methodology, Pollutant identification, Gravimetric analysis, Synthesis, Hydrogen ion concentration, Chemical precipitation, Chemical reactions, 2 4 6-Triphenylpyrylium, Reagents, Perchlorates, Boric acid, Accuracy, Experimental error, Ionic interference.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7536

"SIMULATED DISTILLATION OF NARROW, HIGH BOILING HYDROCARBON FRACTIONS", Gouw, T. H., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 987-989.

A graphical technique has been used to obtain data on the average boiling point and the boiling range of narrow boiling hydrocarbon fractions for characterization purposes. The procedure was carried out in conjunction with a reasonably good gas chromatograph and a device for integrating peak areas. The technique was tested using cuts from the distillation of two Southern California crude oils. Simulated distillation was carried out using 2 Perkin-Elmer GC units equipped with flame ionization detectors and an Aerograph unit equipped with a thermal conductivity detector. Area integration was carried out with an optical integrator or a Disc integrator. The average standard deviations for the three temperatures used were considerably smaller than the deviations obtained by the ASTM simulated distillation method. The described method does not require equipment as sophisticated as what is necessary for regular simulated distillation. It appears to yield quite precise values for the average boiling point of narrow boiling, high molecular weight hydrocarbon fractions. The method is obviously also applicable to lower molecular weight fractions; in this case, it would probably be more appropriate to carry out a complete component analysis by gas chromatography. The described approach should not be regarded as a replacement or alternative technique to the ASTM D 2887-T method; it should be considered as a complementary method which is very useful in specific applications.

INDEX TERMS: Distillation, Methodology, Crude oil, Graphical techniques, Boiling point, Petroleum fractions, Flame ionization gas chromatography, Thermal conductivity gas chromatography, Reproducibility.

AMIC-7539

"IMPROVED DOUBLE DETECTION GAS CHROMATOGRAPH-MASS SPECTROMETER INTERFACE FOR THE ANALYSIS OF COMPLEX ORGANIC MIXTURES", Bruner, F., Ciccioli, P., Zelli, S., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 1002-1006.

The results are reported that were obtained by modifying an AEI MS 12 mass spectrometer for better gas chromatography - mass spectrometry operation. The changes introduced in the gas lines have been the following: Elimination of every metal part except the three-way connection at the end of the column, and substitution of the metal capillary with a glass rod (0.5-mm i.d., 5-mm o.d.) to connect the column to the separator. The part of the chromatograph usually employed for the inlet splitter of capillary columns injection is used to make the connection with the mass spectrometer. In this way the injection port, FID, and the first part of the line connecting the GC to the MS are placed very close to each other and heated at the same temperature using the original heating system given by the manufacturer. With the modified apparatus, it is possible to eliminate the Total Ion Monitor (TIM) recording of the chromatogram using for this scope FID trace. By working with the repetitive scanning device operating continuously during the chromatogram and watching the output of the mass spectrometer on an oscilloscope, one has only to check the intensity of the spectrum, and when it reaches the right value, push the button to record the spectrum of a given chromatographic peak on the UV light oscillograph to get it displayed on paper. The results of the present work show also that many defects of coupling MS and GC, attributed to the separator, are actually dependent on the inefficiency of the gas lines of the interface.

INDEX TERMS: Organic compounds, Instrumentation, Chemical analysis, Laboratory equipment, Research equipment, GC-Mass spectrometry, Mixtures.

AMIC-7541

"PHOSPHORUS IN WASTEWATER", Hetling, L. J., Carcich, I. G., Water and Sewage Works, Vol. 120, No. 2, February 1973, pp 59-62.

A demonstration of the use of pressure sewers to determine the proportion of phosphorus contributive to domestic waste from detergents was conducted in Albany, New York, using 12 individual, single family homes connected to a pressure main via grinder-pump units. All wastewater but extraneous flows (cellar, yard, and roof drainage) produced was included in the system during installation. Using a specially constructed device, a composite sample was collected daily along with complementary wastewater flow data and analyzed for total and dissolved phosphorus daily for 3 weeks. A non-phosphate, heavy duty soap was then substituted in each household for their usual phosphorus detergent. Daily composite samples were collected and analyzed for a 3-week period. A 48 percent reduction of the total phosphorus was found when phosphorus free soap was used in place of phosphorus detergents. As expected, all of this decrease occurred in the soluble form. The particulate phosphorus loading remained essentially constant throughout the experiment. Removal of phosphorus from detergent washing products would lower concentrations of phosphorus in wastewater from the present average of 11 mg/l to approximately 5 mg/l.

INDEX TERMS: Phosphorus, Detergents, Wastewater (pollution), Soaps, Chemical analysis, Water pollution sources, Domestic wastes, Pressure sewer system.

AMIC-7542

"MERCURY IN PUBLIC SEWER SYSTEMS", Evans, R. L., Sullivan, W. T., Sundar, L., Water and Sewage Works, Vol. 120, No. 2, February 1973, pp 74-76.

A summary is presented of analyses for total mercury in a limited number of samples from raw sewages of five municipalities in central Illinois (Creve Coeur, Morton, Marquette Heights, Washington, and Peoria). At least 10 grab samples were collected in polyethylene bags from each sewer system near the intake structure of the waste treatment facilities. The samples were preserved with dilute nitric acid and analyzed for Hg using the flameless atomic absorption method of Hatch and Ott (1968). Values of total Hg concentrations found in the raw sewages ranged from 0.1 to 7.9 ppb. The geometric mean of total mercury concentrations in the five public sewer systems in central Illinois ranged from 1.3 to 1.8 ppb. Illinois standards stipulate a maximum concentration of 0.5 ppb of mercury in public sewer systems. Without lowering the existing tolerance guidelines for mercury in foodstuffs, paper products, drinking water, etc, it would appear difficult to comply with Illinois standards. There appears to be a background concentration of mercury in public sewer systems solely devoid of industrial waste influence.

INDEX TERMS: Mercury, Pollutant identification, Sewerage, Municipal wastes, Waste water (pollution), Water quality standards, Flameless atomic absorption spectrophotometry.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7546

"POLAROGRAPHIC METHOD FOR NITRATE AND DISSOLVED OXYGEN ANALYSES", Hwang, C. P., Forsberg, C. R., Water and Sewage Works, Vol. 120, No. 4, April 1973, pp 71-74.

A polarographic apparatus with a rapid dropping electrode was investigated as a potentially better method to determine nitrate and dissolved oxygen. Nitrate was found to produce well-defined waves of d-c curves in region of -1.25 v, however, the recommended measurement of nitrate is at -1.40 v. It takes only seven minutes (five minutes for deaerating, one minute for reading, and one minute for using the calibration curve) compared to five hours for the phenoldisulfonic acid method. The precision of the polarography method and the phenoldisulfonic acid method is plus or minus 0.27 mg/l and plus or minus 0.22 mg/l. Results using the polarograph method and the azide modification of the iodometric method in the determination of dissolved oxygen in BOD tests show that the polarographic method mostly yields the higher values. The azide modification requires 30 minutes to get results, the polarographic method requires only 2 minutes and, in contrast, can measure DO in the range found in water, wastewater, and industrial wastes. This method is not subject to the usual interferences; its precision in 0.1 N KCl solution is plus or minus 0.075 mg/l.

INDEX TERMS: Nitrates, Dissolved oxygen, Polarographic analysis, Methodology, Pollutant identification, Chemical analysis, Water analysis, Industrial wastes, Waste water (pollution), Phenoldisulfonic method, Iodometric method, Accuracy, Precision.

AMIC-7548

"BOD: DETERMINING THE NECESSARY DILUTION TECHNIQUE", Brown, J. A., Jr., Paul, J., Rice, L. C., Lines, J. M., Water and Sewage Works, Vol. 120, No. 5, May 1973, pp 105.

A method is presented whereby the dilutions necessary for the BOD test are calculated mathematically with the virtual elimination of trial and error methods outlined in 'Standard Methods'. With the simple calculations presented and by utilizing a few logical assumptions, the authors state that the BOD sample size can be adequately calculated. In the Industrial Pollution Abatement Laboratory which performs BOD's at a rate of about 1200 a year this method has been an improvement over the trial and error method of determining dilution volumes. The number of tests that have to be repeated because of improper dilution has been greatly reduced.

INDEX TERMS: Methodology, Biochemical oxygen demand, Mathematical studies, Measurements, Water quality, Water pollution effects, Equations, Chemical oxygen demand, Dilution technique, Sample size, Accuracy.

AMIC-7547

"PROGRESS REPORT ON WATER QUALITY OF LAKE MICHIGAN NEAR CHICAGO", Vaughn, J. C., Reed, P. A., Water and Sewage Works, Vol. 120, No. 5, May 1973, pp 73-80.

Data are presented primarily from the South Water Filtration Plant (SWFP) operating and test information on various water quality parameters of Lake Michigan near Chicago. These data were compared to the Illinois Pollution Control Board (IPCB) standards. The comparisons with the IPCB standards lead, not surprisingly, to the same general conclusions as those based on the repealed regulation SWB-7. One may tentatively conclude that relatively little sewage plant effluent is entering the lake in the area of interest. The data do not permit exact analysis or differentiation but the principal sources of pollution appear to be industrial wastes and possibly runoff. The spotty pattern of changes in concentration, with improvement in some respects (coliform, phenol, and ammonia nitrogen, as examples) and deterioration in others, also suggests that the most useful method of further investigation would concentrate on investigation of specific possible sources. Any other approach would probably be out of date and inappropriate.

INDEX TERMS: Water quality, Water quality standards, Lake Michigan, Surveys, Water pollution, Bioindicators, Illinois, Water policy, Water properties, Chemical indicators.

AMIC-7549

"DDT, DDE, AND POLYCHLORINATED BIPHENYLS IN BIOTA FROM THE GULF OF MEXICO AND CARIBBEAN SEA--1971", Giam, C. S., Hanks, A. R., Richardson, R. L., Sackett, W. M., Wong, M. K., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 139-143.

Samples of fish and crustaceans (shrimp, crabs, and others) were collected by net and by hook and line from the Gulf of Mexico and the Caribbean Sea for analysis of residues of DDT, DDE, and PCB. Samples were put in mason jars and frozen until analysis by gas chromatography. Fish and crustaceans were analyzed whole except when fish muscles and organs were removed for separate analysis. Recoveries were 85 percent or better with spiked samples, and detection limits ranged from 0.1 to 0.3 micrograms per kg wet weight for DDT and DDE and 1 to 3 micrograms per kg for PCB's. All three compounds were found widely distributed in all biota; however, samples from coastal areas generally had higher levels than samples from open waters. The ratios of DDE to DDT varied widely between samples. Livers from larger fish generally contained higher levels of DDE than DDT, possibly indicating the capability of this organ to metabolize DDT. Fish liver usually had the highest concentration of all three compounds and muscle tissue the lowest.

INDEX TERMS: Pesticide residues, DDT, DDE, Polychlorinated biphenyls, Crabs, Shrimp, Marine fish, Biological samples.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7550

"MERCURY RESIDUES IN FISH, 1969-1970 - NATIONAL PESTICIDE MONITORING PROGRAM", Henderson, C., Inglis, A., Johnson, W. L., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 144-159.

As part of the fish monitoring program conducted by the Bureau of Sport Fisheries and Wildlife since 1967, composite fish samples collected during the fall of 1969 and 1970 were analyzed for mercury. Fish were collected using seines, gill nets, traps, hook and line, and electrofishing. Three composite samples, each of a different species and consisting of 3-5 adult fish, were collected at each of 50 monitoring stations in 1969; similarly, three composite samples and in most cases a replicate sample of one of the species were collected at each of 100 stations in 1970. Stations were located on major rivers and lakes throughout the United States. Samples were wrapped in foil, frozen, and shipped to a laboratory for analysis by atomic absorption. Each composite was thawed, cut in small pieces, homogenized in a food chopper, digested, and analyzed by the cold vapor technique. Total mercury residues equal to or exceeding the sensitivity level of 0.05 ppm were found in 129 of the 145 samples in 1969 and 373 of the 393 samples in 1970. Values ranged from less than 0.05 to 1.25 ppm in 1969 samples and from less than 0.05 to 1.80 ppm in 1970 samples. Analyses by two different laboratories of 40 selected samples from the 1970 collection gave comparable results. Analyses of 24 selected 1970 samples indicated that 90 percent or more of the mercury in fish was in the form of methyl mercury.

INDEX TERMS: Mercury, Freshwater fish, Marine fish, Biological samples, Sample preparation, Atomic absorption spectrophotometry, Methylmercury.

AMIC-7551

"DURSBAN (TRADEMARK) AND DIAZINON RESIDUES IN BIOTA FOLLOWING TREATMENT OF INTERTIDAL PLOTS ON CAPE COD - 1967-69", Marganian, V. M., Wall, W. J., Jr., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 160-165.

This paper reports the results of a 3-year study (1967-69) conducted on Cape Cod, Massachusetts, to determine if the use of Dursban (Trademark) and diazinon for control of larvae of Culicoides melleus breeding in intertidal sand, C. hollensis and C. furens breeding in salt marsh mud, and Tabanus nigrovittatus and T. lineola breeding in salt marsh sod, would result in harmful effects to nontarget organisms and to determine residue levels in the intertidal biota. Nontarget organisms sampled included oligochaetes, polychaetes, clams, oysters, mussels, snails, crabs, prawns, periwinkles, and killifishes. Analytical methods were developed which consisted of blending samples of biota, sand, mud, or water with acetonitrile and petroleum ether. Samples were extracted three times with both extractants, treated with saturated NaCl solution and distilled water. The two aqueous layers were then treated with petroleum ether, and the ether phases combined and dried. The ether extracts were concentrated with nitrogen and subjected to gas chromatographic analysis. The detection limit was 0.01 ppm; the precision was 6 percent; and recovery ranged from 80-85 percent. The results showed that 1 percent granular Dursban (Trademark) applied manually at an optimum concentration of 0.05 lb/acre controlled Culicoides larvae effectively with no noticeable harm to fiddler crabs or other organisms. Residues recovered ranged from trace amounts to 2.30 ppm in white oligochaete, 2.58 ppm in ribbed mussel, 4.62 ppm in fiddler crab, 14.0 ppm in horsefly, and 15.7 ppm in marsh snail. Two percent granular diazinon applied manually at 0.20 lb/acre controlled Culicoides effectively, but killed small sand organisms. In general, concentrations of diazinon residues recovered were higher than those for

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Dursban (Trademark) in the same organisms reported above. Data collected on residues in organisms at various periods after treatment and persistence periods for these pesticides in substrates of intertidal sand, salt marsh sod, salt marsh mud, and seawater are also discussed.

INDEX TERMS: Pesticide toxicity, Diazinon, Pesticide residues, Gas chromatography, Fish, Clams, Crabs, Snails, Oysters, Persistence, Sand, Mud, Water, Separation techniques, Dursban, Biological samples, Sample preparation, Polychaetes.

AMIC-7552

"PESTICIDES IN WATER", Bradshaw, J. S., Loveridge, E. L., Rippee, K. P., Peterson, J. L., White, D. A., Barton, J. R., Fuhrman, D. K., et al., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 166-170.

Gallon-water samples were taken from 15 tributaries and 1 outlet point of Utah Lake biweekly from March 1 - July 1, 1970, and weekly or semiweekly through February 1971. The samples were extracted as soon as possible (within 3 days) with nanograde petroleum ether in a continuous liquid-liquid extractor for 24 hours. The ether extract was dried, filtered, evaporated to 10 ml, and analyzed for pesticide residues by electron capture gas chromatography. Fish caught in the lake were analyzed by gas-liquid chromatography. The water samples were found to contain aldrin, alpha-BHC, gamma-BHC, heptachlor, heptachlor epoxide, methoxychlor, DDT, and DDE. DDE, dieldrin, methoxychlor, DDT, and BHC were found in the fish analyzed, with DDE being the most common. The smaller and younger fish contained lesser amounts of DDE. Definite surges of pesticides (1 ppb or more) were shown to enter Utah Lake three times per year - early spring, late spring, and fall, generally corresponding to the application times of pesticides by farmers in the area. The pesticides involved were mainly aldrin and BHC in the early spring; heptachlor (plus heptachlor epoxide) and methoxychlor in the late spring; and aldrin, heptachlor and methoxychlor in the late fall.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Pesticide residues, Freshwater fish, Chemical analysis, Water analysis, Water pollution sources, Insecticides, Water sampling, Channel catfish, Carp, White bass, Path of pollutants, Utah Lake, Seasonal variation, Sample preparation, Electron capture gas chromatography, Gas liquid chromatography, Black bullhead.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7553

"SAMPLING PROCEDURES AND PROBLEMS IN DETERMINING PESTICIDE RESIDUES IN THE HYDROLOGIC ENVIRONMENT", Feltz, H. R., Culbertson, J. K., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 171-178.

Diligent use of standardized sampling and analytical techniques is essential to meaningful assessments of the occurrence, distribution and fate of pesticide residues in the hydrologic environment. The validity of analytical data and subsequent interpretations are interdependent and limited to the confidence level of adequate, representative sampling of various components. Equally important are appropriate sample-preservation practices and procedures for sample preparation and cleanup and identification, measurement, and confirmation of residues. Analytical schedules should include pesticides listed in the Revised Chemicals Monitoring Guide for the National Pesticide Monitoring Program and should be responsive to special interests. Samplers are available for collecting acceptable water, fluvial material, and bottom-material samples in about 75 percent of the river miles and in lakes and estuaries throughout the United States; however, more experience is needed in sampling hydrosols and low intensity deposits at the active water-sediment interface.

INDEX TERMS: Aquatic environment, Pesticide residues, Methodology, Equipment, Sampling, Pollutant identification, Data interpretation, Sample preservation.

AMIC-7557

"RESIDUES OF CHLORINATED HYDROCARBON PESTICIDES IN THE NORTHERN QUAHOG (HARD-SHELL CLAM), MERCENARIA MERCENARIA-1968 AND 1969", Check, R. M., Canario, M. T., Jr., Pesticides Monitoring Journal, Vol. 6, No. 3, December 1972, pp 229-230.

Samples of the northern quahog (hard-shell clam), *Mercenaria mercenaria*, were collected monthly, when possible, from September 1968 to September 1969 at five locations in Narragansett Bay, Rhode Island, and one location in nearby Mount Hope Bay. The clams were shucked and drained; a 300-g composite sample of meat (14-18 clams from each location) was blended until homogenized, and frozen until analysis by electron capture gas chromatography. All pesticides residues found were confirmed by thin layer chromatography using precoated aluminum oxide G plates. All 56 composite samples contained dieldrin at an average level of 0.040 ppm; p,p'-DDD was present in three samples at an average level of 0.026 ppm. Quahogs from upper reaches of Narragansett Bay contained higher levels of residues than samples from lower Bay areas.

INDEX TERMS: Pesticide residues, Chlorinated hydrocarbon pesticides, Pollutant identification, Clams, Chemical analysis, Sampling, *Mercenaria mercenaria*, Northern quahog, Macroinvertebrates, Animal tissues, Thin layer chromatography, Electron capture gas chromatography, Sample preparation.

AMIC-7554

"ORGANOCHLORINE INSECTICIDES IN SURFACE WATERS IN GERMANY-1970 AND 1971", Herzel, F., Pesticides Monitoring Journal, Vo. 6, No. 3, December 1972, pp 179-187.

As part of a series of studies initiated in 1969 to determine the organochlorine insecticide content of major waters in the Federal Republic of Germany, unfiltered water and suspended solids were analyzed from approximately 25 sites sampled in May 1971, and unfiltered water was analyzed from 7 sites sampled monthly from April 1970-June 1971. As in former studies (June and October 1969, April and September 1970), the insecticide concentrations found in waters and suspended solids were almost exclusively in the ppt range (ng/liter). The compounds found most frequently were gamma-BHC (lindane) and alpha-BHC; alpha and beta-endosulfan were detected in the Main, Regnitz, and Rhine Rivers. DDT and particularly its metabolites DDD and DDE were found infrequently except in samples from the Berlin Teltovkanal. Findings of heptachlor, heptachlor epoxide, dieldrin, and parathion (the only organophosphorous insecticide included in the study) were rare.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Suspended solids, Surface waters, Chemical analysis, Water analysis, Pollutant identification, Insecticides, Phosphothioate pesticides, Water sampling, Methodology, Germany, Sample preparation, Chemical recovery.

AMIC-7561

"PETROLEUM HYDROCARBONS IN FATTY ACIDS IN WASTEWATER EFFLUENTS", Farrington, J. W., Quinn, J. G., Journal Water Pollution Control Federation, Vol. 45, No. 4, April 1973, pp 704-712.

Samples of the effluent from three secondary treatment plants were surveyed to determine fatty acid and hydrocarbon distributions and concentrations. The samples were obtained in glass containers with aluminum-lined caps. Lipid extracts were obtained by either (1) extracting the acidified effluent with chloroform, saponifying the lipid residues with 0.5 N KOH in (1:1) benzene:methanol, acidifying the saponified extract, and partitioning the lipids into petroleum ether; or (2) refluxing subsamples with 0.5 N KOH in (1:1) benzene:methanol, acidifying the extract and partitioning the lipids into petroleum ether. Fatty acid analysis was carried out using flame ionization gas chromatography. Hydrocarbons were also analyzed by gas chromatography after isolation from the effluent lipid extracts by column and thin-layer chromatography. The analyses confirm that the predominant fatty acids ratios in effluents are 16:0, 18:0, 18:1. The relative abundance of these acids suggests animal fats and vegetable oils as their sources. Concentrations of fatty acids ranged from 0.73 to 43.05 mg/l. Petroleum hydrocarbons are discharged by two of the treatment plants studied. Hydrocarbon concentrations ranged from none detected for the effluent of one treatment plant to 16.2 mg/l for the effluent of another. These results confirm suggestions that significant amounts of petroleum hydrocarbons are discharged in effluents.

INDEX TERMS: Waste water (pollution), Sewage effluents, Pollutant identification, Sewage treatment, Oil, Separation techniques, Fatty acids, Flame ionization gas chromatography, Sample preparation, Animal fat, Vegetable oil, Chemical concentration.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7579

"DISPERSED AND PARTICULATE PETROLEUM RESIDUES IN THE GULF OF ST. LAWRENCE", Levy, E. M., Walton, A., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 261-267.

Concentrations of petroleum residues both as material in solution or dispersed through the water column and as fresh oil or tarry particles floating on the surface in the Gulf of St. Lawrence were measured during July-August 1971. Niskin samplers were used to collect water samples for dissolved and dispersed oil determinations from varying depths at stations 1.9, 7.6, and 18.5 km from the site of a sunken barge. CCl₄ extracts were analyzed by fluorescence spectrophotometry. The sea surface was sampled by towing a modified neuston sampler for one nautical mile at 5-7 knots. The sample was frozen for later processing and fresh oil was removed from the net with CCl₄. Dissolved and dispersed forms were present in concentrations generally less than 5 ppb over the southern and western regions while 5-10 ppb were encountered in the north and east. A major source of these residues appears to be the Atlantic water that enters through Cabot Strait, and the distribution of these materials is closely related to the circulation of water within the Gulf. Surface oil was present at approximately 50 percent of the stations occupied in concentrations generally less than 100 micrograms/sq m but as great as 12,400 micrograms/sq m in the vicinity of the sunken barge Whale. There is no evidence to indicate an appreciable change in concentrations to those of a year ago.

INDEX TERMS: Water pollution sources, Oil pollution, Oily water, Distribution, Sea water, Pollutant identification, Chemical analysis, Gulf of St. Lawrence, Petroleum residues, Fluorescence spectrophotometry.

AMIC-7580

"ARSENIC, CADMIUM, COPPER, MERCURY, AND ZINC IN SOME SPECIES OF NORTH ATLANTIC FINFISH", Windom, H., Stickney, R., White, D., Smith, R., Taylor, F., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 275-279.

Ninety-one individuals representing 35 species of North Atlantic finfish (Osteichthyes and Chondrichthyes) were analyzed for arsenic, cadmium, copper, mercury, and zinc. Depending on the size of the fish, muscle samples taken from one site or varying sites, or the whole body minus the head was analyzed. As, Cd, Cu, and Zn were determined by flame atomic absorption; Hg was determined by cold vapor atomic absorption. The results indicate that these metals occur at similar levels in both inshore and offshore species. Chondrichthyes and Osteichthyes have similar concentrations of all the metals, excepting arsenic which is higher in Chondrichthyes. Analyses of various tissues of Chondrichthyes reveal higher metal concentrations in the liver except for mercury which was higher in muscles.

INDEX TERMS: Marine fish, Cadmium, Copper, Mercury, Zinc, Pollutant identification, Atlantic Ocean, Chemical analysis, Heavy metals, Arsenic, Finfish, Chondrichthyes, Osteichthyes, Animal tissues, Cold vapor atomic absorption, Atomic absorption spectrophotometry, Flame atomic absorption, Sample preparation, Wet ashing, Chemical digestion.

AMIC-7584

"MERCURY IN THE MARINE ENVIRONMENT: CONCENTRATION IN SEA WATER AND IN A PELAGIC FOOD CHAIN", Williams, P. M., Weiss, H. V., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 293-295.

To test the premise that mercury may be increasingly concentrated along successively higher trophic levels of marine food chains and that the concentration of mercury in the seawater column is affected by biological activity, organisms, water, and sediment were collected at one open-ocean (pelagic) station 29 degrees 00.0 minutes N, 122 degrees 31.2 minutes W) 430 km southeast of San Diego, California. The mercury content of the organisms and sediment was determined by a modification of the neutron activation technique of Johansen and Steinnes (1969). The mercury content of the sea water was determined by neutron activation analysis (Weiss and Crozier, 1972). The concentration of mercury in zooplankton slightly increased with depth of collection. The mercury content in almost all of the higher trophic levels of organisms collected at greater depths was indistinguishable from the concentration of mercury in zooplankton at these depths. Mercury concentration in the seawater column was essentially constant below 100 m and significantly higher at the surface. This vertical profile of mercury content is not ascribable to biological activity.

INDEX TERMS: Mercury, Food chains, Sea water, Neutron activation analysis, Radioactivity, Marine animals, Zooplankton, Water sampling, Bottom sampling, Methodology, Chemical analysis, Crustaceans, Bathypelagic fish, Animal tissues, Sample preparation, Sample preservation, Biological activity.

AMIC-7592

"A QUANTITATIVE, SEMIROUTINE METHOD FOR DETERMINING ALGAL AND SEDIMENTARY CHLOROPHYLL DERIVATIVES", Daley, R. J., Gray, C. B. J., Brown, S. R., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 345-356.

An integrated quantitative method is described for the determination of chlorophylls and chlorophyll degradation products in freshwater phytoplankton and sediments. Prior to extraction, algal samples were concentrated by filtration through glass fiber filters while sediment samples were lyophilized. All materials were extracted in a mixture of acetone, methanol, and water (80:15:5) by ultrasonication in a glass extraction chamber refrigerated at -10 C. Extracts were filtered through solvent-resistant membrane filters, rather than centrifuged, and then fractionated without prior drying by reverse-phase thin-layer chromatography on oil-impregnated layers of kieselguhr G. Using three chromatographic systems consisting of different developing solvents and oil phases (triolein, paraffin oil, and castor oil), rapid, artefact-free separations of chlorophylls a, b, and c and 18 of their derivatives were obtained. Individual pigments were estimated by direct, in situ thin-layer scanning with a filter fluorometer. The sensitivity and reproducibility of the procedure are ca. 2 ng and 11 percent, respectively. In routine operation, the method is fast and relatively simple, a complete analysis being accomplished in 1.5 hr.

INDEX TERMS: Algae, Sediments, Methodology, Separation techniques, Phytoplankton, Aquatic algae, Plant pigments, Marine Aalgae, Plant tissues, Chemical analysis, Reverse-phase thin layer chromatography, Chlorophyll derivatives, Sample preparation, Chlorophyll a, Chlorophyll b, Chlorophyll c, Sensitivity, Reproducibility.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7600

"TOTAL MERCURY AND METHYLMERCURY CONTENT OF THE AMERICAN EEL (*ANGUILLA ROSTRATA*)", Freeman, H. C., Horne, D. A., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 454-456.

Two groups of American eels (*Anguilla rostrata*) obtained from the Medway River in Nova Scotia were analyzed for the presence of mercury. Homogenates were prepared from about 50 percent of the dorsal muscle using a blender; portions of the same homogenate were used for both total mercury and methylmercury determinations. Total Hg and methylmercury were determined in duplicate on each homogenate by the semiautomated flameless atomic absorption method of Armstrong and Uthe (1971) and the semimicro gas-liquid chromatography method of Uthe et al (1972), respectively. The total mercury content was found to be 0.72 plus or minus 0.05 ppm and the methylmercury content was 0.40 plus or minus 0.06 ppm (mean plus or minus SE for 23 fish). Since the mean total mercury content was less than 1 ppm and the toxic methylmercury content was 50 percent of this, or less than the 0.5 ppm guideline, such eels may be acceptable for human consumption.

INDEX TERMS: Mercury, Pollutant identification, Chemical analysis, Marine fish, Methylmercury, *Anguilla rostrata*, Muscle, American eel, Animal tissues, Semimicro gas liquid chromatography, Flameless atomic absorption spectrophotometry.

AMIC-7602

"PREPARATION AND PROPERTIES OF 3-TRIFLUOROMETHYL-4-AMINOPHENOL", Lech, J. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 461-463.

A method is described for the preparation of 3-trifluoromethyl-4-aminophenol (RTFM), a selective larvicidal agent used to control the sea lamprey (*Petromyzon marinus*) in the upper Great Lakes, and metabolite of 3-trifluoromethyl-4-nitrophenol (TFM). Some of its physical-chemical properties, including infrared spectrum, pK sub a, and gas chromatography, were examined which may aid in the design of analytical procedures for metabolite residues. Generally, the metabolite is prepared from the parent compound by reduction with hydrogen by: (1) dissolving TFM in absolute ethanol to which was added 5 percent palladium on charcoal, (2) reducing the chemical in a Parr apparatus at 60 psi H₂, (3) filtering to remove the catalyst, and bubbling HCl gas through the mixture in an ice bath, and (4) collecting the precipitate by vacuum filtration and washing with ice-cold acetone. The resulting material dried under vacuum and stored under nitrogen is a white fluffy powder which decomposed at 210-220 C. Elemental analysis indicated that this material contained 39.19 percent C, 26.95 percent F, and 3.28 percent H.

INDEX TERMS: Physiochemical properties, Methodology, Larvicides, Phenolic pesticides, Gas chromatography, Halogenated pesticides, 3-Trifluoromethyl-4-aminophenol, * Preparation (chemical), Dissociation constants, Infrared spectra, Metabolites, Ultraviolet spectra, Chemical composition.

AMIC-7601

"A SIMPLE MICROSCALE VACUUM COLLECTOR FOR THE ELUTION OF CLOSELY SITUATED SPOTS FROM THIN-LAYER CHROMATOGRAMS", Cheng, J. Y., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 460-461.

A "homemade" device, utilizing disposable Pasteur pipettes and a side-armed test tube, is described for convenient quantitative removal and elution of closely separated spots from thin-layer chromatograms. Its simplicity of manipulation and "disposability" after use offer an excellent economic and timesaving elution technique for routine handling of numerous samples.

INDEX TERMS: Reliability, Laboratory equipment, Plant pigments, Laboratory tests, Marine algae, Separation techniques, Thin layer chromatography, Microscale vacuum collector, Elution, Chemical recovery.

AMIC-7605

MERCURY, DDT AND PCB IN HARBOUR SEALS (*PHOCA VITULINA*) FROM THE BAY OF FUNDY AND GULF OF MAINE", Gaskin, D. E., Frank, R., Holdrinet, M., Ishida, K., Walton, C. J., Smith, M., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 471-475.

Samples of blubber, longissimus muscle, liver and cerebrum from 12 harbour seals (*Phoca vitulina*) were analyzed for DDT, dieldrin, PCBs, and total mercury content. Analysis for total mercury was a previously described by Gaskin et al. (1972), whereby elemental Hg was released and read as a cold vapor at 253.7 nm with an AA-5 Techtron atomic absorption spectrophotometer. For organochlorine compound estimation macerated samples were subjected to exhaustive soxhlet fat extraction with hexane, cleaned on a florisil column and eluted with 20 percent dichloromethane in hexane. An aliquot was dissolved in hexane after preliminary GC analysis and introduced to an activated coconut charcoal column to separate the DDT group from PCBs. The DDT group was eluted with 25 percent acetone in ether, the PCBs with benzene, and both fractions passed through a mixed phase column for residue qualification and quantitation by GC. The results were compared with those obtained previously for harbour porpoises (*Phocoena phocoena*). DDT and PCB levels appear to be of the same magnitude in the fat of seals from both southern New Brunswick and southern Maine, being lowest in a lactating female. Virtually no o, p'-DDT and relatively little dieldrin were found in seal fat, in contrast to porpoises, which contained significant amounts of both in the depot fat. Mercury levels were generally similar to those found for porpoises, but total liver Hg was considerably greater in adults from the New Brunswick islands than in those from the southern Maine ledges.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-7605 (Continued)

Card 2/2

INDEX TERMS: Mercury, DDT, Polychlorinated biphenyls, Dieldrin, Pollutant identification, Marine animals, Mammals, Maine, Canada, Gas chromatography, Sea water, Phoca vitulina, Gulf of Maine, Bay of Fundy, Harbor seals, Sample preparation, Animal tissues, Atomic absorption.

AMIC-7625

"ANALYTICAL REVIEWS 1973/APPLICATIONS", Analytical Chemistry, Vol. 45, No. 5, April 1973, pp 1R-403R.

The following are review articles concerned with analytical methods that may be applicable to environmental studies: (1) 'Air Pollution' by Peter K. Mueller and Evaldo L. Kothny, (2) 'Essential Oils and Related Products' by Ernest Guenther, Gilbert Gilbertson, and Roman T. Koenig, (3) 'Fertilizers' by Charles W. Gehrke, Larry L. Wall, Sr., and Paul R. Rexroad, (4) 'Pesticide Residues' by Wayne Thornburg, (5) 'Petroleum' by Richard W. King, (6) 'Pharmaceuticals and Related Drugs' by David W. Cornish, Daniel M. Grossman, Allen L. Jacobs, Arthur F. Michaelis, and Ben Salsitz, (7) 'Water Analysis' by Marvin J. Fishman and David E. Erdmann, and (8) 'Food' by James A. Yeransian, Katherine G. Sloman, and Arthur K. Foltz.

INDEX TERMS: Analytical techniques, Chemical analysis, Air pollution, Water pollution, Reviews, Methodology, Documentation, Pollutant identification, Instrumentation, Pollutants, Organic compounds, Inorganic compounds, Physical properties, Laboratory tests, Reliability, Chemical properties, Radioactivity techniques, On-site investigations, Radiochemical analysis, Sample preparation, Collaborative studies.

AMIC-7606

"IDENTIFICATION OF THE CONSTITUENTS OF KRAFT PULPING EFFLUENT THAT ARE TOXIC TO JUVENILE COHO SALMON (ONCORHYNCHUS KISUTCH)", Leach, J. M., Thakore, A. N., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 479-484.

The nonvolatile constituents that are acutely toxic to juvenile coho salmon (Oncorhynchus kistuch) have been fully identified in a kraft pulping effluent derived from Douglas fir and western hemlock. Toxicity and material balances were maintained throughout a fractionation procedure leading to isolation of the toxic factors. Fractions were monitored by flame ionization gas chromatography and thin-layer chromatography. Individual compounds were identified initially by combination GC-mass spectrometry. Over 80 percent of the toxicity was caused by three resin acid soaps: sodium isopimarate (55 percent), sodium abietate (22 percent), and sodium dehydroabietate (5 percent). The remaining toxicity (18 percent) was contributed by sodium salts of the unsaturated fatty acids: palmitoleic, oleic, linoleic, and linolenic.

INDEX TERMS: Pollutant identification, Effluents, Pulp wastes, Toxicity, Juvenile fish, Chemical analysis, Coho salmon, Bioassay, Douglas fir trees, Hemlock trees, Distillation, Organic compounds, Methodology, Oncorhynchus kisutch, Chemical composition, Fatty acids, Resin acid soaps, Flame ionization gas chromatography, Unbleached whitewater, GC-Mass spectrometry, Sample preparation, Thin layer chromatography.

AMIC-7626

"ANALYSIS OF SEA WATER BY DIFFERENCE CHROMATOGRAPHY] SUMMARY OF PROGRESS 1972", Mangelsdorf, P. C., Jr., Chang, W. M., Woods Hole Oceanographic Institution, Department of Chemistry, Woods Hole, Massachusetts, Report No. COO-3119-1, Contract No. AEC AT(11-1)-3119, 1972, 27 pp.

During the past year the principal new developments in work with Difference Chromatography have been: (1) Design and construction of a sturdier model of an in situ interstitial water sampler for collecting undisturbed pore water samples from marine sediments, (2) Successful use of this instrument at 24 locations across the North Atlantic on the Cork-Woods Hole leg of the R/V CHAIN cruise 105, (3) Discovery that the water samples collected in-situ are dramatically different from ordinary sea water and also different from what was expected, (4) Analysis of a suite of South Atlantic sea water samples taken with close vertical spacing, (5) Overhaul and reconstruction of two existing Difference Chromatographs to improve their reliability, (6) Design and construction of a new separate dual column Difference Chromatograph to permit further development work on anion analysis, resolution and sensitivity, etc., without interruption of the analytical program, (7) Further work on the reaction of fluvial sediments with sea water, probably resolving earlier discrepancies in the extent of ion exchange.

INDEX TERMS: Water analysis, Connate water, Ion exchange, Sulfates, Calcium, Sodium, Magnesium, Potassium, Carbonates, Difference chromatography, Samples.

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-7668 "THE HEAVY METAL CONTENT OF RAINFALL IN THE EAST MIDLANDS", Hallsworth, E. G., Adams, W. A., <u>Environmental Pollution</u>, Vol. 4, No. 3, April 1973, pp 231-235.</p> <p>Analyses of rainfall were made between March 1963 and March 1964 to determine whether irregularities in the growth of clover plants at the University of Nottingham were due to contamination by fly-ash from power stations in the area. In order to test this, a series of small polyethylene funnels were set up and the rainwater was collected in polyethylene bottles which were emptied at monthly intervals or more frequently depending upon rainfall intensity. The rainwater was washed out of the bottles with distilled water, evaporated to dryness, the weight of dry matter obtained, and ashed before analysis. Cu and Co were determined colorimetrically, and other constituents by optical spectrography. The disparity recorded between rainfall and contamination and the apparent dependence of the latter on seasonal factors, such as fog, suggested that the major contribution to the input was not airborne soil. The differing heavy metal content of the fly-ash and rainfall ash from the various sources was discussed, the copper and molybdenum content being found to be considerably higher at certain sites than at others. An unusually high level of lead was noted.</p> <p>INDEX TERMS: Heavy metals, Rainfall, Chemical analysis, Water analysis, Air pollution effects, Fly ash, Pollutant identification, Water pollution, Fog, Colorimetry, Optical spectroscopy.</p>	<p>AMIC-7669 (Continued) Card 2/2</p> <p>INDEX TERMS: Cations, Forest watersheds, Discharge (water), Appalachian Mountain Region, Physical properties, Demonstration watersheds, Hydrology, Calcium, Magnesium, Potassium, Sodium, Mountain forests, Vegetation, Topography, Monitoring, Nutrient interchange.</p>
<p>AMIC-7669 "STUDIES OF CATION BUDGETS IN THE SOUTHERN APPALACHIANS ON FOUR EXPERIMENTAL WATERSHEDS WITH CONTRASTING VEGETATION", Johnson, P. L., Swank, W. T., <u>Ecology</u>, Vol. 54, No. 1, Winter 1973, pp 70-79.</p> <p>Nutrient fluxes within and through watershed ecosystems at the Coweeta Hydrologic Laboratory are under study. This paper describes the annual budgets and seasonal fluctuations for selected cations. Concentrations and flux of cations moving through a hardwood forest stand, a weed to forest succession, a hardwood coppice stand and an eastern white pine stand on steep mountain topography are compared. Stream discharge was greater by 6 percent for the successional weed stand, and 10 percent for the second hardwood coppice, but 15 percent less for the young pine stand in contrast to pretreatment levels. Although concentrations for Ca, Mg, K, and Na combined were usually less than 3.5 ppm, over 98 percent of the loss of each cation was in dissolved form on all four watersheds. Regression analysis showed that 50 to 60 percent of the variations in monthly weighted average concentration was accounted for by monthly discharge amounts. Annual losses of the four cations from the mature hardwood stand were in the amounts of approximately 7, 3, 5 and 10 kg/ha respectively for the Ca, Mg, K, and Na. Annual budgets showed net changes to be -0.8, -1.8, -2.0, and -4.3 kg/ha, respectively, for this mature hardwood ecosystem. In contrast, the weed stand lost significantly greater amounts, and the young pine and hardwood coppice watersheds showed a net gain in Ca and significantly lower losses than the mature ecosystem for the other three ions. These budgets show that major alterations to these forest ecosystems are not now producing a substantial out-flux for these cations.</p>	<p>AMIC-7681 "OCCURENCE OF FREE AMINO ACIDS IN POND WATER", Zygmuntowa, J., <u>ACTA Hydrobiologica</u>, Cracow, Vol. 14, No. 3, 1972, pp 317-325.</p> <p>The qualitative and quantitative variations of amino acids in ponds were investigated with consideration given to the time of day of sampling. Temperature, oxygen content, oxidation potential, and pH were determined at each sampling period by the method of Just and Hermanowicz (1964). The qualitative composition of phytoplankton was also determined in the examined water samples. For the determination of the total amounts of free amino acids and their quality, the pond water was treated with chloroform for preservation purposes and subsequently filtered through hard filter paper in order to remove seston and possible mineral suspension. After this the water was passed through a column filled with cationite in hydrogen form (Zerolit 225-SRC-13). Adsorbed amino acids were eluted with NH₃ which was evaporated and the dry residue was eluted with amino nitrogen being determined quantitatively using ninhydrin. Qualitative determinations were made by means of thin layer chromatography. Amino acid content of the pond was found to vary from some scores to some hundred ppb. The following amino acids appeared most frequently: cystine, aspartic acid, serine with glycine, glutamic acid, alanine, valine, leucine. The concentration of free amino acids dissolved in pond water depends, to a certain extent, on the fertility of the pond, the time of the day, and the layer in vertical section.</p> <p>INDEX TERMS: Amino acids, Water analysis, Chemical analysis, Ponds, Pollutant identification, Nutrients, Methodology, Variability, Quantitative analysis, Thin layer chromatography, Sample preparation, Organic nitrogen compounds, Ninhydrin.</p>

2. BIOLOGICAL METHODS

AMIC-6634

"A NEW CRAYFISH OF THE SUBGENUS JUGICAMBARUS FROM TENNESSEE WITH AN EMENDED DEFINITION OF THE SUBGENUS (ASTACIDAE, DECAPODA)", Bouchard, R. W., The American Midland Naturalist, Vol. 89, No. 1, January 1973, pp 103-111.

Cambarus crinipes, a new species of crayfish from the Cumberland Plateau in Tennessee has been described. This new species belongs to the subgenus Jugicambarus which has been emended. Color notes, relationships, distribution, life history notes and ecological data are given. A more accurate method of measuring the carapace is proposed and the use of the posterior margin of the epistome as a possible taxonomic structure is introduced.

INDEX TERMS: Crustaceans, Speciation, Crayfish, Invertebrates, Tennessee, Ecology, Distribution, Color, Aquatic animals, Life cycles, Jugicambarus, Macroinvertebrates, Decapods, Arthropods, Cambarus (Jugicambarus) crinipes, Cambarus crinipes.

AMIC-7074

"SPRING PHYTOPLANKTON ABUNDANCE AND PRODUCTIVITY IN GRAND TRAVERSE BAY, LAKE MICHIGAN, 1970", Stoermer, E. F., Schelske, C. L., Santiago, M. A., Feldt, L. E., University of Michigan, Great Lakes Research Division, Ann Arbor, Michigan, Report No. CONF-720451--2, No. GA-4507, April 5-7, 1972, 20 pp. NTIS Report No. COO-2003-1.

Water samples were taken from twelve stations in Grand Traverse Bay using a Nansen bottle cast on May 20, 1970, at 5 m and June 18, 1970, at depths of 5 m from the surface and 1 m above the bottom. Secchi disc transparencies, particulate P, nitrate, silica and carbon fixation rates were measured. Phytoplankton cell number and species composition were determined microscopically. In May 1970, the phytoplankton abundance (standing crop) ranged from 1455 to 3355 cells/ml and increased significantly in June from 2500 to 6469 cells/ml. The same populations dominated the assemblages at all stations and estimated diversity of assemblages was relatively high and uniform, ranging from 2.3 to 2.6 in May to 1.8 - 2.2 in June. Estimates of primary productivity in May from the same stations ranged from 3.8 mg C/cu m/hr to 9.1 mg C/cu m/hr and followed the same general pattern of areal distribution as the standing crop estimates. Estimates of primary productivity were more variable during the June sampling period, with values ranging from 2.7 mg C/cu m/hr to 13.4 mg C/cu m/hr, with greatest differences again being between most productive stations in the lower west arm and least productive stations in the upper east arm.

INDEX TERMS: Standing crops, Primary productivity, Phytoplankton, Diatoms, Water sampling, Turbidity, Nitrates, Silica, Phosphorus, Aquatic algae, Seasonal, Dominant organisms, Species diversity, Grand Traverse Bay, Particulate matter.

AMIC-6846

"BIOLOGICAL ASPECTS OF LEAD: AN ANNOTED BIBLIOGRAPHY - LITERATURE FROM 1950 THROUGH 1964. PARTS I AND II", Campbell, I. R., Mergard, E. G., University of Cincinnati, College of Medicine, Cincinnati, Ohio, Report No. AP-104, Contract No. CPA 22-69-48, May 1972, 935 pp. NTIS Report No. PB 210 884.

This bibliography has been compiled from several abstract sources and represents the scientific periodical literature covered by the principal abstracting and indexing services. Books and proceedings of conferences and symposia devoted to lead and its compounds are also included. The material is arranged in 10 sections covering such areas as environmental surveys, plants and animals, man, occupational exposure, pollution and effects, legal aspects, analytical methods, and chemistry and technology.

INDEX TERMS: Lead, Bibliographies, Abstracts, Analytical techniques, Lead radioisotopes, Surveys, Pollutant identification, Water pollution effects, Chemical analysis, Soil contamination, Documentation, Conferences, Public health, Water pollution, Air pollution, Path of pollutants, Human pathology, Phytotoxicity, Microorganisms, Pesticides, Waste water (pollution), Legal aspects, Animal pathology, Ecological distribution, Organolead compounds, Toxicology, Pollutant effects, Mobilization, Fate of pollutants, Bioaccumulation, Biological materials, Quantitative analysis,

AMIC-7136

"THE ROLE OF NITROGEN IN THE AQUATIC ENVIRONMENT", Martin, D. M., Goff, D. R., Academy of Natural Sciences of Philadelphia, Department of Limnology, Philadelphia, Pennsylvania, Report No. ANSP-CLDP-2, 1972, 46 pp. NTIS REPORT No. PB 213 496

A comprehensive, up-to-date overview is presented of the significance and interactions of various nitrogen compounds within the aquatic environment. Sections are included on nitrogen occurrence (flowing water, ground water, lakes, oceans); mechanics of transformation, uptake and release; sources, toxicity, methods of treatment for removal; and association with eutrophication and water quality standards. The authors, noting that the term "Eutrophication has been very loosely used in the past," observe that "one of the common results of increased nitrogen loading, especially in water-bodies known to previously have had limited biological productivity due to nitrogen deficiencies is, 'Eutrophication.' However, the authors caution against predictive generalization about the response of plants to any single nutrient applicable to all situations. Many factors such as turbidity, predator pressure, thermal effects and availability of complementary nutrients may be overriding in any given situation. Their suggestion that 'to single out for removal any one nutrient,' or 'to recommend a specific treatment method applicable to all situations is not a realistic stand to take,' is well taken.

INDEX TERMS: Nitrogen, Nutrients, Aquatic environment, Eutrophication, Cycling nutrients, Nitrogen cycle, Nitrogen fixation, Water pollution sources, Nitrogen compounds, Toxicity, Absorption, Water quality standards, Path of pollutants, Trophic level, Biotransformation, Pollutant removal.

2. BIOLOGICAL METHODS

AMIC-7167

"CARBON DIOXIDE DYNAMICS: A RECORD OF ORGANIC CARBON PRODUCTION, RESPIRATION, AND CALCIFICATION IN THE ENIWETOK REEF FLAT COMMUNITY", Smith, S. V., Limnology and Oceanography, Vol. 18, No. 1, January 1973, pp 106-120.

Samples of sea water were collected before and after flowing over the Eniwetok reef flat and analyzed for alkalinity, pH, and carbon dioxide to determine whether CO₂ content could be used to monitor organic carbon production, respiration, and calcification in the marine environment. Changes in pH and alkalinity were used to partition the CO₂ changes into those due to production-respiration and those due to calcification. The results showed that both a transect visually dominated by a mixture of corals and algae and a transect dominated by an algal turf calcified at an average rate of 4,000 g CaCO₃ per square mile per year, with no apparent day-to-night difference. Although nighttime respiration on both transects was 0.12 g C per square mile per hour, the algal transect exhibited a much higher daytime net production rate than did the coral-algal transect (0.72 vs 0.25 g C per square mile per hour). Although little particulate CaCO₃ was removed from the reef flat during these studies, there has been virtually no net CaCO₃ accumulation there over the last several thousand years. The technique applied to flowing water respirometry is demanding on present capabilities of resolution; however, it should be easily applicable in incubation chambers or in natural water, low-flow rate situations.

INDEX TERMS: Primary productivity, Monitoring, Hydrogen ion concentration, Alkalinity, Marine algae, Coral, Respiration, Carbon dioxide, Calcification.

AMIC-7203

"FUNGI OF THE CHESAPEAKE BAY AND ITS TRIBUTARIES II. THE GENUS CONIOSCYPHA", Shearer, C. A., Mycologia, Vol. 65, No. 1, January-February 1973, pp 128-136.

The morphology and conidium ontogeny of two species of Conioscypha isolated from balsa wood submerged in the Patuxent River were studied. One species appears to be identical to the type material of Conioscypha lignicola while the second is described as a new species. The description of the genus Conioscypha is emended on the basis of type and pure culture studies of Conioscypha lignicola.

INDEX TERMS: Marine fungi, Systematics, Conioscypha lignicola, Conioscypha varia, Patuxent River.

AMIC-7202

"FERROUS IRON AND THE GROWTH OF TWENTY ISOLATES OF PHYTOPHTHORA INFESTANS IN SYNTHETIC MEDIA", Cuppett, V. M., Lilly, V. G., Mycologia, Vol. 65, No. 1, January-February 1973, pp 67-77.

Twenty isolates of Phytophthora infestans grew well in a D-glucose-L-asparagine medium containing 1.0 ppm of ferric iron provided that 200mg/liter of L-ascorbic acid were added. Under these conditions ferric iron was reduced to the ferrous state. Most of the isolates reduced ferric iron after variable periods of incubation. Growth in media not containing L-ascorbic acid was associated with the reduction of ferric iron.

INDEX TERMS: Cultures, Growth rates, Culture media, Phytophthora infestans.

AMIC-7212

"TROPICAL ROLE OF BACTERIA IN THE ECOSYSTEM OF THE CORAL REEF", Sorokin, Y. I., Nature, Vol. 242, No. 5397, April 6, 1973, pp 415-417.

Micorbial biomass determinations at several atolls in the Pacific Ocean were determined by direct microscopy on stained membrane filters. Bacteria production and destruction, photosynthesis of phytoplankton and phytobenthos, and a quantitative study of the feeding of aquatic animals on bacteria have been made using C-14. These results showed that biomass and production of bacteria were in the range of those for eutrophic or mesotrophic lakes. The rate of destruction of organic matter usually exceeded the rate of primary production in the surface layers of water and sediments. Bacteria cells made up 2-5 percent of the total organic matter of the reef sediments. The daily production of raw bacterial biomass in the reef sediments was about 5-15 g/sq m of bottom surface. The high rate of bacterial production may provide a significant part of the food of the fauna of the coral reefs. Experiments were also conducted in which corals were fed with bacterioplankton and seston labelled with C-14. The evolution of labelled metabolic CO₂ by corals was used as a measure of the intensity of feeding and digestion of labelled bacteria. All the corals tested were able to feed on and digest the bacteria at concentrations close to that in the lagoon. The data show the importance of the bacteria population in the metabolism and productivity of the reef ecosystem. The internal function of the bacteria is nutrient regeneration and production of particulate protein food. The external function may be the consumption and assumption of external energy.

INDEX TERMS: Biomass, Bacteria, Primary productivity, Reefs, Trophic level.

2. BIOLOGICAL METHODS

AMIC-7280

"CONTINUOUS CULTURE OF RHODOTORULA RUBRA: KINETICS OF PHOSPHATE-ARSENATE UPTAKE, INHIBITION, AND PHOSPHATE-LIMITED GROWTH", Button, D. K., Dunker, S. S., Morse M. L., Journal of Bacteriology, Vol. 113, No. 2, February 1973, pp 599-611.

The kinetics of phosphate uptake, growth limitation, and inhibition of arsenate transport in Rhodotorula rubra are described in view of their relevance to microbial processes in dilute aquatic environments. R. rubra is a pink yeast which was recently isolated from sea water and is able to grow in continuous culture systems at low pH and at low phosphate concentrations. Population density averages were determined from routine plate counts and with a model B Coulter counter. Uptake rates were determined by scintillation counts of P-32-labelled phosphorus; arsenate was determined by As-73 labelling. The yeast was found to be capable of extended growth at very low phosphate concentrations (Concentration at one half maximal growth rate was 10.8 nanomoles). Average intracellular phosphate concentrations, based on isotope exchange techniques, were 15 to 200 millimoles, giving concentration gradients across the cell envelope of about one million. Inability of the phosphate transport system to discriminate against arsenate transport led to arsenate toxicity at 1 to 10 nanomoles. Phosphate competitively prevented arsenate toxicity. Phosphate uptake experiments showed that maximal growth rates could be achieved with approximately 4 percent of the total phosphate-arsenate transport system. Organisms adapted to a range both of concentration of NaCl and of pH. Phosphate initial uptake rates that were in agreement with the steady-state flux in continuous culture were obtained by using organisms and medium directly from continuous culture. This procedure resulted in rates about 500 times greater than one in which harvested batch-grown cells were used. Growth could not be

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sustained below a threshold phosphate concentration of 3.4 nanomoles. Equations are presented for evaluation of growth rate-limiting substrate concentrations in the presence of background substrate and for evaluating low inhibitor concentration inhibition mechanisms by substrate prevention of inhibitor flux.

INDEX TERMS: Kinetics, Phosphates, Absorption, Hydrogen ion concentration, Inhibition, Growth rates, Nutrient requirements, Rhodotorula rubra, Electron transport, Arsenates, Bioaccumulation.

AMIC-7370

"BIOASSAYS OF QUALITY IN WATER RESOURCES OF MAJOR IMPORTANCE TO NEW MEXICO", Smith, G. S., New Mexico State University, Department of Animal, Range, and Wildlife Sciences, Las Cruces, New Mexico, Report No. 015, November 1972, 82 pp. NTIS Report No. PB 213 628.

Samples of water from municipal supplies, wells, and surface sources in New Mexico were collected in polyethylene cans for use in studying the effects of water quality on ruminant and non-ruminant animals. White mice and rumen microorganisms were used in the bioassays. The waters were characterized by electrical conductivity, total dissolved solids, pH, hardness, and Ca, Mg, Na, K, Cl, HCO₃, CO₃, SO₄, NO₃, Cd, Hg, and Pb content. The studies showed that with waters which varied in mineralization from less than 100 to more than 4700 milligrams of total dissolved solids per liter, mouse growth and reproduction were not significantly affected by water sources, even though precision was sufficient to detect differences in growth of about 5 percent from the population means. Water sources markedly affected the degradation of fibrous substrates by rumen cultures, especially when purified cellulose rather than forage (alfalfa hay) was used as the substrate. The results indicate that the mouse is insensitive, in terms of growth and reproduction, to differences in quality of drinking water, at least in regard to the degree of gross mineralization; whereas, cultures of rumen microorganisms respond to changes in apparent quality of water which have been poorly documented and are apparently poorly defined to date. The data suggest that mineralized waters in certain major resources of New Mexico may have greater potential for usage in animal production than would be expected from standards of water quality currently in usage.

INDEX TERMS: Bioassay, Water quality, Potable water, Rumen microorganisms, Mice.

AMIC-7389

"POPULATION STUDIES OF THREE AQUATIC GASTROPODS IN AN INTERMITTENT BACKWATER", Eckblad, J. W., Hydrobiologia, Vol. 41, No. 2, March 29, 1973, pp 199-219.

Three snail populations of an intermittent backwater were studied over a 20-month period, and estimates were made of rate of population change, mean biomass, annual and summer net production, and survival under conditions of little standing water. Lymnaea palustris and Physa integra populations were essentially univoltine, while Gyraulus parvus appeared to produce several generations during the year. L. palustris formed a protective epiphyram and was apparently better suited to recurrent dry periods than either G. parvus or P. integra. The population density of G. parvus was usually well below, and more aggregated, than the other two species. The estimated annual production rates for L. palustris and P. integra were 2.18 g/sq m and 1.59 g/sq m, respectively, and these two species accounted for about 98 percent of the total gastropod production. About 75.9 percent and 66.5 percent of the L. palustris and P. integra production, respectively, occurred between June and November. Summer turnover ratios in 1969 were 4.69 for L. palustris and 2.94 for P. integra. An extended dry period early in the summer of 1970 reduced total snail production to about 18-24 percent of that of the previous season, although summer turnover ratios were fairly consistent.

INDEX TERMS: Snails, Dry beds, Standing crops, Productivity, Biomass, Backwater, Survival, Lymnaea palustris, Physa integra, Gyraulus parvus.

2. BIOLOGICAL METHODS

AMIC-7390

"EXPERIMENTS ON THE MOVEMENT BEHAVIOR OF SINGLE-CELL FLOWING WATER ALGAE", Mueller-Haeckel, A., *Hydrobiologia*, Vol. 41, No. 2, March 29, 1973, pp 221-239.

A schematical model is given of the drifting and recolonization of algal cells in an artificial channel with algal growth on the bottom when water free of algae was flowing through, as well as of the colonization of a clean channel by algal cells, when water of a brook was flowing through. Both phenomena are compared with drift and colonization in a natural channel by means of quantitative sampling. Before settling down again after drifting away a single algal cell may cover a distance of less than 38 m only. Multiple sampling over a period of 24 hours demonstrated diurnal periodicity in the drifting and colonization of various algal species from running water. (In German)

INDEX TERMS: Diatoms, Aquatic drift, Model studies, Colonization, Repopulation, *Ceratoneis arcus*, *Synedra minuscula*, *Achnanthes minutissima*.

AMIC-7426

"THE INFLUENCE OF SIMAZINE ON THE PHOTOSYNTHETIC PIGMENTS OF GREEN ALGAE", Paromenskeya, L. N., Lyalin, G. N., Defence Research Information Centre, Orpington, England, DRIC Translation No. 2992, DRIC-BR-30358, November 1972, 10 pp. Translated from *Friziol. Rast.* Vol. 15, No. 6, 1968, pp 1002-1007. NTIS Report No. AD 754 220.

The amount of chlorophylls a and b, carotin, lutein and violaxanthin and the chlorophyll luminescence spectra were determined after the incubation for 2, 7 and 17 days of three species of green algae in a medium which either contained or did not contain simazine. The pigment content, and particularly that of lutein, carotin and chlorophyll a, decreased in the cells of the herbicide sensitive species *Chlorella vulgaris* and *Ankistrodesmus braunii*. On the basis of the measurement of the chlorophyll luminescence spectra in suspensions of algae, it was deduced that the observable decrease of chlorophyll with sensitive algae is not directly linked to the interaction of the pigment with simazine. In the cells of the resistant species of *Chlorosarcina* sp, such an interaction takes place even by the second day, which apparently must be one of the reasons for the detoxication of simazine in the cells.

INDEX TERMS: Herbicides, Triazine pesticides, Water pollution effects, Plant pigments, Pesticide toxicity, Chlorophyta, Aquatic algae, Chlorinated hydrocarbon pesticides, Simazine, *Chlorella vulgaris*, *Ankistrodesmus braunii*, *Chlorosarcina*, Photosynthetic pigments, Luminescence spectra, Lutein, Carotin, Chlorophyll a, Culture media.

AMIC-7422

"THE USE OF AQUATIC PLANTS IN THE REHABILITATION OF ACID POLLUTED STREAMS", Wagner, R. H., Pennsylvania State University, Institute for Research on Land and Water Resources, University Park, Pennsylvania, Report No. W73-02611, Contract No. DI-14-31-0001-3538, June 1972, 13 pp. NTIS Report No. PB-213 507.

The general ecology of *Eleocharis acicularis* (L.) R. and S. was studied with special emphasis placed on its relation to acid polluted streams. Distribution and vigor appear to be related to the pH and P levels of the water and substrate: in laboratory experiments, growth was optimal in the pH range of 3.6 to 5.0 and inversely proportional to P concentration. Other mineral factors appear to be related to *Eleocharis acicularis* distribution. The adult plant also has a broad temperature amplitude for it is able to grow at 32 C and overwinter in a vegetative state at 4 C. Reciprocal transplants and microscopic examination of the culm confirmed the identity of the sterile-aquatic form and the fertile-terrestrial form. Under proper conditions of moisture or cold treatment, the seeds will germinate readily with a germination rate of 80 percent. Internationally, the seed is simple and relatively undifferentiated. The mode of germination closely resembles that of *Eleocharis palustris*. The abundance of *aufwuchs* and certain insect larvae point to the importance of *Eleocharis acicularis* in providing suitable substrate and shelter for other organisms.

INDEX TERMS: Aquatic plants, Rehabilitation, Acid streams, Water pollution control, Mine drainage, Plant growth, Iron, Phosphorus, Laboratory tests, Ecological distribution, Limiting factors, Periphyton, Water pollution effects, *Eleocharis acicularis*, Macrophytes, Sedges.

AMIC-7433

"PESTICIDE DEGRADATION BY MARINE ALGAE", Boush, G. M., Matsumura, F., University of Wisconsin, Department of Entomology, Madison, Wisconsin, Report No. 1, Contract No. N00014-67-A-1028-0023, February 1, 1973, 7 pp. NTIS Report No. AD 754 841

A collection has been developed of marine algae representative of the major groups in pure culture. An improved technique has been developed to effectively survey algae for potential degradative ability with reference to pesticides. The pesticide is added to the algal cultures in the log, or active growth phase. The cultures are then analyzed for metabolites after a 7-day incubation period. Such a procedure allows for a minimum possibility of pesticide inhibition of growth. All pesticides were C-14-labeled and degradation products were examined by comparative TLC and autoradiography. Marine algae, in general, appeared to be influenced by low levels (ppb range) of many pesticides adversely. Pesticide degradation abilities appeared less than those encountered with bacteria. A study of the 'Effect of DDT on Growth and Morphology of *Platymonas* sp.' has been proposed as an addition to the present project.

INDEX TERMS: Marine algae, Pesticides, Degradation (decomposition), DDT, Methodology, Chlorophyta, Diatoms, Systematics, Radioactivity techniques, 2 4-D, 2 4 5-T, Pure cultures, Fate of pollutants, Metabolites, Thin layer chromatography, Autoradiography.

2. BIOLOGICAL METHODS

AMIC-7439

"ENVIRONMENTAL EFFECTS ON TOXAPHENE TOXICITY TO SELECTED FISHES AND CRUSTACEANS", Courtenay, W. R., Jr., Roberts, M. H., Jr., Aquatic Sciences, Inc. Boca Raton, Florida, Report No. EPA-R3-731035, Contract No. 14-12-532, April 1973, 73pp.

Laboratory studies were conducted to determine lethal limits (96 hr TL sub 50) for Toxaphene, salinity, temperature, and dissolved oxygen and their interaction effects on developmental stages of selected warm-temperate and subtropical fishes and crustaceans. Species tested were *Micropterus salmoides* (largemouth bass), *Mugil cephalus* (stripped mullet), *Mugil curema* (silver mullet), *Trachinotus carolinus* (pompano), *Callinectes sapidus* (blue crab), *Penaeus duorarum* (pink shrimp), *Sesarma cinereum* (drift line crab), and *Rhithropanopeus harrisii* (mud crab). Histopathological and gross morphological studies were conducted on all early life history stages of the species included. Earliest developmental stages of the fish species treated are more resistant to high levels of salinity, and to low levels of dissolved oxygen, but more sensitive to high temperatures than are later stages. Decapod larvae showed increasing tolerance to Toxaphene with increasing developmental age. Synergistic effects between Toxaphene and the three environmental factors were suggested in the species tested. Some histopathology was noted in fry of bass and mullet, and in larvae of *Sesarma cinereum*, *Callinectes sapidus*, and *Rhithropanopeus harrisii*.

INDEX TERMS: Fish, Environmental effects, Pesticide toxicity, Water pollution effects, Bioassay, Crustaceans, Laboratory tests, Shrimp, Salinity, Dissolved oxygen, Larvae, Food habits, Water temperature, Chlorinated hydrocarbon pesticides, Animal behavior, Juvenile fish, Larvae, Crabs, Histopathology, Toxaphene, Synergistic effects, Median tolerance limit.

AMIC-7460

"TRACE ANALYSIS BY ENZYME INHIBITION AND ACTIVATION", Townshend, A., *Process Biochemistry*, Vol. 8, No. 3, March 1973, pp 22-24.

The use of enzyme inhibition and activation to detect metals, non metals, pesticides and drugs is reviewed. Activation techniques have been used to detect K, Ca, Mg, Mn, Zn, Fe, Mo, Cu, and Co. Inhibition methods have been used to detect F, Hg, Ag, I, sulfite, cyanide, Ba, Be, Zn, Cu, Fe, In, Rb, the pesticides aldrin, sevin, lindane, heptachlor, methyl parathion, DDT, and chlordane, and the drugs LSD, tetrahydrocannabinol, morphine sulfate, sodium phenobarbitone, and sodium barbitone. Tables are included which show the enzymes used to detect metals, pesticides, and drugs and their detection limits.

INDEX TERMS: Enzymes, Pollutant identification, Inhibition, Chlorinated hydrocarbon pesticides, Heavy metals, Potassium, Calcium, Magnesium, Manganese, Zinc, Iron, Molybdenum, Copper, Cobalt, Fluorine, Mercury, Iodine, Sulfides, Beryllium, Lead, Aldrin, Heptachlor, DDT, Drugs, Cyanides, Silver, Barium, Indium, Sevin, Lindane, Methyl parathion, Chlordane.

AMIC-7484

"SUMMARY OF RECENT TECHNICAL INFORMATION CONCERNING THERMAL DISCHARGES INTO LAKE MICHIGAN", Argonne National Laboratory, Center for Environmental Studies and Environmental Statement Project, Argonne, Illinois, Report No. EPA/V-CR-72-1, August 1972, 131 pp. NTIS Report No. PB 214 261

This report is a review of new technical information, relevant to the environmental effects of thermal discharges into Lake Michigan, which is not reflected in the existing record of the Lake Michigan Enforcement Conference. The report discusses separately the physical and biological aspects of thermal discharges. It includes descriptions of preoperational field studies, thermal-bar measurements, field measurements of the physical and biological characteristics of thermal discharges, mathematical modeling techniques, laboratory tests on biological effects of heated water, intake and outfall designs, power plant operational data, analyses of environmental effects and cost estimates of closed-cycle cooling systems, and chemical discharges from both fossil and nuclear power plants.

INDEX TERMS: Lake Michigan, Environmental effects, Thermal pollution, Heated water, Nuclear powerplants, Thermal powerplants, Water pollution effects, Aquatic life, Reviews, Pollution abatement, On-site investigations, Physical properties, Biological properties, Laboratory tests, Periphyton, Benthos, Chemical wastes, Cooling towers, Documentation, Phytoplankton, Zooplankton, Freshwater fish, Saline water fish, Data collections, Effluents, Cooling water, Biological effects.

AMIC-7486

"THE UPTAKE OF INSECTICIDES BY FRESHWATER MUSSELS AND THE EFFECTS OF SUBLETHAL CONCENTRATIONS OF INSECTICIDES ON THESE MUSSELS", Zabik, M. J., Bedford, J. W., Michigan State University, Department of Entomology, East Lansing, Michigan, Project Completion Report, Contract No. 14-31-01-0001-3022, December 1972, 27 pp. NTIS Report No. PB-214 090.

Freshwater mussels were exposed to several concentrations of DDT (2,2 bis(p-chlorophenyl)-1,1,1-trichloroethane) and dieldrin (hexachlorocyclooctahydro-endo, exo-dimethanonaphthalene) in natural lake water and reconstituted distilled water under continuous flow and constant temperature conditions. Mussels from the test aquaria were removed from their shells, drained, weighed to the nearest milligram, dissected into various portions and blended with hexane: acetone (2:1) three times. The extract was washed with 10 percent NaCl to remove the acetone and dried. An aliquot was used for determination of percent of fat and the remaining extract was concentrated for introduction onto a cleanup column, eluted, extracted, and analyzed by electron capture gas chromatography. The identities of the insecticides and their metabolites found were confirmed gas chromatographically using columns packed with 5 percent DC 11 on Gas Chrom Q and 11 percent QF-1-OV-17 (1.3:1) on Gas Chrom Q. Selected samples were also spotted on Brinkman pre-made silica gel thin layer plates, developed with hexane-diethyl ether (4:1) and detected with Rhodamine B. The mussels concentrated DDT approximately 2400 fold and dieldrin 1200 fold in lake water. They concentrated DDT about 1000 fold in distilled water. The concentration of pesticides in the mussels reached equilibrium with the level in the water faster in lake water than in distilled water and the pesticide also had a shorter half-life in the mussel in lake water. The half-life of dieldrin was 4.7 days in lake water compared to 12.6

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<p>AMIC-7486 (Continued) Card 2/2</p> <p>days for DDT in lake water. The pesticide concentrations were highest in the digestive and reproductive tissue and low in the muscle, mantle, and gill tissues. The concentrations were very low in the marsupia in tests run in distilled water but were almost as great as those the digestive and reproductive tissue in lake water.</p> <p>INDEX TERMS: DDT, Dieldrin, Mussels, Absorption, Bioassay, Water effects, Natural streams, Insecticides, Lakes, Pollutant identification, Chemical analysis, Aquatic animals, Lethal limit, Bioaccumulation, Metabolites, Macroinvertebrates, Sample preparation, Animal tissues, Electron gas capture chromatography, Lampsillia siliquidea, Anodonta grandis, Elliptio dilatatus, Continuous flow technique.</p>	<p>AMIC-8487 (Continued) Card 2/2</p> <p>asures are listed that might be taken to prevent further enrichment of the lake with these nutrients.</p> <p>INDEX TERMS: Limiting factors, Water pollution sources, Primary productivity, Seasonal, Pollutant identification, On-site investigations, Water properties, Eutrophication, Phytoplankton, Zooplankton, Regression analysis, Correlation analysis, Water chemistry, Nutrients, Biological properties, Chemical properties, Physical properties, Standing crops, Lake Cochrane, Lake Hendricks, Chlorophyll a.</p>
<p>AMIC-7487</p> <p>"ECOLOGICAL FACTORS INFLUENCING PRODUCTION OF ALGAE IN NORTHERN PRAIRIE LAKES", Haertel, L., South Dakota State University, South Dakota Water Resources Institute, Brookings, South Dakota, Completion Report, October 1972, 63 pp.</p> <p>Two prairie lakes (Cochrane and Hendricks) were samples weekly, biweekly, and monthly, respectively, during the summer, spring and winter in order to determine what factors influence production. This was directed toward determining (1) the steps that might be taken to prevent the massive algal blooms, with emphasis on possible nutrient limitation of the algal population, and (2) which lakes would profitably fit into the scheme. Water samples were obtained for chemical and chlorophyll a analyses and algal cell counts; zooplankton were also sampled. Primary plankton production and nutrient enrichment studies were carried out in situ using BOD bottles. Temperature and water transparency were measured at all sites. All samples from all dates within a given season were run through linear correlation analysis to determine which biological, chemical, and physical variables were interrelated. Included in the correlation analysis were the following weather data: Solar radiation (Langley's), rainfall, wind stress (t), and the effective displacement index (EDI). After a correlation matrix was determined, multiple regression (Little, 1966) was performed on certain variables from all data to determine causative factors. Dependent variables were: algal standing crops (determined as both chlorophyll a, and cell counts of the most important species); inorganic and organic nitrogen; inorganic phosphorus; inorganic carbon; and water transparency. Algal populations in Lake Hendricks did not give as clear cut a picture of nutrient limitation as Lake Cochrane which exhibited very close correlations between N, P, and algal populations. There was also a light and/or temperature limitation during the spring season. Recommended</p>	<p>AMIC-7491</p> <p>"EFFECTS OF CHEMICAL VARIATIONS IN AQUATIC ENVIRONMENTS. VOL. II. TOXIC EFFECTS OF AQUEOUS ALUMINUM TO RAINBOW TROUT", Everhart, W. H., Freeman, R. A., Colorado State University, Department of Fishery and Wildlife Biology, Fort Collins, Colorado, Report No. EPA-R3-73-011b, February 1973, 41 pp.</p> <p>Fertilized eggs, fry, and fingerlings were exposed to aqueous aluminum complexes in neutral and basic media under constantly flowing, controlled conditions of aluminum concentration, pH, and temperature in order to examine the toxic effects of aluminum. Concentrations chosen were significant in terms of possible solubility within the range of pH to be investigated. During the course of the tests, water samples were collected at about 2-wk intervals for analysis of dissolved solids, DO, alkalinity, chloride, nitrate, silicate and sulfate by 'Standard Methods'. Metallic cations were determined by atomic absorption and emission spectroscopy. Toxicities of various concentrations were highly pH dependent. Dissolved concentrations over 1.5 ppm aluminum caused physiological and behavioral aberrations as well as acute mortality. Toxic effects of suspended aluminum, though greater at lower concentrations, did not increase as much as the effects of dissolved aluminum with higher concentrations. Growth of trout exposed to high dosages of aluminum was reduced only as long as or slightly longer than exposure continued. Egg and fry bioassays were conducted with exposures in trays and simulated natural redds. Fertilization was not affected by any concentrations tested, and most mortalities occurred during hatching and in the post swim-up stage. Trends in toxicity were similar to those found with fingerlings indicating dissolved aluminum to be more toxic than equivalent suspended amounts.</p> <p>INDEX TERMS: Bioassay, Rainbow trout, Aluminum, Fish physiology, Fish eggs, Fry, Toxicity, Fish behavior, Metal complexes, Continuous flow technique, Salmo gairdneri</p>

2. BIOLOGICAL METHODS

AMIC-7497

"EFFECTS OF CHEMICAL VARIATIONS IN AQUATIC ENVIRONMENTS: VOL. I. BIOTA AND CHEMISTRY OF PICEANCE CREEK", Everhart, W. H., May, B. E., Colorado State University, Department of Fishery and Wildlife Biology, Fort Collins, Colorado, Report No. EPA-R3-73-011a, February 1973, 117 pp.

A study of Piceance Creek was undertaken to obtain information about physical, chemical, and biological parameters of a small stream in northwestern Colorado. Oil shale, abundant in this area, will likely be mined and processed in the future resulting in an alteration of the habitats in the Piceance basin, the White River, and the Colorado River. Therefore, this study could provide information on at least one unaltered habitat. Water samples for chemical analysis, biological samples, and data on the physical factors (water temperature, discharge, and conductivity) were collected monthly. Distinct seasonal trends and habitat preference were noted in invertebrate populations. Discharge was a major influence on invertebrates and chemical composition of the stream. Seasonal variations, biomass, and species composition of invertebrates appear characteristic of oil shale area streams.

INDEX TERMS: Physical properties, Chemical properties, Biological properties, Water chemistry, Environmental effects, Natural streams, Aquatic environment, Oil shales, Biota, Invertebrates, Colorado, Water analysis, Water quality, Fish populations, Aquatic insects, Annelids, Spatial distribution, Ecological distribution, Mollusks, Freshwater fish, Crustaceans, Piceance Creek, Macroinvertebrates.

AMIC-7499

"FISH AND FOOD ORGANISMS IN ACID MINE WATERS OF PENNSYLVANIA", Butler, R. L., Cooper, E. L., Crawford, J. K., Hales, D. C., Kimmel, W. G., Wagner, C. G., Pennsylvania State University, Department of Biology and Cooperative Fishery, University Park, Pennsylvania, Report No. EPA-R3-73-032, February 1973, 158 pp.

The objectives of this study were to: (1) develop a rapid and nonlethal bioassay for acid water using changes in utilization of cover and activity of fish, (2) determine the effect of different levels of acid mine drainage on the presence or absence of fish populations in the watersheds of Pennsylvania, (3) determine the median tolerance limits to low levels of pH of five aquatic insects chosen on the basis of their wide occurrence and common association in soft-water streams. Analysis of variance revealed there was no relationship between cover utilization and pH levels or between activity and pH levels for four species of fish (smallmouth bass, longnose dace, rock bass and brook trout). The failure of cover utilization and activity to reflect changes in water quality conditions makes this bioassay technique as tested unsuitable for the establishment of water quality criteria. In part II of the project it was found that common fish species normally distributed over several watersheds were absent where there was severe acid mine drainage. Of the 116 species of fishes found 10 species exhibited some tolerance to acid mine drainage (values of pH 5.5 or less). An additional 38 species were found at pH values between 5.6 and 6.4 with the remaining 68 species at pH levels above 6.4. Severe degradation occurred at pH levels between 4.5 and 5.6. In part III all five aquatic species survived exposure for four days to pH levels from 6.5 to 4.0. The 96-hour TL sub m values ranged from 3.31 for the most sensitive animal, *Stenonema* sp., to 1.72 for the most tolerant insect, *Nigronia fasciata*.

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INDEX TERMS: Bioassay, Water pollution effects, Mine drainage, Acid mine water, Aquatic insects, Freshwater fish, Fish behavior, Fish food organisms, Water quality, Watersheds (basins), Fish populations, Acidic water, Pennsylvania, Resistance, Ecological distribution, Median tolerance limit, Data interpretation, Continuous flow technique, Survival, Macroinvertebrates.

AMIC-7500

"LIMNOLOGY OF YELLOWTAIL RESERVOIR AND THE BIGHORN RIVER", Wright, J. C., Moore, F. L., Montana State University, Bozeman, Montana, Report No. EPA-R3-73-002, February 1973. 96 pp.

A comprehensive investigation of the physical, chemical and biological limnology of Bighorn Lake (formerly Yellowtail Reservoir) and its tributaries was initiated in the fall of 1967 to determine if a decline in primary productivity of this new impoundment would occur. The study specifically encompassed the heat budget, salinity regime, internal currents and biological productivity (phytoplankton) of the reservoir. The three-year study was undertaken to relate the physical and chemical environment of the reservoir to primary production and to determine what changes in the primary production took place over the entire study. An effort was also made to assess the physical and chemical characteristics of the influent and effluent waters of the reservoir. Chemically, water impounded in the reservoir, was a calcium, sodium, sulfate, bicarbonate type. Mean salinity of the effluent was essentially the same as that of the influents. Impoundment and deep water withdrawal displaced the maximum and minimum temperatures and conductivities of the effluent approximately two months behind the influent occurrence and greatly reduced the amplitude of seasonal change. Of the influent total carbon, nitrogen and phosphate, 24 percent, 25 percent and 86 percent respectively were retained in the reservoir. The major fraction retained was the particulate fraction. Of the trace metals there was a 97 percent retention for iron, 86 percent for manganese, 40 percent for copper and 71 percent for zinc. Particulate carbon, nitrogen, and phosphate, orthophosphate, nitrate and trace metals were in higher concentration in the upper end of the reservoir associated with silt. A withdrawal created density current was evident

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which altered the vertical and longitudinal distribution of physical and chemical parameters. Volume based phytoplankton density and chlorophyll concentration decreased down-reservoir. However, the depth of the euphotic zone increased down-reservoir as silt settled out. Consequently the euphotic zone standing crops were greatest in the mid-section of the reservoir. Insufficient light penetration was the principal limiting factor to primary production in the upper end of the reservoir. Decreased primary production in the lower end of the reservoir did not appear to be due to nutrient limitation.

INDEX TERMS: Limnology, Primary productivity, Physical properties, Chemical properties, Biological properties, Effluent streams, Influent streams, Limiting factors, Lake morphometry, Standing crops, Phytoplankton, Impounded waters, Water quality, On-site investigations, Laboratory tests, Withdrawal, Ecology, Yellowtail Reservoir, Bighorn River, Bighorn Lake.

AMIC-7503

"DEVELOPMENT OF A RECEIVING WATER QUALITY BIOASSAY CRITERION BASED ON THE 48-HOUR PACIFIC OYSTER (*CRASSOSTREA GIGAS*) EMBRYO", Woelke, C. E., Washington Department of Fisheries, Management and Research Division, Olympia, Washington, Technical Report No. 9, Contract No. 68-01-0710, October 1972, 93 pp.

In this report, a numerical marine receiving water criterion based on the 48-hour Pacific oyster, *Crassostrea gigas* 'embryo' is proposed. Choice of the criterion is based on the results of 10 years of field bioassays conducted with the 48-hour Pacific oyster embryo on the marine waters of Washington State. The choice of the 48-hour Pacific oyster embryo development as a meaningful measure of marine water quality is justified by comparing its response to that of other bivalve embryos, bivalve adults and marine larvae, crustacea, fishes, and algae to a wide variety of toxicants. Facilities and equipment needed for conducting bioassays with Pacific oyster embryos are described, as well as methods for conditioning the adult oysters for spawning during all months of the year. A standard method for conducting bioassays with 48-hour Pacific oyster embryos is described in detail. Statistical validation of the method and its extension to marine field waters is presented, as well as procedures for treating and processing data from Pacific oyster embryo bioassays.

INDEX TERMS: Bioassay, Embryonic growth stage, Methodology, Water quality standards, Laboratory animals, Laboratory equipment, On-site tests, Computer programs, Data processing, Laboratory tests, Pacific oyster, Receiving waters, *Crassostrea gigas*, Data interpretation, Method validation.

AMIC-7501

"DEVELOPMENT OF DISSOLVED OXYGEN CRITERIA FOR FRESHWATER FISH", Warren, C. E., Doudoroff, P., Shumway, D. L., Oregon State University, Department of Fisheries and Wildlife, Corvallis, Oregon, Report No. EPA-R3-73-019, February 1973, 121 pp.

This terminal report nominally covers laboratory research on the dissolved oxygen requirements of salmonid and centrarchid fishes conducted from September 1, 1968, through August 31, 1971. Because the interpretation of the results of this research, the conclusions, and the recommendations are to a considerable extent based on the results of research conducted from September 1, 1955 through August 31, 1968, a summary of this earlier work is included. The research reported here has involved laboratory studies on the survival, development, bioenergetics and growth, swimming performance, and avoidance behavior of chinook and coho salmon, steelhead trout, and largemouth bass. Some of the studies have been conducted under very simple laboratory conditions, as in aquaria or other apparatus, but some of the studies on bioenergetics and growth have also been conducted under rather natural conditions in laboratory streams and ponds. In some important cases, we have found close correspondence between the effects of reduced oxygen concentration in aquarium studies of growth at maximum rations and its effects under more natural conditions in laboratory streams and ponds. Some of the biological responses of the fish studies were affected by any appreciable reduction in dissolved oxygen below the air saturation levels, whereas others were affected only at levels below about 50 percent the air saturation levels.

INDEX TERMS: Laboratory tests, Dissolved oxygen, Oxygen requirements, Freshwater fish, Water quality, Research and development.

AMIC-7544

"NITROGEN AND PHOSPHORUS UPTAKE BY *CHLORELLA PYRENOIDOSA* IN SEWAGE TREATMENT PROCESS", Michel, T. M., Michel, J. L., *Water and Sewage Works*, Vol. 120, No. 3, March 1973, pp 76-79.

In a series of experiments the alga, *Chlorella pyrenoidosa*, was grown using the primary effluent of a domestic sewage treatment plant as a nutrient base and studied specifically for its ability to utilize the nitrogen and phosphorus forms present in the secondary stages of wastewater treatment. To study N and P assimilation, a controlled system in a batch culture format was set up which included a method for continuous monitoring of DO, pH and culture temperature. Samples of primary effluent were analyzed for basic nutrient data and then placed in the culture vessels. Tests were conducted for between 48 and 168 hours on the metabolic behavior of the algae and on the patterns of nutrient assimilation. All soluble, precipitate and total forms of organic and inorganic P were measured, and quantitative analyses of total Kjeldahl N, organic N and NH₃ were made. Culture samples were analyzed for coliform organisms, cell count and mass, chlorophyll, NO₂, NO₃, suspended solids, BOD, COD, DO, and pH. Photosynthetic activity was determined by evaluating DO concentrations. About 50 percent of all P forms present in the primary effluent were removed by *Chlorella*. Media pH rose during the initial bloom periods but tended to stabilize over the entire run. During an experimental run period there was a significant drop in the number of fecal and total coliform group organisms present. N uptake closely paralleled the rate of biosynthetic activity and over 80 percent of the N forms present were removed. Experimentation showed that growth and nutrient assimilation rates for *Chlorella pyrenoidosa* far exceed those of the strain of *Scenedesmus acutus* isolated from the sewage samples.

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INDEX TERMS: Nitrogen, Phosphorus, Nutrient removal, Sewage effluents, Sewage treatment, Absorption, Domestic wastes, Cultures, Chemical analysis, *Chlorella pyrenoidosa*, Assimilation, *Scenedesmus acutus*, Substrate utilization, Quantitative analysis.

AMIC-7564

"FOULING ON EELGRASS (*ZOSTERA MARINA* L.)", Sieburth, J. McN., Thomas, C. D., Journal of Phycology, Vol. 9, No. 1, March 1973, pp 46-50.

The heavily fouled, immersed part of the blade, and the emerged portion of the blade undergoing fouling from mature, first-year plants collected by SCUBA from a brackish marsh were examined by scanning electron microscopy. It was observed that the surface of young shoots emerging in the spring and the surface of mature blade tips immersed in the fall when examined at 500 to 2000 times have a minimal scattering of coccoid and filamentous bacteria which are relatively insignificant in comparison to the colonization by pennate diatoms. Broken frustules and detritus adhere to form a crust which then becomes colonized nonselectively by a variety of microorganisms (stalked and colonial diatoms, filaments of red alga, a blue-green alga (*Spirulina*), a bacterium, and mycelia and sporangia of a fungus). Removal of the crust shows that the original 'cobblestone' surface of the eelgrass is obscured with a layer of deformed cells of *Cocconeis scutellum* which appears to be impressed into the epithelium.

INDEX TERMS: Fouling, Diatoms, Marsh plants, Marine microorganisms, *Cocconeis scutellum*, *Zostera marina*, Colonization, Eelgrass, Scanning electron microscopy.

AMIC-7562

"ECOLOGICAL COMPARISONS OF THERMALLY AFFECTED AQUATIC ENVIRONMENTS", Parker, E. D., Hirshfield, M. F., Gibbons, J. W., Journal Water Pollution Control Federation, Vol. 45, No. 4, April 1973, pp 726-733.

Ecological comparisons were made of three South Carolina reservoirs differently affected by thermal effluent from nuclear reactors. One of the reservoirs received thermal effluent, another was recovering from thermal loading, and the third study area had had no direct elevation of water temperatures. The reservoirs were compared in species composition of vascular aquatic plants, fish, and reptiles and in relative abundance of shoreline vegetation. One obvious effect was the elimination of certain species of vascular plants and aquatic vertebrates, resulting in a lowered diversity. Relative abundance of most species of shoreline plants was reduced in the heated areas. This effect was noticeable until at least 6 yr following the termination of thermal input.

INDEX TERMS: Thermal pollution, Heated water, Water pollution effects, Aquatic plants, Reservoirs; Aquatic animals, Ecology, Ecosystems, Freshwater fish, Reptiles, Species diversity, Macrophytes.

AMIC-7572

"ABUNDANCE AND DIVERSITY OF MOLLUSCA IN AN INDUSTRIALIZED PORTION OF THE OTTAWA RIVER NEAR OTTAWA-HULL, CANADA", Mackie, G. L., Qadri, S. U., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 167-172.

A study was conducted to compare the abundance and diversity of Gastropoda and Pelecypoda during May-November 1968 in portions of the Ottawa River near Ottawa-Hull immediately upstream and downstream of outfalls from a slaughter house and two pulp and paper mills. Weekly determinations were made on both bottom and surface waters at 5 sites of velocity, dissolved oxygen and carbon dioxide, pH, and conductivity. Every 2 weeks bottom and surface waters were analyzed for 15 parameters, including BOD, orthophosphate, nitrate, nitrite, calcium hardness, total coliform and total fecal coliform bacteria. Gastropods and pelecypods were sampled using a random sampling technique using the Ekman grab. Percentage estimates of organic matter in the sediments were made by ashing after removal of all animals and weighing 3 samples from each station. Organic pollution was a major factor in limiting the abundance and diversity of Gastropoda and Pelecypoda in the Ottawa River near Ottawa-Hull. Analyses of 472 Ekman grab samples taken from May to November of 1968 showed that the average standing crop (no./sq m) of mollusks were larger in areas immediately upstream than in areas immediately downstream of slaughter house and pulp and paper mill outfalls.

INDEX TERMS: Water pollution effects, Ecological distribution, Spatial distribution, Gastropods, Industrial wastes, Standing crops, Mollusks, Snails, Clams, Pulp wastes, Pulp and paper industry, Outlets, Bottom sampling, Aquatic plants, Water quality, Water sampling, Organic wastes, Wood wastes, Sewage effluents, Water chemistry, Downstream, Upstream, Ottawa River, Pelecypods, Macroinvertebrates, Species diversity, Species density, Slaughterhouse wastes.

2. BIOLOGICAL METHODS

AMIC-7577

"THE SEASONAL CYCLE OF VITAMIN B12 IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA", Cattell, S. A., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 215-222.

Water samples were collected from four stations in the Strait of Georgia, British Columbia and one station in the waters connecting the Strait of Georgia and Juan de Fuca Strait over a period of 17 months for use in investigating the seasonal cycle of vitamin B12. Samples were filtered and frozen in polyethylene containers for analysis of phosphate, nitrate-nitrite nitrogen and vitamin B12. Salinity and temperature were also determined for each sample. Vitamin B12 was determined by bioassay using *Amphidinium carterae*. After culturing for 11 or 12 days, bioassay samples were diluted and counted on a Model B Coulter Counter. The final yield of cell numbers was found with control solutions to be linearly related to vitamin B12 concentrations of at least 10 mg/liter. The results show that monthly averages for B12 in the upper 10 m of the Strait of Georgia are similar in temporal distribution to those of the inorganic nutrients including a winter high followed by an early spring decrease and a slight peak in late spring. However, B12 showed a peak in the summer while inorganic nutrients were at minimal concentrations. Furthermore, inorganic nutrients tended to increase with depth and correlated with water density. B12, however, showed little correlation with this parameter, even with summer stratification. It is concluded that the temporal and spatial distribution of B12 in the Strait is more complex than that of nitrate and phosphate. It is hypothesized that the observed heterogeneity of B12 is largely a result of interactions of vitamin particulate matter.

INDEX TERMS: Bioassay, Seasonal, Cycling nutrients, Phosphates, Nitrates, Distribution patterns, Vitamin B-12, *Amphidinium carteri*, Strait of Georgia.

AMIC-7581

"RESPONSE OF LOBSTERS *HOMARUS AMERICANUS* TO ODOR SOLUTION IN THE PRESENCE OF BLEACHED KRAFT MILL EFFLUENT", McLeese, D. W., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 279-282.

Lobsters (*Homarus americanus*) were exposed to dilute solutions of freeze-dried cod muscle extract (FDC) with and without bleached kraft mill effluent (BKME) in flowing water runways to investigate the possible effect of BKME on feeding response. Differences between test and control responses occurred in only two of 12 comparisons when FDC was associated with 10, 50, and 100 percent BKME. With six concentrations of BKME, ranging from 0.01 to 2.0 percent, maintained in the runways, responses to FDC were variable, but average responses for controls and tests did not differ. Conditions in the latter tests most closely approximated those in nature where some lobsters could be exposed continuously to low concentrations of BKME. It is concluded that exposure to low concentrations of BKME for short periods does not reduce the response of lobsters to FDC solutions or, if so, to a minor extent only. The effect of long-term exposures was not tested.

INDEX TERMS: Bioassay, Odor, Feeding rates, *Homarus americanus*, Bleached kraft mill effluent.

AMIC-7583

"AN IMPROVED EKMAN-TYPE GRAB", Burton, W., Flannagan, J. F., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 287-290.

An improved Ekman-type grab with top lids, which are locked open during descent and weighted to keep them closed during retrieval, is described. In comparative trials with a Wildco Tall 6-inch Birge-Ekman, the new grab collected significantly more chironomids and oligochaetes, and about the same number of the heavier and larger animals such as gastropods, sphaeriids, trichopterans, etc. The new design also improves the versatility and mechanical reliability of the grab.

INDEX TERMS: Sampling, Design, Reliability, Grab sampler, Ekman grab sampler.

AMIC-7586

"A COMPARISON OF BENTHIC MICROALGAL PRODUCTION MEASURED BY C-14 AND OXYGEN METHODS", Hunding, C., Hardgrave, B. T., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 309-312.

A comparison of estimates of benthic primary production on a sandy beach measured by in situ oxygen and laboratory C-14 methods showed that both methods gave similar measures of the magnitude of production. Sources of error in each method are discussed. Measures of C-14 uptake offer sensitivity when production is low, but when undisturbed sediment cores can be obtained, production is most easily measured by following changes in dissolved oxygen.

INDEX TERMS: Primary productivity, Radioactivity techniques, Benthic flora, Algae, Carbon, Absorption, Dissolved oxygen, Sensitivity.

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AMIC-7589

"SURVIVAL AND GILL CONDITION OF BLUEGILL (*LEPOMIS MACROCHIRUS*) AND FATHEAD MINNOWS (*PIMEPHALES PROMELAS*) EXPOSED TO SODIUM NITRILOTRIACETATE (NTA) FOR 28 DAYS", Macek, K. J., Sturm, R. N., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 323-325.

The toxicity of NTA to bluegills and fathead minnows has been evaluated under conditions of 28 days' continuous exposure to measured concentrations of NTA ranging from a mean (SE) of 3.4 (0.2) to 172.8 (3.7) mg/liter. Tests were conducted in a continuous-flow proportional dilution apparatus, the flow rate of which was 6 liters/hr. During the 28-day study water samples were analyzed for NTA using the Zinc-Zincon method for sequestrant in waste and sewage (Thompson and Duthie, 1968). Gills from the exposed fish were fixed in Bouin's fixative, stained using Heidenhain's Azan technique, and examined microscopically for possible NTA-induced damage. Dynamic bioassays in soft water (35 mg/liter as CaCO₃) indicated the 96-hr median tolerance limit (95 percent confidence interval) for NTA was 98 (72-133) mg/liter for rainbow trout, and 127 (93-170) mg/liter for fathead minnow. Such tolerance exceeded 1000 times the mean environmental levels that might be anticipated from detergent use. A 28-day dynamic bioassay with bluegill and fathead minnows indicated a lack of cumulative toxicity associated with levels of NTA up to 1000 times expected environmental concentrations in water. Fishes exposed to 96 mg/liter NTA for 28 days exhibited no NTA-induced gill pathology.

INDEX TERMS: Bioassay, Toxicity, Water pollution effects, Animal pathology, Gills, *Lepomis macrochirus*, *Pimephales promelas*, Continuous flow technique, Sodium nitrilotriacetate, Pollutant effects, Fathead minnow, Bluegills, Survival.

AMIC-7590

"A CYPRINODONTID FISH, *JORDANELLA FLORIDAE*, AS A LABORATORY ANIMAL FOR RAPID CHRONIC BIOASSAYS", Smith, W. E., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 329-330.

The flagfish (*Jordanelia floridae*) is proposed as a useful laboratory fish for chronic toxicity studies. It matures rapidly, reaching breeding age in 6 to 8 weeks under optimum conditions, and the fish will spawn at any time of the year. The adults are sexually dichromatic. A complete chronic test may be conducted with this species in as little as 3 to 4 months.

INDEX TERMS: Toxicity, Bioassay, Laboratory animals, Laboratory tests, Water pollution effects, *Jordanelia floridae*, Flagfish.

AMIC-7593

"COPPER INDUCED LESIONS IN ESTUARINE TELEOSTS", Gardner, G. R., LaRoche, G., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 363-368.

The advanced fry, zygotes and adults of the mummichog, *Fundulus heteroclitus*, and adult Atlantic silversides, *Menidia menidia*, were exposed to Cu in seawater. Adult *Fundulus* were also exposed by means of intraperitoneal injection. The initial copper concentrations to which adult (both species) and fry were exposed in their aquatic media were 0.0, 0.5, 1.0, and 5.0 mg/liter. In the portions of the study employing external exposures, the metal was added to the media following the introduction of fish. The exposure of zygotes was at concentrations of 0.0, 0.25, 0.5, 1.0, 3.0, 5.0, and 10.0 mg/liter. The intraperitoneal injections were given to adults at concentrations of 0.0, 0.5, 1.0, 10.0, 20.0, and 100.0 mg/liter in a 0.05 ml volume of 0.7 percent saline. Cellular changes attributable to copper were observed in the mechanoreceptors of the lateral line canals in the head of adult mummichog and Atlantic silverside. The epithelium of these canals was also altered in *F. heteroclitus*. In both species, lesions were observed in the olfactory organs, which included the chemoreceptive sites. These manifestations of copper poisoning were evident at all studied concentrations of the metal. In *M. menidia* dilation of blood vessels was apparent, and in five cases hemorrhage had occurred in the brain and in periorbital connective tissues. Renal lesions in *F. heteroclitus* exposed to 1.0 and 5.0 mg/liter of copper were apparent; these changes could not be identified in *M. menidia*. Hepatic changes were not detectable by light microscopy in either species following external exposures to copper. High concentrations of copper administered intraperitoneally to *F. heteroclitus* did induce liver damage. Fry of *F. heteroclitus* were more sensitive to copper than were the adults or their zygotes. The emergence of larval forms from the zygote, the time required for

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emergence, and their survival was impaired by the metal. Lesions were not evident in developing sensory areas of the lateral line or the olfactory systems in these immature forms.

INDEX TERMS: Copper, Toxicity, Growth stages, Bioassay, Fish diseases, Fish eggs, Juvenile fish, Larvae, Mature growth stage, Laboratory tests, *Menidia menidia*, *Fundulus heteroclitus*, Histopathology, Atlantic silverside, Mummichogs, Animal tissues.

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AMIC-7594

"SUBLETHAL EFFECTS OF BLEACHED KRAFT PULP MILL EFFLUENT ON RESPIRATION AND CIRCULATION IN SOCKEYE SALMON (*ONCORHYNCHUS NERKA*)", Davis, J. C., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 369-377.

Sublethal effects of aerated neutralized, filtered, full-bleach kraft mill effluent (BKME) on circulation and respiration of Pacific salmon were examined. Samples of the effluent were collected every 7-10 days from the alkaline waste sewer and sampling valves in the mill. Caustic extraction effluent was sampled along with the alkaline waste. All the samples were stored, unmixed at 2 C for up to 10 days. Composite samples approximating the composition of the waste discharged into the sea were tested for toxicity using 4-day static bioassay procedures (Sprague, 1969). Ventilatory water flow, oxygen uptake, cough frequency, and buccal pressure increased in a group of 19 sockeye salmon, *Oncorhynchus nerka*, 207-321 g, at 10.5 plus or minus 0.5 C, upon initial exposure to sublethal BKME concentrations. The threshold concentration for these responses appeared to be around 20 percent of the 4 day LC50 (static bioassay). Following overnight exposure to BKME, ventilatory volume, oxygen uptake rate, cough frequency, and oxygen utilization tended to approach pre-exposure levels, particularly at the higher sublethal concentrations. Changing effluent toxicity, acclimation phenomena, or physiological adjustment are discussed as possible explanations for these results. Measures of arterial oxygen tension in sockeye salmon indicated that arterial tension declines rapidly and remains depressed following up to 24 hr exposure to BKME (33-47 percent of 4 day LC50). On the average this decline represented a 20 percent decrease in oxygen saturation of the blood. Decreased arterial PO2 may be due to mucous production at the gills and resulting gas diffusion problems, as well as abnormalities in ventilation. Reduction in scope for

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activity might result from impaired oxygen uptake at the gills. A similar response was observed in rainbow trout, *Salmo gairdneri*.

INDEX TERMS: Pulp wastes, Toxicity, Bioassay, Respiration, Water pollution effects, Fish physiology, Industrial wastes, *Oncorhynchus nerka*, Circulation (blood), Bleached kraft mill effluent, Median tolerance limit.

AMIC-7597

"EFFECTS OF A 12-HR AND 25-DAY EXPOSURES TO KRAFT PULP MILL EFFLUENT ON THE BLOOD AND TISSUES OF JUVENILE COHO SALMON (*ONCORHYNCHUS KISUTCH*)", McLeay, D. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 3, March 1973, pp 395-400.

Juvenile coho salmon (*Oncorhynchus kisutch*) were exposed for periods of 12 hr and 25 days to pulp mill waste (neutralized unbleached white water) collected from the main sewer of a coastal British Columbia kraft pulp mill in order to establish the 96-hr median tolerance limit. Red blood cell counts and hematocrits of juvenile coho salmon were unaltered by 12-hr exposure to neutralized kraft pulp mill effluent, although hematocrits were decreased by exposure for 25 days. The number of circulating immature erythrocytes increased in effluent-exposed fish in both the 12-hr and 25-day exposures. The number of circulating small lymphocytes decreased markedly after 12-hr exposure. However, following the prolonged exposure, the number of small lymphocytes returned to normal, while the number of circulating neutrophils increased. The level of plasma glucose increased in fish exposed to effluent for 12 hr, and decreased in fish exposed for 25 days. Liver glycogen was not altered significantly during either exposure period. No pathological changes attributable to exposure to kraft pulp mill were observed in the tissues examined, including the spleen, kidney, gill, interrenal gland, skin epithelium, and thyroid gland. Results are discussed in terms of a stress response.

INDEX TERMS: Pulp wastes, Coho salmon, Juvenile fish, Bioassay, Water pollution effects, Fish physiology, Industrial wastes, Toxicity, Fish diseases, Lethal limit, Laboratory tests, Histopathology, Blood, Animal tissues, Hematology, *Oncorhynchus kisutch*, Spleen, Kidney, Gills, Thyroid gland, Liver, Glycogen, Glucose, Plasma, Unbleached white water, Median tolerance limit.

AMIC-7607

"TEMPERATURE EFFECTS ON MERCURY ACCUMULATION, TOXICITY, AND METABOLIC RATE IN RAINBOW TROUT (*SALMO GAIKDNERI*)", MacLeod, J. C., Pessah, E., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 485-492.

Hatchery-reared rainbow trout fingerlings were exposed to 5 concentrations of mercury (mercuric chloride and phenylmercuric acetate) at each of three temperatures (5, 10, and 20 C) in aquaria. Each aquarium was divided into 2 compartments, one holding 10-15 fish for assessing mortality and the other, 6 fish for Hg residue determinations in their flesh. Two fish were removed after 6, 24, and 96 hr of exposure, frozen whole and later thawed and weighed. The muscle, bones and skin were analyzed for total Hg by a wet digestion and flameless atomic absorption spectrophotometric method. Active metabolism determinations were made in respirometer flasks equipped with magnetic stirrers. Mercury toxicity was related to temperature and chemical formulation of the mercury. At 10 C, the 24-hr TL sub m concentration (median tolerance limit) for mercuric chloride (HgCl₂) was approximately 30 times that for phenyl mercuric acetate (PMA). The 96-hr TL sub m values for mercuric chloride at 5, 10, and 20 C were 0.40, 0.28, and 0.22 mg Hg/liter. The velocity of mortality, (V equals reciprocal of time to death in hours), was linearly related to temperature. For a mercuric chloride concentration of 0.5 mg Hg/liter, V equals 0.002 plus 0.0023t, where t equals temperature in centigrade degrees. Temperature also affected accumulation rate of mercury in the fish muscle. At 5, 10, and 20 C a mercuric chloride concentration of 0.1 mg Hg/liter in the water produced biological magnification factors (conc. in fish divided by conc. in water) of 4, 10, and 22 times, respectively. PMA produced higher magnification factors of 80-100 times at 10 C. Active metabolic rate,

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though increased by higher temperatures, was depressed by mercuric chloride, and higher temperatures augmented the depressant effect.

INDEX TERMS: Mercury, Toxicity, Rainbow trout, Bioassay, Juvenile fish, Fish physiology, Bioaccumulation, Metabolic rates, Biological magnification, *Salmo gairdneri*, Median tolerance limit, Mercuric chloride, Phenylmercuric acetate.

AMIC-7609

"EFFECTS OF SUBLETHAL CONCENTRATIONS OF SODIUM PENTACHLOROPHENATE ON GROWTH RATE, FOOD CONVERSION EFFICIENCY, AND SWIMMING PERFORMANCE IN UNDERYEARLING SOCKEYE SALMON (*ONCORHYNCHUS NERKA*)", Webb, P. W., Brett, J. R., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 499-507.

Two response systems, swimming speed and growth (along with food conversion efficiency) have been used as indicators of stress from sublethal concentrations of sodium pentachlorophenate. Tests were performed at 15 C, pH 6.8, and dissolved oxygen values of 90-100 percent air saturation. Growth rate and conversion efficiency were measured by feeding a ration level of 15 percent body dry weight/day to underyearling sockeye salmon (*Oncorhynchus nerka*) held at sodium pentachlorophenate (PCP) concentrations of 0, 1.14, 1.99, 3.49, 7.16, 13.60, 27.73, 31.57, and 47.18 ppb. Swimming performance was measured at PCP concentrations of 0, 7.21, 19.00 and 50.00 ppb. The 96-hr LC50 was 63 ppb PCP. Growth rate and conversion efficiency were almost equally affected by PCP, the EC50 values being 1.74 for ppb for growth rate and 1.80 ppb for conversion efficiency. This is approximately 2.8 percent of the 96-hr LC50. Swimming performance was unaffected by PCP at the concentrations used.

INDEX TERMS: Phenolic pesticides, Growth rates, Bioassay, Pesticide toxicity, Juvenile fish, Fish physiology, Fish behavior, Water pollution effects, Sockeye salmon, Food conversion efficiency, Sodium pentachlorophenate, Swimming, Data interpretation, *Oncorhynchus nerka*, Median tolerance limit.

AMIC-7608

"MACROBENTHIC ECOLOGY OF A SAWDUST-BEARING SUBSTRATE IN THE PENOBSCOT RIVER ESTUARY (MAINE)", Shorey, W. K., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 493-497.

The macrobenthos of sawdust-bearing substrates in the Penobscot River estuary (Maine) were sampled bimonthly from January through November 1968. The polychaete *Scolecoplex viridis* and the bivalves *Macoma balthica* and *Mya arenaria* dominated the sandy sediments of the shallow station. *Prionospio malmgreni* and *Corophium volutator* were dominant in the granular substrate of the deeper station. The population of the shallow station (1-m depth, mean low water) was seasonally more stable and had a higher mean monthly bio-index (number of individuals/number of species) than that of the deeper station (6-m depth, mean low water).

INDEX TERMS: Benthic fauna, Ecology, Estuarine environment, Annelids, Mollusks, Crustaceans, Nematodes, Systematics, Penobscot River, Macroinvertebrates, Sawdust, Substrates, Echinoderms, Nemertean, Species abundance.

AMIC-7610

"CRUSTACEAN PLANKTON AND THE EUTROPHICATION OF LAKES IN THE OKANAGAN VALLEY (BRITISH COLUMBIA)", Patalas, K., Salki, A., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 519-542.

In early September 1969 and late August 1971, the vertical and horizontal distribution of temperature, Secchi disc visibility, some chemical components, and zooplankton abundance in lakes Okanagan, Skaha, and Osoyoos were investigated. In addition, lakes Kalamalka and Wood were sampled only in late August 1971. Four different basins could be distinguished in Lake Okanagan; total dissolved solids, calcium, and electrical conductivity within the lake decreased gradually from north to south. Macroelement values within lakes Okanagan, Skaha, and Osoyoos were apparently not substantially different but Kalamalka and Wood lakes were about twice higher in sodium, potassium, magnesium and about 1.5 higher in total dissolved solids. Four species of copepods and nine species of cladocerans were found with *Cyclops bicuspidatus thomasi* and *Diaptomus ashlandi* dominant in all five lakes. *Diaphanosoma leuchtenbergianum* and *Daphnia longiremis* were the most common cladocerans in all five lakes. Also, *Daphnia thorata* was common in all except Wood Lake. Eighty-nine percent of the total plankters in Lake Okanagan were located in the upper 50-m layer. Relatively little horizontal variation was found within the lake but two areas, near Kelowna and in the northern end showed in both years of investigation greater abundance of plankton than the remaining areas. Crustaceans were usually less abundant inshore than offshore. Volume of settled net plankton varied from 8 cu mm/sq mm in Okanagan Lake to 31 cu mm/sq mm in Wood Lake. No substantial changes in species composition of zooplankton, Secchi disc visibility, and dissolved oxygen in the hypolimnion were found relative to the data of 1935 reported by Rawson. However, in 1969 and 1971 net plankton volumes were about five

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and three times larger, respectively, than in 1935. Calculations of total phosphorus load from two independent sources of data provided similar results and indicated that lakes Okanagan and Kalamalka are still in the oligotrophic range but close to mesotrophy. Lake Wood is moderately eutrophic and lakes Skaha and Osoyoos showed a marked degree of eutrophy, higher than in Lake Washington, U. S. A. before sewage diversion, or in Lake Erie. The estimates for lakes Wood, Skaha, and Osoyoos were supported by the values of the hypolimnetic areal deficits characteristic for highly eutrophic lakes. The trend of changes in phosphorus load during the past century is presented and predictions are made about the load in 1990 in situations with and without phosphorus removal from sewage.

INDEX TERMS: Eutrophication, Zooplankton, Crustaceans, Copepods, Waterfleas, Limnology, Okanagan Lake, Skaha Lake, Osoyoos Lake, Macroinvertebrates, Phosphorus load, Species abundance.

AMIC-7613

"INFLUENCE OF LEAD AND OTHER METALS ON FISH DELTA-AMINOLEVULINATE DEHYDRASE ACTIVITY", Jackim, E., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 560-562.

Mummichogs (*Fundulus heteroclitus*) and winter flounder (*Pseudopleuronectes americanus*) were exposed to solutions of Cu, Cd, Pb, Zn, and Ag salts for periods of 96 hours and 2 weeks to study the effects of lead and other metals on delta-aminolevulinic acid dehydrase activity (ALA-D). ALA-D activity was determined by homogenizing the organs in KCl, adding phosphate buffer and ALA-D. After one hour, reactions were stopped by the addition of HgCl₂ and trichloroacetic acid. This solution was centrifuged, the supernatant treated with Erlich's reagent and glacial acetic acid and allowed to react, and optical density determined as a measure of enzyme activity. Lead decreased ALA-D activity in both acute and chronic exposures in fish. The inhibition was not unique to lead, but appears to be limited to a few toxic heavy metals, namely lead, mercury, and copper. Other metals (Zinc, silver, and cadmium) increased enzyme activity at least during early periods of exposure or low concentrations. The results of the tests are expected to provide an index of response to heavy metals in estuarine waters.

INDEX TERMS: Bioassay, Inhibition, Heavy metals, Enzymes, Copper, Cadmium, Lead, Zinc, Silver, Sample preparation, Mummichogs, Winter flounder, Aminolevulinic acid dehydrase.

AMIC-7617

"ACUTE AND LONG-TERM ACCUMULATION OF COPPER BY THE BROWN BULLHEAD, *ICTALURUS NEBULOSUS*", Brungs, W. A., Leonard, E. N., McKim, J. M., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 4, April 1973, pp 583-586.

The present study was conducted to determine the acute and long-term toxicity and accumulation of copper by the brown bullhead (*Ictalurus nebulosus*) and to investigate the use of copper residues as a possible autopsy procedure. In addition, an attempt was made to collect some initial information on the transport, distribution, and accumulation rate of copper in fish. The fish were exposed to constant concentrations of copper ranging from 6.5 to 422 micrograms/liter. Copper concentrations in gill, opercle, liver, and kidney tissues of live fish did not differ from those that died during the acute exposure. Exposure of fish to sublethal concentrations for 20 days before exposure to lethal concentrations resulted in higher tissue levels in the dead fish than in fish not previously exposed. A distinct increase in liver and gill tissue copper concentrations occurred at exposure levels of 27 micrograms/liter and above. Equilibrium tissue levels of copper in the liver and gill were reached within 30 days. Copper levels in red blood cells and plasma after 20-months exposure did not differ from the controls. Red blood cells analyzed after 6-days and 30-days exposure to copper also showed no increased copper residues.

INDEX TERMS: Bioassay, Copper, Heavy metals, Toxicity, Water pollution effects, Brown bullhead, *Ictalurus nebulosus*, Biological samples, Gills, Opercle, Liver, Kidney, Blood, Bioaccumulation.

AMIC-7620

"THE LIMNOLOGY OF NITROGEN IN AN OKLAHOMA RESERVOIR: NITROGENASE ACTIVITY AND RELATED LIMNOLOGICAL FACTORS", Toetz, D. W., The American Midland Naturalist, Vol. 89, No. 2, April 1973, pp 369-380.

The surface waters of Lake Carl Blackwell, Oklahoma, were assayed, using acetylene reduction techniques, for their N₂ fixing potential at intervals of 2 to 3 weeks, between November 1969, and July 1971. Data were obtained on limnological factors which affect the rate of N₂ fixation; temperature, transparency of the water and concentration of nitrate, nitrite and ammonia at meter intervals. The ranges of the rates of ethylene production by concentrated and unconcentrated plankton were 0.1 to 225.6 and 50.6 to 185.4 nmoles per mg N hr, respectively. Rates fluctuated widely during the season and were nil in winter. Acetylene reduction at the surface was associated with the expanding phase of blooms of blue-green algae. Acetylene reduction by the sediments was also observed and uptake of nitrogen-15 by the plankton verified that an N₂ fixing potential exists in the lake. Observations on the seasonal cycle of inorganic nitrogen revealed that nitrification predominated in winter and early spring. Decreases in inorganic N in early summer at the surface were attributed to uptake by autotrophs. Mineralization proceeded after the demise of the autotrophs in autumn. During summer stagnation, nitrate, ammonia and nitrite were stratified, but there was no evidence of denitrification.

INDEX TERMS: Nitrogen fixation, Nitrogen cycle, Nitrification, Water analysis, Water temperature, Nitrates, Nitrites, Ammonia, Nitrogenase, Acetylene reduction, Transparency.

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AMIC-7624

"BIOLOGICAL EFFECTS OF FLUCTUATING WATER LEVELS IN THE SNAKE RIVER, GRAND TETON NATIONAL PARK, WYOMING" Kroger, R. L., The American Midland Naturalist, Vol. 89, No. 2, April 1973, pp 478-481.

Water levels fluctuate widely in the Snake River, Wyoming because of the demands for irrigation waters by Idaho potato growers. This study was conducted to determine whether these fluctuations had any significant effect on the biota in the river. Five samples of exposed stream bed (0.092 sq m by 0.1 m deep) were collected after flow was reduced from 2.8 to 0.3 cu m per sec. in less than 5 minutes, and aquatic invertebrates separated. A total of 15,490 invertebrates weighing 13.6 g were identified. Dipterans, caddisflies, mayflies, and stoneflies, in that order, were most abundant. A drift net and a migration trap placed below the riffles before drawdown showed that all of the macroinvertebrates in the exposed areas were left stranded. It was estimated that in a 3-km stretch of the river over 3 billion invertebrates were destroyed. In addition, 55 sculpins were left stranded in three 0.84 sq meter areas. The results indicate that fluctuating water levels may be more harmful to the production of sport fish than the actual destruction of prey organisms since algae and higher aquatic plants, which provide necessary habitat for these organisms, are also destroyed. Extreme low water levels may be more detrimental to productivity than fluctuating flows since other studies have shown that many organisms cannot adapt to alternating lotic and lentic habitats. It is concluded that flow conditions will have to be altered to improve the productivity of this area of the Snake River.

INDEX TERMS: Flow rates, Water level fluctuations, Irrigation effects, Stoneflies, Mayflies, Caddisflies, Diptera, Mites, Sculpins, Water beetles, Aquatic populations, Snake River.

AMIC-7627

"PLANT ANALYSIS FOR NUTRIENT ASSAY OF NATURAL WATERS", Gerloff, G. C., Wisconsin University, Department of Botany and Institute of Plant development, Madison, Wisconsin, Report No. EPA-R1-73-001, February 1973, 66 pp.

Plant analysis was developed as a relatively simple procedure for evaluating nutrient supplies and growth-limiting nutrients for nuisance macrophytes in lakes and streams. Plant analysis requires establishing in index segments of the macrophytes the critical concentration (minimum plant concentration for maximum yield) of each essential nutrient likely to limit growth. Critical concentrations for nitrogen, phosphorus, sulfur, calcium, magnesium, potassium, iron, manganese, zinc, boron, and molybdenum were established in appropriate index segments of Elodea occidentalis. The copper critical concentration was estimated. Critical concentrations for nitrogen, phosphorus, and several other elements were established in Ceratophyllum demersum. To evaluate plant analysis, samples of Elodea and Ceratophyllum were routinely collected from Wisconsin Lake, analyzed for essential nutrients, and the analyses were compared with the critical concentrations for indications of nutrient deficiency. A growth-limiting role of an element in a lake was indicated by plant concentrations below the critical level. Nitrogen, phosphorus, calcium, and copper were at or close to critical levels in one or more lakes. Neither phosphorus nor nitrogen seemed to be a general growth-limiting nutrient in the lakes sampled. The most unexpected result was an indication of copper deficiency in several lakes. From the extensive nutritional experiments to establish critical element concentrations, a synthetic nutrient medium for general macrophyte culture was developed.

INDEX TERMS: Bioassay, Nitrogen, Phosphorus, Sulfur, Calcium, Magnesium, Potassium, Iron, Manganese, Zinc, Nutrient requirements, Boron, Molybdenum, Plant growth, Elodea occidentalis, Ceratophyllum demersum, Culture media.

AMIC-7632

"THE ACCUMULATION FROM WATER OF ZN-65, MN-54, CO-58, AND FE-59 BY THE MUSSEL, MYTILUS EDULIS", Pentreath, R. J., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 1, February 1973, pp 127-143.

The accumulation from seawater of Zn-65, Mn-54, Fe-59, and Co-58 by the mussel, Mytilus edulis, has been studied in relation to the stable element levels of these isotopes both in the sea water and in individual tissues. For all four radionuclides the greatest accumulation occurred in the stomach and digestive gland samples and further localization of Zn-65 and Fe-59 was demonstrated by autoradiography. As the animals were starved during the accumulation period the loss of stable elements by individual tissues was also followed. Again the most notable effect occurred in the digestive gland tissues with the exception of a large of iron by the foot. Autoradiography showed that after two weeks accumulation Fe-59 occurs in large clusters in the foot, notable in the byssus gland area. These clusters disappear after a further two-week period and may thus be secreted into new byssus threads. The accumulation of nuclides was examined using a single exponential model and values obtained for flux rates, biological half times and asymptotic values were compared with the stable element concentration factors. An analysis of parameters of exchange of nuclides in individual tissues with the water was further examined using the Kendall coefficient of concordance. There is an indication that as well as accumulating nuclides via particulate matter in suspension the mucus itself is capable of sequestering them, even though they are in the soluble form, and may even preferentially accumulate soluble forms. The actual role of water in the accumulation of the nuclides studied appears to be relatively minor compared with that of food accumulation as estimated by difference from the calculated stable element values.

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INDEX TERMS: Bioaccumulation, Zn-65, Mn-54, Fe-59, Co-58, Bioassay, Mussels, Mathematical models, Mytilus edulis.

2. BIOLOGICAL METHODS

AMIC-7633

"THE OCCURRENCE AND SEASONAL VARIATION OF TRACE METALS IN THE SCALLOPS PECTEN MAXIMUS (L.) AND CHLAMYA OPERCULARIS (L.)", Bryan, G. W., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 1, February 1973, pp 145-166.

Two species of scallops, Pecten maximus (L.) and Chlamys opercularis (L.) were collected over a period of about 3 years from the English Channel in an attempt to follow seasonal changes in trace metal concentrations, to see whether reasons for individual variations could be detected, and to establish baseline concentrations for species from other areas. The body fluid, gonad, foot, kidneys, and remaining tissues from six animals were pooled for analysis of Ag, Cd, Cr, Co, Cu, Fe, Mn, Ni, Pb, and Zn by atomic absorption. Samples were prepared by drying, ashing, dissolving the ash in HCl, evaporating, and adding HCl and distilled water. Since lead, nickel, and cobalt contents were low a concentration procedure was used which involved chelation with ammonium pyrrolidine dithiocarbamate and extraction into methyl isobutyl ketone. Although there was considerable variation between individual animals, the mean concentrations of Ag, Co, Cr, Cu, Mn, Ni, Pb, and Zn were higher in the whole body of Chlamys than in Pecten but concentrations of Al, Cd, and Fe were lower. In both species seasonal changes in the concentrations of Co, Cu, Fe, Mn, Ni, Pb, and Zn were observed and in general, the highest values were found in the autumn and winter months. These changes may be related to food supply, since concentrations were generally highest when phytoplankton productivity was low and tended to fall in the spring as productivity increased rapidly to its annual peak. Despite problems arising from individual and seasonal variation, the kidneys and digestive glands of scallops appear to have potential as biological indicators of trace metals. The results obtained for Pecten and Chlamys are compared with those in the literature for species from the family Pectinidae.

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INDEX TERMS: Bioassay, Aluminum, Cadmium, Chromium, Cobalt, Copper, Iron, Manganese, Lead, Nickel, Zinc, Mollusks, Heavy metals, Absorption, Season, Silver, Scallops, Atomic absorption spectrophotometry, Pecten maximus, Sample preparation, Chlamys opercularis, Biological samples, Macroinvertebrates, Tissue juice, Gonads, Foot, Kidney, Tissue, Preconcentration, Bioaccumulation, English Channel, Body fluids.

AMIC-7634

"SOND CRUISE 1965: FACTOR AND CLUSTER ANALYSES OF THE PLANKTON RESULTS, A GENERAL STUDY", Angel, M. V., Fasham, M. J. R., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 1, February 1973, pp 185-231.

The data for five planktonic taxa sampled during the SOND cruise (autumn 1965) by R. R. S. 'Discovery' in a day and a night series of horizontally towed nets have been analyzed by factor and cluster analyses. The factor analyses of hauls showed that there were five biologically distinct zones in the water column between the surface and 1000 m. The zones were more distinct in the day series than in the night. Factor analyses of the individual taxa gave sensible groupings of species and the factor score plots gave 'averaged' depth distributions for each group. Cluster analyses of the individual taxa gave results consistent with the factor analyses. Both methods gave groupings which fitted the zonation patterns of the hauls, except for the two zones between 100 and 460 m at night. Only cluster analyses could be carried out on the total data matrices. Although satisfactory interpretation was only possible with the aid of the analyses of the individual taxa, the zonation and species groupings were again largely retained. The zonation of the planktonic taxa is shown to be very similar to that described for nektonic species sampled on the same cruise. The usefulness of these analytical methods is compared with the conclusions of other investigators. It is concluded that the rotation of the matrices to simple structure in the factor analysis gave a marked improvement in the ease of interpretation. For this data, principal component analyses gave very similar results to the full factor analyses.

INDEX TERMS: Distribution patterns, Copepods, Biological communities, Amphipods, Data interpretation, Ostracods, Euphausiids, Chaetognaths, Factor analysis, Cluster analysis.

AMIC-7635

"SOME EFFECTS OF A POWER PLANT ON MARINE MICROBIOTA", Fox, J. L., Moyer, M. S., Chesapeake Science, Vol. 14, No. 1, March 1973, pp 1-10.

Primary productivity, chlorophyll a, adenosine triphosphate (ATP), bacterial counts, total and dissolved solids, temperature and dissolved oxygen were used to evaluate the direct and indirect effects of power plant cooling water on marine microbiota. Both "shock" effects and changes occurring as organisms remained exposed to the warmer effluent were determined by following and sampling the heated water as it flowed out the discharge canal. The results showed that increased water temperature is having an effect on the marine organisms present. Effects are most profound immediately following heat exposure and their severity seems to be proportional to the temperature of the intake water. Primary productivity dropped an average of 25.9 percent. ATP and bacterial populations generally increased. Chlorophyll a showed wide fluctuations. The results showed that some organisms, such as phytoplankton, may be killed (or at least hindered in their ability to assimilate carbon) whereas other organisms, such as bacteria, survive condenser tube passage and may even increase in numbers as a result of prolonged exposure to increased heat.

INDEX TERMS: Primary productivity, Thermal pollution, Bacteria, Electric powerplants, Chlorophyll a, Adenosine triphosphate, Total solids.

2. BIOLOGICAL METHODS

AMIC-7636

"SWIMMING PERFORMANCE OF THREE WARMWATER FISHES EXPOSED TO A RAPID TEMPERATURE CHANGE", Hocutt, C. J., Chesapeake Science, Vol. 15, No. 1, March 1973, pp 11-16.

To evaluate the potential effects of thermal pollution on fish, largemouth bass, spotfin shiners, and channel catfish were collected from lake water at 27-31 C and immediately exposed to temperatures of 15 to 35 C at intervals of 5 C for 14-20 hours. Swimming tests were conducted in a 37 liter oval, plexiglass, closed system tunnel respirometer equipped with a pump capable of producing a velocity of 82 m/min circulated water in the tank. Water temperature was controlled by mixing water from two tanks, one at a temperature of 7-10 C and one at a temperature of 50 C. Fish were conditioned in the test tanks for 20 minutes with currents of 11.0 m/min for largemouth bass and spotfin shiners and 14.6 m/min for channel catfish. After conditioning the velocity was increased 3.6 m/min every 20 minutes until the fish collapsed against the retaining screen. Critical swimming speeds and weighted polynomial regressions were calculated for each species using data on absolute and relative performance. With all species, swimming performance increased with increasing temperature up to 30 C after which performance decreased. The optimum performance temperature, therefore, was the same as the ambient temperature of the natural habitat.

INDEX TERMS: Bioassay, Thermal pollution, Flow rates, Swimming, Channel catfish, Velocity, Spotfin shiner, Largemouth bass, Critical swimming speed.

AMIC-7637

"SUBLETHAL EFFECTS OF BALTIMORE HARBOR WATER ON THE WHITE PERCH, MORONE AMERICANA, AND THE HOGCHOKER, TRINECTES MACULATUS", Morgan, R. P., II, Fleming, R. F., Rasin, V. J., Heinle, D. R., Chesapeake Science, Vol. 14, No. 1, March 1973, pp 17-27.

Possible sublethal effects of Baltimore Harbor Water, which receives various industrial and domestic wastes, were investigated in bioassays with white perch and hogchokers. The tests were conducted in 170 liter polyethylene tanks containing full-strength Harbor water, half-strength Harbor water and water from the Patuxent River. Exposures were for 14 to 30 days for white perch and 7 to 28 days for hogchokers. After exposure, blood samples were collected for differential staining and bodies were dissected for enzyme, histology, heavy metal, and pesticide analyses. There were no significant variations in Cd, Cr, Cu, Fe, Hg, and Zn in the three tests. Dieldrin was the only pesticide found and variations were slight among the tests. However, physiological effects of Baltimore Harbor water included changes in thrombocyte, neutrophil, and basophil levels in white perch. Biochemical effects included increased LDH activity in the serum of white perch and hogchokers when exposed to Baltimore Harbor water, decreased acetylcholinesterase activity in white perch and hogchoker brains, and decreased catalase levels of the liver of both white perch and hogchokers. Sublethal effects were noted at the longer (28 and 30 day) exposures to the Baltimore Harbor water.

INDEX TERMS: Fish physiology, Bioassay, White perch, Heavy metals, Dieldrin, Enzymes, Cadmium, Chromium, Copper, Iron, Mercury, Zinc, Baltimore Harbor, Hogchoker, Histology.

AMIC-7649

"ECOLOGY AND PRODUCTION OF THE PROFUNDAL BENTHOS IN RELATION TO PHYTOPLANKTON IN LAKE ESROM", Jonasson, P. M., OIKOS Supplementum, Vol. 14, 1972, pp 1-148.

Morphometric and environmental data of the 17.3 sq km and 22 m deep dimictic, eutrophic Lake Esrom, Denmark are given. The seasonal variation in solar radiation, temperature, oxygen, specific conductivity, pH, transparency, ionic composition, and its relationship to primary production of phytoplankton was measured over 10 years. A spring maximum of diatoms usually occurs in April after the ice cover has gone and a summer maximum of bluegreens occurs in August. The seasonal succession is correlated with duration of ice cover, solar radiation, temperature, and nutrient supply. Mean annual phytoplankton gross production was 260 g C/sq m/yr, with a range from 170 to 330 g C/sq m/yr (2,440 kcal/sq m/yr). Net production, estimated as 75 percent of the gross production, consequently, was 195 g C/sq m/yr (1,830 kcal/sq m/yr). The essential relationships between environment, food, growth, life cycles, and population dynamics are described for three detritivores and two carnivores. The detritivore Chironomus anthracinus feeds at the mud surface. Oxygen content and food are the growth determining factors, because the periods when planktonic algae reach the bottom as fresh food coincide with the growth periods of Chironomus anthracinus. Changes in dry and wet weight, nitrogen (protein) and fat of the larvae also follow the environmental changes. The detritivorous tubificid Ilyodrilus hammoniensis and the mussel Pisidium casertanum both feed below the mud surface. Their food, growth, and life cycles have the same seasonal pattern, but are entirely different from Chironomus anthracinus and the following carnivores. Both species show similar seasonal changes in dry and wet weight and nitrogen content. The carnivores Chaoborus flavicans and Procladius pectinatus show the same growth pattern, similar changes in dry and wet weight

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and nitrogen content, and the same one-year life cycle. Insects dominate secondary production, which amounts to 100 kcal/sq m/yr. Mortality in the detritivore is high (3.59 kcal/sq m/yr) but lower in the carnivores (2.6 and 1.3 kcal/sq m/yr). Other losses are due to emergence. Turn over rates are rather low. Community respiration of the macrofauna amounted to 432 kcal/sq m/yr, or more than four times the secondary production. The production of profundal benthos in the lake is compared with the estimated production of zooplankton and the trophic relations between phytoplankton, zooplankton and benthos are discussed.

INDEX TERMS: Benthic fauna, Ecology, Phytoplankton, Secondary productivity, Profundal zone, Hypolimnion, Environmental effects, Aquatic insects, Food habits, Life cycles, Growth rates, Mollusks, Annelids, Biorhythms, Mortality, Dominant organisms, Annual turnover, Standing crops, Energy budget, Lake Esrom, Seasonal variation, Insect physiology, Nutrient supply, Seasonal succession, Energy flow, Data interpretation.

2. BIOLOGICAL METHODS

AMIC-7651

"ENERGY FLOW IN A WOODLAND STREAM ECOSYSTEM: II. THE TAXONOMIC COMPOSITION AND PHENOLOGY OF THE CHIRONOMIDAE AS DETERMINED BY THE COLLECTION OF PUPAL EXUVIAE", Coffman, W. P., Archiv fur Hydrobiologie, Vol. 71, No. 3, March 1973, pp 281-322.

The taxonomic composition and phenology of the chironomid community of a small woodland stream in eastern Northern America were investigated by the utilization of natural collections of surface drifting pupal exuviae. Based on pupal identifications 143 chironomid taxa were recognized: Orthocladinae (83), Chironomini (25), Tanytarsini (21) and Tanypodinae (14). A total of 34 patterns of emergence were summarized in six major and three minor types. Almost all Orthocladinae species had an emergence period in the late winter to mid-spring months. The other major taxa generally appeared later with the Chironomini and Tanypodinae being the most extreme. The onset of the emergence of the major taxa coincided sharply with the spring water temperature increase, the attainment of the maximum summer temperature and the period of maximum diel temperature fluctuation. Preliminary experiments on the decomposition of exuviae indicate that they remain floating for about two days. The quantification of the collecting method is discussed in conjunction with its possible use in benthic production studies. A short review of recently published work on the chironomid pupal life stage is included.

INDEX TERMS: Life cycles, Systematics, Phenology, Biorhythms, Pennsylvania, Midges, Biological communities, Linesville Creek, Species diversity.

AMIC-7657

"LOW pH VALUES SHOWN TO AFFECT DEVELOPING FISH EGGS (BRACHYDANIO RERIO HAM.-BUCH.)", Johansson, N., Kihlstrom, J. E., Wahlberg, A., AMBIO, Vol. 2, Nos. 1/2, February 1973, pp 42-43.

Since the acidity of lakes and rivers in northwestern Europe has been increasing, purportedly due to emission of sulfur compounds into the atmosphere from burning fossil fuel, tests were conducted with zebrafish eggs to determine the effects on fish populations. Eggs were collected and reared at 25 C in petri dishes containing water at pH ranges of 4.0 to 10.0. Dead and hatched eggs were counted daily. A total of about 2100 eggs were studied. The frequency of hatching decreased from about 50 percent at pH 7 to about four percent at pH 4, the young embryos being the most sensitive to the acid water. There was also a tendency towards a prolongation of the period from fertilization to hatching at low pH values. In slightly alkaline solutions the frequency of hatching remained unchanged, but there was a slight shortening of the period from fertilization to hatching.

INDEX TERMS: Water pollution effects, Hydrogen ion concentration, Bioassay, Fish eggs, Hatching, Sulfur compounds, Survival.

AMIC-7658

"PLANKTONIC CHANGES FOLLOWING THE RESTORATION OF LAKE TRUMMEN, SWEDEN", Anderson, G., Cronberg, G., Gelin, C., AMBIO, Vol. 2, Nos. 1/2, February 1973, pp 44-47.

Restoration of Lake Trummen, a shallow oligotrophic lake near Vaxjo, Sweden, was attempted by first cutting off pollutant sources and then removing the nutrient-rich sediment by suction-dredging. This paper reports some of the changes in the plankton communities in 1969 (before restoration) and 1972 (the year after restoration). Water samples were analyzed for phosphates, total phosphorus, ammonia, Kjeldahl nitrogen, pH, and transparency. Phytoplankton samples were collected at least once a month with a Ruttner sampler. Primary productivity of phytoplankton was determined by C-14 uptake. Zooplankton samples were collected in a plexiglass tube from 20 sites over 1-2 week intervals and composited for counts. Comparison of data showed that transparency increased and pH normalized after the restoration. Other primary changes occurred as follows. Biomass of phytoplankton was reduced; the massive bloom of *Microcystis aeruginosa* disappeared; maxima of diatoms occurred during August rather than in spring and autumn; Chrysophyceae and Glenodinium developed under ice; nanoplankton increased; and productivity, although not greatly different, resulted in larger part from nanoplankton. The most striking change in zooplankton was that species indicative of eutrophy (*Brachionus angularis*, *Trichocerca pusilla*, *Keratella quadrata*, *Chydorus sphaericus*) declined dramatically.

INDEX TERMS: Nutrients, Primary productivity, Phytoplankton, Zooplankton, Hydrogen ion concentration, Trophic level, Dredging, Succession, Restoration, Transparency.

AMIC-7663

"THE ZOOPLANKTON OF THE GULF OF GUINEA", Bainbridge, V., Bullens of Marine Ecology, Vol. 8, No. 1, September 1972, pp 61-97.

This paper concerns the quantity and composition of the zooplankton in the coastal waters of tropical West Africa and its variability in relation to the hydrographic climate of the region. Three series of zooplankton collections were used in this study: (a) samples taken with closing nets near the edge of the shelf off Guinea in October, 1956 and off Nigeria in 1961 and 1962 to investigate vertical distributions and migrations; (b) a series of samples collected from July 1961 to July 1962 at the stations of a monitoring oceanographic transect off Lagos, Nigeria, to study the annual cycle of zooplankton; and (c) samples collected in 1952 during extensive fishery surveys along the West African shelf between Cape Verde and Fernando Po. All collections were preserved in 5 percent formaldehyde made up in filtered sea water and neutralized with borax. A standard procedure was followed in examining the samples. The results of the plankton analyses were considered in terms of community diversity and trophic structure. Zooplankton showed a marked discontinuity at the thermocline, many copepod species being restricted to the Tropical Surface Water (TSW) or the South Atlantic Central Water (SACW) while others migrated diurnally between the two water masses. Off Lagos in 1961 and 1962, quantities of zooplankton within the upper 30 m were normally low, showing a gradual transition from a neritic to an oceanic fauna with increasing distance from the coast. During a weak upwelling in August and September, zooplankton volumes over the shelf increased fourfold or more. Two copepods, *Calanoides carinatus* and *Eucalanus monachus*, both relatively rare over the shelf during stable conditions, became abundant in the surface waters. During the upwelling, the faunal diversity

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declined and the percentage of carnivores in the population fell below the usual 20-40 percent level. Extensive surveys in the Gulf of Guinea have confirmed the great ecological importance and frequent dominance of the relatively large copepod Calanoides carinatus during the localized upwellings off Ghana and Senegal where it would appear to be one of the main exploiters of the accompanying diatom blooms. The relevance of these studies to some well known concepts regarding speciation in tropical environments is discussed. The key factor leading to the usually highly diverse zooplankton appears to be the relative stability of the environment.

INDEX TERMS: Zooplankton, Sampling, Atlantic Ocean, Distribution patterns, Migration patterns, Upwelling, Species diversity, Sample preservation, Gulf of Guinea.

AMIC-7665

"A STUDY OF A SMALL TROPICAL LAKE TREATED WITH THE MOLLUSCICIDE FRESCON", Corbet, S. A., Green, J., Betney, E., Environmental Pollution, Vol. 4, No. 3, April 1973, pp 193-206.

N-tritylmorpholine was applied, as the 16.5 percent w/v emulsifiable concentrate in tetrachloroethylene, to parts of the shores of two lakes in West Cameroon against the vectors of schistosomiasis. The concentrations of N-tritylmorpholine, with its breakdown product, triphenylcarbinol, in the lakes just after spraying ranged from 0.9 to 8.0 ppm. The treatment killed many cichlid fishes, particularly the young that live close inshore, and the higher concentrations killed or immobilized several species of aquatic insects, crustaceans and rotifers. Ostracods and hydracarinae survived 4.8 ppm. There were no obvious long-term effects on the populations of fishes or invertebrates, probably because these animals quickly recolonize the treated beaches from unsprayed areas nearby. The use of an alternative, granular, formulation of N-tritylmorpholine may prove less harmful to fishes and invertebrates other than snails.

INDEX TERMS: Pesticide toxicity, Freshwater fish, Molluscicides, Invertebrates, Snails, Rotifers, Diptera, Dragonflies, Mayflies, Oligochaetes, Mites, Nematodes, Frescon.

AMIC-7664

"SMALL-SCALE EXPERIMENTS TO DETERMINE THE EFFECTS OF CRUDE OIL FILMS ON GAS EXCHANGE OVER THE CORAL BACK-REEF AT HERON ISLAND", Kinsey, D. W., Environmental Pollution, Vol. 4, No. 3, April 1973, pp 167-182.

A coral reef at Heron Island which is subjected to low-tide slack water conditions, was fenced with steel posts, fencing wire, and acetate-covered wire mesh for investigation of the effect of oil slicks on gas exchange. Three tests were conducted during low tides: (1) control with no oil film; (2) with an oil film of about 0.1 mm thickness; and (3) with an oil film of about 0.7 mm thickness. Moonie crude oil was used in the experiments. Oxygen levels, temperature, pH, alkalinity, salinity, and wind speed were measured. Carbon dioxide was calculated from other data. The following points were indicated: (1) Films as thin as 0.1 mm caused considerable calming of the water surface. (2) Under conditions of light wind, films of 0.1 mm and 0.7 mm nominal thickness caused no significant interference with oxygen and carbon dioxide transfer through the water surface other than that associated directly with the calming effect. Respiration of the reef community remained normal. (3) A 0.1 mm film of the heavier residual oil left after prolonged exposure of the 'fresh' crude may have given some slight interference with gas transfer but it is more probable that this effect was an artefact of temperature. (4) No toxicity effects or abnormal behavior patterns were observed over the time periods used. (5) More information is required on the effects of dead calm weather, higher temperature, thicker and more viscous oil films, and longer periods of exposure.

INDEX TERMS: Oil spills, Reefs, Toxicity, Dissolved oxygen, Carbon dioxide, Gas exchange, Moonie crude oil.

AMIC-7666

"THE EFFECTS OF REFUSE-TIP LIQUOR UPON STREAM BIOLOGY", Nuttall, P. M., Environmental Pollution, Vol. 4, No. 3, April 1973, pp 215-222.

An assessment was made of the effects of drainage from five refuse-tips upon the biology of the receiving watercourses. Refuse-tip liquor is a complex suspension and solution of organic and inorganic constituents, with an acid pH, high conductivity and usually high concentration of iron in solution. Phosphate content is high and nitrogen, as free and saline ammonia, is usually high. Refuse-tip liquor tends to have a high BOD and causes severe de-oxygenation of the river at the point of discharge. Three refuse-tips were found to be the cause of gross pollution of the stream, resulting in massive growths of sewage fungus Leptomitia lacteus, with the invertebrate community dominated by the oligochaete Nais elinguis over a considerable distance downstream. Chironomidae and the oligochaetes Tubifex ignotus, Tubifex tubifex and Lumbriculus variegata were frequent immediately below discharges. The absence of many invertebrate species appears to be associated with the presence of massive growths of sewage fungus in the stream trapping silt and blocking the interstices between stones, and the increase in pollution.

INDEX TERMS: Water pollution effects, Fungi, Oligochaetes, Diptera, Crustaceans, Stoneflies, Mayflies, Caddisflies, Water beetles, Mollusks, Refuse-tip liquor, Turbellaria, Hirudinea.

2. BIOLOGICAL METHODS

AMIC-7667

"RECOVERY OF SALT MARSH VEGETATION FROM SUCCESSIVE OIL SPILLAGES", Baker, J. M., Environmental Pollution, Vol. 4, No. 3, April 1973, pp 223-230.

Field experiments involving different numbers of successive oilings with Kuwait crude were carried out on three types of salt marsh vegetation (Spartina anglica, Puccinellia maritima, Juncus maritimus) in 1968. Recovery from up to four oilings was generally good, but considerable changes resulted from eight and twelve oilings. Changes in species dominance or exposure of bare mud persisted in 1972, indicating that recovery was likely to be very slow.

INDEX TERMS: Oil spills, Dominant organisms, Salt marshes, Aquatic plants, Recovery.

AMIC-7673

"ESTABLISHMENT OF INVERTEBRATE COMMUNITIES ON LOG SUBSTRATES IN THE KASKASKIA RIVER, ILLINOIS", Nilsen, H. C., Larimore, R. W., Ecology, Vol. 54, No. 2, Spring, 1973, pp 366-374.

Development of invertebrate communities on log substrates was investigated in three habitats. In slowly moving, shallow water, standing crops (weights) of colonizing invertebrates followed a sigmoid growth curve during a 6-week exposure period. Initial colonization was rapid, followed by 2 weeks of slow growth, a rapid increase during the next 2 weeks, and then a leveling off at 1,650 mg/sq m during the final week. Numbers followed a similar pattern of growth, attaining a high of approximately 100,000/sq m by the end of the 5th week. Chironomid larvae colonized first and in the greatest numbers, followed sequentially by sessile rotifers and oligochaetes. These three organisms had the greatest influence on standing crops and total numbers. In a riffle, colonization was also rapid: 569 mg and 8,830 individuals per sq m at the end of four weeks. The riffle community was dominated by Taeniopteryx nivalis, hydropsychid larvae, chironomid larvae, and simuliid larvae. In a pool, the standing crop was largest on logs at an intermediate depth, next largest near the surface, and smallest near the bottom. The oligochaete, Aeolosoma sp., attained their largest population on logs at the greatest depth, while chironomid larvae and taeniopterygid naiads attained their largest populations at or above the intermediate depth. Communities on naturally occurring logs contained more planaria and insects of the families Hydropsychidae, Heptageniidae, and Elmidae than on the experimental logs in slowly moving, shallow water. Communities on the introduced logs did not reach a climax stage during the experimental period because organisms, organic detritus, and silt were constantly

AMIC-7670

"EFFECTS OF LOGGING ON PERIPHYTON IN COASTAL STREAMS OF OREGON", Hansmann, E. W., Phinney, H. K., Ecology, Vol. 54, No. 1, Winter 1973, pp 194-199.

Changes in the stream algal flora were observed during a multi-disciplinary logging study of small watersheds in Oregon. Clearcut logging was applied to one watershed of 71 hectares, while a second watershed of 304 ha was patch-cut leaving a buffer-strip of vegetation along the stream channel. A third watershed of 203 ha was not logged but remained as a control. Pre-logging and post-logging oxygen levels, temperature, and sedimentation loads were analyzed. Access roads were built in 1963, and logging completed in 1966. Analysis of the algal communities of the three watershed streams prior to the logging operation of 1966 indicated that the communities were predominantly a periphyton type composed mainly of diatoms. Immediately following the yarding operation of the clearcut watershed, large quantities of Sphaerotilus natans colonized all debris and mud in the stream, and a change in the algal flora appeared to take place. Large mats of green algae were observed colonizing all mud and slash. Results from glass substrates indicate that some changes may have taken place in the diatom community.

INDEX TERMS: Water pollution effects, Lumbering, Oregon, Streams, Chlorophyta, Cyanophyta, Dissolved oxygen, Water temperature, Sediment load, Chrysophyta, Dominant organisms.

AMIC-7673 (Continued)

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accumulating or sloughing off, the substrate was slowly decomposing, and changes were occurring seasonally in the chemical and physical condition of the water, all of which modified the habitat and influenced community development.

INDEX TERMS: Natural streams, Biological communities, Invertebrates, Periphyton, Phytoplankton, Dominant organisms, Aquatic habitats, Aquatic insects, Larvae, Oligochaetes, Ponds, Shallow water, Water levels, Rotifers, Crustaceans, Nematodes, Mollusks, Colonization, Logs, Kaskaskia River, Iffles, Water mites, Planarians.

2. BIOLOGICAL METHODS

AMIC-7675

"A CENTRIFUGE METHOD FOR DETERMINING LIVE WEIGHTS OF AQUATIC INSECT LARVAE, WITH A NOTE ON WEIGHT LOSS IN PRESERVATIVE", Stanford, J. A., Ecology, Vol. 54, No. 2, Early Spring 1973, pp 449-451.

A reproducible centrifuge drying method for determining live or preserved weights of aquatic insects is described. Live or preserved larvae are transferred into centrifuge tubes with forceps, or they may be filtered from the preservative by pouring the sample through a tube. The tubes are inserted into the shields of the centrifuge head; the larvae are spun for 3 min at 650 rpm. Weights are computed by subtracting the weight of the empty centrifuge tube from the weight of the tube plus insects after spinning. Care must be taken, however, to keep water from the outside of the tube since it does not spin off. An attempt was made to derive a conversion factor for weight loss in preservative. Results showed a great interspecific variation in weight loss over a period of time due to the effect of preservative.

INDEX TERMS: Aquatic insects, Larvae, Methodology, Weight loss, Live weights, Sample preservation, Reproducibility, Data interpretation.

AMIC-7684

"SILICON AND THE ECOLOGY OF MARINE PLANKTON DIATOMS. II. SILICATE-UP TAKE KINETICS IN FIVE DIATOM SPECIES", Paasche, E., Marine Biology, Vol. 19, No. 3, April 1973, pp 262-269.

The variation of the rate of silicate uptake with varying silicate concentration in the medium was investigated in short-term experiments with the following marine diatom species: *Skeletonema costatum*, *Thalassiosira pseudonana*, *Thalassiosira decipiens*, *Ditylum brightwellii*, and *Licmophora* sp. The uptake conformed to Michaelis-Menten kinetics only after a correction had been made for reactive silicate that apparently could not be utilized by the diatoms. The magnitude of this correction was in the range of 0.3 to 1.3 microgram-at Si/l. Mean values of the half-saturation constant of silicate uptake were calculated for the different species. The lowest value was found in *Skeletonema costatum* (0.80 microgram-at Si/l) and the highest in *Thalassiosira decipiens* (3.37 microgram-at Si/l). Growth limitation by low silicate concentrations could be a cause of species succession in marine plankton-diatom blooms. See also: AMIC-7725.

INDEX TERMS: Diatoms, Silicates, Absorption, Kinetics, Cultures, Phytoplankton, Marine algae, Chrysophyta, Regression analysis, Limiting factors, Substrate utilization, *Skeletonema costatum*, *Thalassiosira pseudonana*, *Thalassiosira decipiens*, *Ditylum brightwellii*, *Licmophora*, Culture media, Algal physiology, Algal growth.

AMIC-7682

"STUDY OF THE RESPIRATION AND THE NITROGEN AND PHOSPHORUS EXCRETION OF ZOOPLANKTONIC POPULATIONS OF THE MAURITANIAN UPWELLING", LeBorgne, R. P., Marine Biology, Vol. 19, No. 3, April 1973, pp 249-257.

Fifty-six experiments were run for 22 h on 200-micron-net zooplankton in non-filtered sea water. The equations of orthogonal regression lines between respiration, and mineral, total nitrogen, and phosphorus excretion rates have been computed for 14 stations in the upwelling Mauritanian area. Correlation coefficients are high: excretion values may be estimated from respiration values in order to follow the N and P flux through the Mauritanian zooplankton populations. O:N, O:P, N:P, mineral:total excretion ratios are calculated for each station and are not significantly different in the 3 areas of the upwelling area studied. On the average, 48 percent of excreted phosphorus is thoroughly oxidized into phosphate and needs 142.4 atoms in respiration per P atom. The remainder, excreted as organic phosphorus, requires the same amount of oxygen for its later mineralization. The O:P ratio thus obtained is close to the theoretical - 276. Fifty four percent of the nitrogen excreted is mineral and the O:N-NH₄(plus) ratio shows a dominant carbohydrate and fat catabolism. The n:p ratio is constant, and close to 10 for both mineral and total excretion. (In French)

INDEX TERMS: Nitrogen, Phosphorus, Respiration, Zooplankton, Nutrients, Marine animals, Sea water, Cycling nutrients, Mathematical studies, Equations, Estimating, Animal metabolism, Phosphates, Animal populations, Carbohydrates, Lipids, Excretion, Nutrient flux, Ammonium, Mauritanian upwelling, Correlation coefficients, Organic phosphorus, Catabolism.

AMIC-7685

"STUDIES ON FRESHWATER MICRO-ORGANISMS: PHOSPHATASE ACTIVITY IN LAKES OF DIFFERING DEGREES OF EUTROPHICATION", Jones, J. G., Journal of Ecology [Vol. 60, No. 3, November 1972, pp 777-791.

Sixteen lakes in the English Lake District were examined during the period of thermal stratification. Epilimnetic samples were analyzed for total phosphorus, total soluble phosphorus and soluble inorganic phosphorus (P sub i) concentrations, chlorophyll a, viable bacteria and alkaline phosphatase activity. Temperature and dissolved oxygen readings enabled the position of the thermocline to be determined and the degree of hypolimnetic oxygen deficit to be assessed. The lakes were placed in a series in order of increasing degree of eutrophication. Total phosphorus and chlorophyll a concentrations, bacterial numbers, hypolimnetic oxygen deficit and phosphatase activity measurements appeared to fit this series and so supported this classification which was based mainly on that of Pearsall (1921). Two methods were used to assess phosphatase activity, one based on the use of an artificial substrate, p-nitrophenol phosphate (PNP-PO₄) and the other on the natural release of P sub i in stored water samples. Both methods produced results which were significantly correlated with total phosphorus levels of the water samples and also with microbial biomass. Repression and/or inhibition of alkaline phosphatase in relation to phosphorus levels found in the lakes was not satisfactorily demonstrated, but the variety of factors affecting these two control mechanisms (particularly inhibition) is such that a more detailed survey of each water body would be required. The high degree of correlation between the two variables indicated that the enzyme was a good indicator of biomass present and degree of eutrophication, except in samples where very high numbers of the dinoflagellate *Ceratium* sp. were present. The

2. BIOLOGICAL METHODS

<p>AMIC-7685 (Continued)</p> <p>Card 2/2</p> <p>organism was found to contain significantly lower levels of the enzyme than those found in other micro-organisms.</p> <p>INDEX TERMS: Biomass, Eutrophication, Lakes, Aquatic microorganisms, Epilimnion, Hypolimnion, Artificial substrates, Dinoflagellates, Diatoms, Phosphorus, Bio-indicators, Alkaline phosphatase, Enzyme activity, p-Nitrophenol phosphate, Chlorophyll a, Heterotrophic bacteria, Substrate utilization.</p>	<p>AMIC-7687</p> <p>"THE INFLUENCE OF ENVIRONMENTAL FACTORS ON THE DISTRIBUTION OF FRESHWATER ALGAE: AN EXPERIMENTAL STUDY. I. INTRODUCTION AND THE INFLUENCE OF CALCIUM CONCENTRATION", Moss, B., <u>Journal of Ecology</u>, Vol. 60, No. 3, November 1972, pp 917-932.</p> <p>This study has attempted to establish factors affecting the distribution of algae in hard and soft waters through a study of the cultural requirements of algae of known distribution in these waters. The present paper establishes the natural distributions of the species used in experiments, and examines the effects of some major cations on growth. Introducing a series of papers examining the reasons for the distribution of freshwater algae in eutrophic and oligotrophic water, this paper outlines the natural distribution of some of thirty-three species studied experimentally. Two groups of species are objectively delineated, one (oligotrophic) whose members are restricted to waters with not more than 1.5 m-equiv/l weak acid salts (bicarbonate), the other (eutrophic) with members present in waters with 0.4 or more m-equiv/l weak acid salts. The ratio of monovalent to divalent cations did not affect growth of five test species. High calcium levels (100 mg/l) did not reduce growth of oligotrophic desmids, and 1.0 mg Ca(2 plus)/l was adequate for maximum growth of sixteen species tested. Two oligotrophic desmids required at least 1-3 mg Ca(2 plus)/l for maximum growth. No evidence was found for the contention that oligotrophic desmids are calciphobic.</p> <p>INDEX TERMS: Distribution patterns, Trophic level, Chlorophyta, Chrysophyta, Pyrrophyta, Euglenophyta, Cyanophyta, Nutrient requirements, Bioassay, Culture media.</p>
<p>AMIC-7686</p> <p>"SITES OF NUTRIENT ABSORPTION IN AQUATIC MACROPHYTES", Denny, P., <u>Journal of Ecology</u>, Vol. 60, No. 3, November 1972, pp 819-829.</p> <p>Six taxa of floating-leaved and submerged-leaved water plants (<u>Potamogeton schweinfurthii</u>, <u>Potamogeton thunbergii</u>, <u>Potamogeton bunyonensis</u>, <u>Ceratophyllum demersum</u>, <u>Hydrilla verticillata</u>, and <u>Vallisneria spiralis</u>) were planted in artificial ponds in Kampala, Uganda. The substratum was divided into nutrient-rich mud and nutrient-poor sand sections, but the waters were homogeneously mesotrophic. The plants were harvested from 8 to 15 weeks after planting. Growth rates, in mg dry weight/plant/day, were calculated for roots and shoots. The growth rate of the totally submerged rootless species, <u>C. demersum</u>, was least affected by substratum whilst the floating-leaved, rooted species, <u>P. thunbergii</u>, showed a fourfold increase on mud. This was reflected in ratios of growth rates of root/shoot of the rooted taxa. The ratios were higher when plants were grown in washed sand, but <u>P. schweinfurthii</u>, a submerged species, showed only a small increase whereas <u>P. thunbergii</u> had a nine-fold greater root/shoot growth rate ratio on sand than on mud. It is concluded that nutrients may enter through roots and shoots, but in some circumstances entry may be through roots or shoots alone.</p> <p>INDEX TERMS: Bioassay, Absorption, Nutrients, Rooted aquatic plants, Submerged plants.</p>	<p>AMIC-7689</p> <p>"AMMONIA ASSIMILATION IN BLUE-GREEN ALGAE", Neilson, A. H., Doudoroff, M., <u>Archiv fur Mikrobiologie</u>, Vol. 89, No. 1, January 18, 1973, pp 15-22.</p> <p>The occurrence of alanine dehydrogenase (AlaDH), glutamate dehydrogenase (GDH), and 2-ketoglutarate:glutamine amidotransferase (GGAT), has been surveyed in a number of blue-green algae. Among nine unicellular strains grown with nitrate, and belonging to five of the major typological groups, AlaDH was present in seven, and GDH in all eight that were assayed. In ten filamentous strains grown with nitrate, and belonging to the three nonheterocyst-forming and four heterocyst-forming groups, AlaDH was present in six, but both AlaDH and GDH were present in only one strain. In those strains which could be grown with N₂ as sole nitrogen source, levels of GDH were generally lower, and AlaDH higher in cells fixing N₂ than in those growing with nitrate. GGAT was undetectable in N₂-grown cells. Two unicellular and three filamentous strains were tested for their ability to use L-alanine, L-glutamate, L-glutamine, and L-asparagine as sole sources of nitrogen. Of these, L-asparagine was utilized most effectively. There was little difference in levels of GDH in cells grown with nitrate or with L-asparagine, while the levels of AlaDH were slightly lower in cells grown with L-asparagine.</p> <p>INDEX TERMS: Ammonia, *Cyanophyta, Aquatic algae, Nitrogen compounds, Enzymes, Assay, Assimilation, Fate of pollutants, Substrate utilization.</p>

2. BIOLOGICAL METHODS

AMIC-7691

"OCCURRENCE AND DISTRIBUTION OF CYANOPHAGES IN PONDS, SEWAGE AND RICE FIELDS", Singh, P. K., Archiv fur Mikrobiologie, Vol. 18, No. 2, February 5, 1973, pp 169-172.

Observations have been made on the occurrence and distribution of cyanophages active against the blue-green alga *Plectonema boryanum* together with fluctuations of blue-green algae in permanent freshwater ponds, sewage and rice fields. Water samples were collected monthly and the genera of blue-green algae present in them identified. The samples were filtered, treated with chloroform, mixed with a concentrated culture of *P. boryanum* and plated by the double agar layer technique (Adams, 1959). Plaques were counted on the 3rd and 7th day of plating, further isolated, multiplied on the alga, and filtered through 0.45-micron millipore filters. Two distinct types of cyanophages, i.e., clear (virulent) and turbid (lysogenic) plaque-forming strains were observed in the natural habitat. The genera of algae observed most were *Microcystis*, *Anabaenopsis*, *Phormidium* and *Plectonema*. The sewage main drain contained mostly species of *Phormidium* and *Oscillatoria*. Presence of cyanophages in ponds and variation in their titre indicated that cyanophages might affect the blue-green algal population in natural habitats. The occurrence of high titre of viruses showed that blue-green algae in rice fields are infected by them.

INDEX TERMS: Cyanophyta, Plant viruses, Nuisance algae, Ponds, Sewage, Rice, Cultivated lands, *Plectonema boryanum*, Cyanophages, Culturing techniques.

AMIC-7694

"EFFECTS OF PESTICIDES ON BLUE-GREEN ALGAE", Singh, P. K., Archiv fur Mikrobiologie, Vol. 89, No. 4, February 21, 1973, pp 317-320.

A study was conducted to determine the effect of pesticides on the nitrogen-fixing blue-green algae *Cylindrospermum* sp., *Aulosira fertilissima* and the aerobic non-nitrogen-fixer, *Plectonema boryanum* strain 594. Commercial (Indian) pesticide preparations in granular form were used: 5 percent BHC, lindane, diazinon, and 2 percent endrin. Growth was measured in terms of percentage transmittance of suspended cultures and acetone-extracted pigment measured with a photoelectric colorimeter. *Cylindrospermum* sp. survived up to 10, 80, 300 and 600 micrograms/ml of BHC, lindane, diazinon and endrin, respectively, with little experimental variations. Tolerance of pesticides was almost similar in nitrogen-free and nitrate-containing medium. The number of cells decreased as the concentrations of BHC increased. *A. fertilissima* showed growth up to 50 micrograms/ml of BHC. Higher concentrations of this pesticide were lethal. Growth of alga was observed in 200, 400 and 500 micrograms/ml of lindane, diazinon and endrin. Its tolerance was similar in nitrogen-free and nitrate containing medium. *P. boryanum* grew up to 30 micrograms/ml of BHC. There was not much inhibition of growth in 200, 400, and 600 micrograms/ml of lindane, diazinon and endrin. There was no growth of algae in presence of any concentrations of pesticides in nitrogen-free medium. *A. fertilissima* and *P. boryanum* were comparatively more resistant than *Cylindrospermum* sp.

INDEX TERMS: Cyanophyta, Pesticide toxicity, Aquatic algae, Chlorinated hydrocarbon pesticides, Phosphothioate pesticides, Insecticides, Water pollution effects, Algal growth.

AMIC-7697

"EFFECT OF NITRATE, AMMONIA AND NITROGEN STARVATION ON THE REGULATION OF NITRATE REDUCTASE IN *CYANIDIUM CALDARIUM*", Rigano, C., Violante, U., Archiv fur Mikrobiologie, Vol. 90, No. 1, March 2, 1973, pp 27-33.

Cells of *Cyanidium caldarium* grown with ammonia or ammonium nitrate as nitrogen source do not contain appreciable nitrate reductase activity. The alga develops the capacity to synthesize the enzyme when it is transferred from the ammonium medium to a nitrogen-free medium. Nitrate is not needed as an inducer and no enhancement in the rate of enzyme synthesis is observed when it is present. By contrast, whereas the synthesis of the enzyme in nitrogen-free medium proceeds at an increasing rate, in the nitrate medium it attains a stationary level after a short time. Nitrate grown cells possess variable amounts of inactive nitrate reductase (from 9 to 60 percent) whereas in nitrogen-free medium the enzyme occurs principally in a fully active form. Addition of ammonia inactivates reversibly the preexisting enzyme. The inactive enzyme is measurable in the crude extract after activation by heating. It is suggested that in *Cyanidium* the inactivating effect of ammonia, which is the end product of nitrate reduction, in association with the repression of enzyme controls the level of nitrate reductase activity.

INDEX TERMS: Deficient elements, Nutrient requirements, Limiting factors, Nitrates, Ammonia, Nitrogen, Cyanophyta, Enzymes, Cultures, Reduction (Chemical), Chemical reactions, Biochemistry, Assay, Nitrites, *Cyanidium caldarium*, Nitrate reductase, Biosynthesis, Enzymatic inhibitors, Substrate utilization, Culture media, Ammonium, Ammonium ions.

AMIC-7709

"STUDIES ON FACTORS AFFECTING SURVIVAL OF NILE FISH IN THE SUDAN. I. THE EFFECT OF HYDROGEN ION CONCENTRATION", Mahdi, M. A., Marine Biology, Vol. 18, No. 2, January 1973, pp 89-92.

Young of *Tilapia nilotica* L. were subjected to acidic and alkaline media of different pH over 24-hr periods. Dilute hydrochloric acid was used to lower the hydrogen ion concentration of the test medium. A pH lower than 2.9 resulted in immediate mortality, whereas a pH of 3.5 and above produced no mortality. Alkaline media had no serious effect on survival. (See also: AMIC-7710 and AMIC-7711)

INDEX TERMS: Hydrogen ion concentration, Water pollution effects, Bioassay, Cichlids, Freshwater fish, Lethal limit, Alkaline water, Acidic water, Mortality, Laboratory tests, Warm-water fish, *Tilapia nilotica*, Nile fish, Median tolerance limit, Survival.

2. BIOLOGICAL METHODS

AMIC-7710

"STUDIES ON FACTORS AFFECTING SURVIVAL OF NILE FISH IN THE SUDAN. II. THE EFFECT OF TEMPERATURE", Mahdi, M. A., Marine Biology, Vol. 18, No. 2, January 1973, pp 93-95.

When *Tilapia nilotica* L. was exposed to different temperatures for 24-hr periods, scattered death points were obtained between 36 and 40 C. Presumably other factors beside temperature affect mortality rate. The median tolerance limit (TLM) over 24 hr was 37.6 C. This temperature is higher than summer Nile water temperatures. (See also: AMIC-7709 and AMIC-7711)

INDEX TERMS: Water temperature, Water pollution effects, Thermal stress, Bioassay, Cichlids, Freshwater fish, Mortality, Lethal limit, Laboratory tests, Warm-water fish, Nile fish, *Tilapia nilotica*, Survival, Median tolerance limit.

AMIC-7713

"THE TOXICITY OF HEAVY METALS TO EMBRYOS OF THE AMERICAN OYSTER *CRASSOSTREA VIRGINICA*", Calabrese, A., Collier, R. S., Nelson, D. A., MacInnes, J. R., Marine Biology, Vol. 18, No. 3, February 1973, pp 162-166.

The acute toxicity of 11 heavy metals tested as inorganic metallic salts to embryos of the American oyster *Crassostrea virginica* was studied and the concentrations at which 50 percent of the embryos did not develop were determined. Static tests were conducted throughout the study and all tests were initiated within one hour after the eggs of the oyster were fertilized. Tests were terminated after 42 to 48 h. To determine the effect of metal toxicity on embryonic development, the embryos that survived and developed into larvae in each culture were collected on a 36-micron nylon screen, resuspended in a 250-ml graduated cylinder and, after thorough stirring to insure uniform distribution of the larvae, a 4-ml quantitative sample was removed and preserved in 5 percent neutral formalin. The samples were examined under a compound microscope and the number of embryos that had survived and developed into larvae was counted. The most toxic metals and their LC sub 50 values were mercury (0.0056 ppm), silver (0.0058 ppm), copper (0.103 ppm) and zinc (0.31 ppm). Those metals that were not as toxic and their LC sub 50 values were nickel (1.18 ppm), lead (2.45 ppm) and cadmium (3.80 ppm). Those metals that were relatively non-toxic and their LC sub 50 values were arsenic (7.5 ppm), chromium (10.3 ppm) and manganese (16.0 ppm). Aluminum was non-toxic at 7.5 ppm, the highest concentration tested.

INDEX TERMS: Heavy metals, Embryonic growth stage, Toxicity, Bioassay, Mollusks, Lethal limit, Water pollution effects, Mortality, American oyster, *Crassostrea virginica*, Median tolerance limit, Eastern oyster, Silver, Pelecypods, Arsenic.

AMIC-7711

"STUDIES ON FACTORS AFFECTING SURVIVAL OF NILE FISH IN THE SUDAN. III. THE EFFECT OF OXYGEN", Mahdi, M. A., Marine Biology, Vol. 18, No. 2, January 1973, pp 96-98.

Tilapia nilotica L. were exposed to different levels of ambient oxygen concentrations for 24-hr periods. Nitrogen was bubbled through the water to reduce the oxygen concentration to the respective test level. When testing concentrations of oxygen between 2.5 and 0.4 ppm over 24-hr periods of exposure, the median tolerance limits (TLM) over 24 hr were attained at 1.41 ppm of oxygen. (See also: AMIC-7709 and AMIC-7710)

INDEX TERMS: Dissolved oxygen, Bioassay, Water pollution effects, Oxygen sag, Oxygen requirements, Cichlids, Freshwater fish, Lethal limit, Laboratory tests, Mortality, Warm-water fish, *Tilapia nilotica*, Nile fish, Survival, Median tolerance limit.

AMIC-7715

"THE USE OF RADIOACTIVE ISOTOPES TO MEASURE THE TRANSFER OF MATERIALS IN AQUATIC FOOD CHAINS", Conover, R. J., Francis, V., Marine Biology Vol. 18, No. 4, February 1973, pp 272-283.

Radioisotopes have been misused extensively by ecologists in transfer studies within food chains. Unless it is known that no recycling of isotope has occurred during the experiment, the assumption of linear uptake when in fact the system is not linear, even over short periods, can lead to significant errors in the estimation of ingestion or feeding. If recycling occurs, at least a 3 or 4-compartment hydraulic-type model is necessary to even approximate the complicated kinetics of isotopic transfer in a simple aquatic feeding experiment. In any event, it is essential to follow the uptake or loss of an isotope (change in specific activity) as a function of time in at least 1 compartment before deciding on an appropriate model. If experiments are designed so that the maximum number of rate processes are summed or integrated by the animal, the kinetics can be considerably simplified. If the food supply is uniformly labelled, the rate of change of tracer can be used to give a rate of ingestion (grazing). If the predator is labelled with a suitable isotope before starting the experiment, the rate of loss of its isotope burden under different experimental conditions can be used to determine respiration or excretion rates, turnover rates, ingestion, and the size and number of major compartments in the transfer system.

INDEX TERMS: Radioactivity techniques, Mathematical models, Food chains, Kinetics, Aquatic life, Transfer, Absorption, Nutrients, Cycling nutrients, Radioisotopes, Feeding rates, Accuracy, Errors, Elimination, Computer simulation.

2. BIOLOGICAL METHODS

AMIC-7716

"TURNOVER AND VERTICAL TRANSPORT OF ZINC BY THE EUPHAUSIID MEGANYCTIPHANES NORVEGICA IN THE LIGURIAN SEA", Small, L. F., Fowler, S. W., Marine Biology, Vol. 18, No. 4, February 1973, pp 284-290.

The participatory turnover time of ionic zinc by the adult Meganyctiphanes norvegica population in the Ligurian Sea ranged between 498 and 1243 years, depending upon the available food supply, and considering the food chain as the only route for zinc accumulation by the population. A total impact turnover time was calculated as the sum of the participatory turnover time for live individuals plus the time required for dead euphausiids to lose 90 percent of their zinc to the water. The net vertical transport of zinc by Meganyctiphanes norvegica from the sea surface to any specified depth can be calculated as the sum of the dissolved zinc excreted below the depth plus the concentrations of zinc left in feces, molts and carcasses after they have sunk to the specified depth. Feces represents the major route for delivering zinc to the bottom of the Ligurian Sea (2500 m) because concentration of the element in the pellets is so much higher than in carcasses or molts. Feces zinc represented over 80 percent of the total zinc transported to the sea floor if only marginal food supplies were available to the euphausiids, and over 90 percent if food was in sufficient supply.

INDEX TERMS: Zinc, Path of pollutants, Heavy metals, Food abundance, Sea water, Mathematical models, Marine animals, Invertebrates, Transport, Meganyctiphanes norvegica, Feces, Turnover, Ligurian Sea, Bioaccumulation, Elimination, Bio-transformation, Molts, Carcasses, Vertical transport, Euphausiids, Macro-invertebrates, Mysids.

AMIC-7717

"TOXICITY STUDIES ON THE COMPONENTS OF AN OIL-SPILL EMULSIFIER USING LICHINA PYGMAEA AND XANTHORIA PARIETINA", Brown, D. H., Marine Biology, Vol. 18, No. 4, February 1973, pp 291-297.

The response of the lichens Lichina pygmaea and Xanthoria parietina to components of the emulsifier BP 1002 was studied, and comparison made to the behavior of the free-living green alga Chlorella pyrenoidosa and the blue-green alga Anabaena cylindrica. Inhibition of photosynthetic C-14-fixation by the emulsifier solvent alone was observed with both lichens. No alteration of the pattern of C-14 recovery in the various fractions was observed. Following treatment with either surfactant, total C-14-fixation was strongly inhibited; increased recovery of C-14 in the solution fraction occurred, mainly at the expense of the alcohol-extract fraction. Surfactant B was more active in this respect than Surfactant A, and its effect was attributed to induced leakiness of the algal cell membranes. Photosynthesis of C. pyrenoidosa and A. cylindrica was inhibited totally by 1 percent emulsifier, and the latter alga lysed rapidly with 90 percent loss of the C-14 fixed. Observations on pigment loss showed removal of the extra-cellular pigment parietin from X. parietina by the solvent to be slightly enhanced by addition of either surfactant. L. pygmaea was unaffected by the solvent; both surfactants caused loss of lipid-soluble photosynthetic pigments, but only Surfactant B induced loss of an unknown water-soluble pigment.

INDEX TERMS: Bioassay, Chlorophyta, Cyanophyta, Lichens, Photosynthesis, Toxicity, Plant pigments, Surfactants, Emulsifiers, Inhibition, Water pollution effects, Radioactivity effects, BP 1002, Oil-spill emulsifiers, Lysis.

AMIC-7721

"THE EFFECTS OF AMMONIUM AND PHOSPHATE ENRICHMENTS ON CHLOROPHYLL A, PIGMENT RATIO AND SPECIES COMPOSITION OF PHYTOPLANKTON OF VINEYARD SOUND", Vince, S., Valiela, I., Marine Biology, Vol. 19, No. 1, March 1973, pp 69-73.

Seawater containing natural phytoplankton populations (dominant species: Asterionella japonica, Skeletonema costata, and Chaetoceros spp.) from Vineyard Sound, USA was enriched in the laboratory with three levels each of ammonium and phosphate and with a combination of ammonium and phosphate which provided three different N:P ratios. The addition of ammonium produced more cells and chlorophyll a than the control or the phosphate enrichments. However, enrichment with ammonium and phosphate, regardless of the N:P ratio, yielded the most cells and chlorophyll a. Thus, nitrogen seems to be the primary limiting nutrient, with phosphate showing secondary limiting effects. The ratios of photosynthetic pigments D430/D663 decreased with the increased chlorophyll a production in the enriched cultures. There were no significant changes in the species composition within the cultures, so that the observed changes in pigment ratio and chlorophyll a content were due to physiological responses.

INDEX TERMS: Diatoms, Limiting factors, Phosphates, Plant pigments, Growth rates, Phytoplankton, Nutrients, Bioassay, Nitrogen, Chlorophyll a, Ammonium, Asterionella japonica, Skeletonema costata, Chaetoceros spp.

AMIC-7722

"THE EFFECTS OF CHLORINATION OF WASTEWATER ON FERTILIZATION IN SOME MARINE INVERTEBRATES", Muchmore, D., Epel, D. Marine Biology, Vol. 19, No. 2, March 1973, pp 93-95.

Gametes were collected from the sea urchin, Strongylocentrotus purpuratus, the echinuroid, Urechis caupo, and the annelid, Phragmatopoma californica, for studies on the effect of chlorination of domestic sewage on fertilization. Two hundred eggs were used in each sample with sperm concentrations of 0.033, 0.010, and 0.003 percent. In controls, fertilization always exceeded 98 percent. Fresh chlorinated and unchlorinated sewage from the Pacific Grove, California sewage treatment facility was used in the tests. Unchlorinated domestic sewage was found to be a relatively weak inhibitor of external fertilization in the 3 marine invertebrates. Chlorinated sewage was a potent spermicide, active in inhibiting fertilization in concentrations of available chlorine as low as 0.05 ppm. Sodium hypochlorite in seawater duplicated the effect, and excess sodium thiosulfate terminated it. The possibility of chlorine disinfection affecting reproductive success in the vicinity of outfalls is discussed.

INDEX TERMS: Chlorination, Fertilization, Worms, Annelids, Bioassay, Toxicity, Sea urchins, Strongylocentrotus purpuratus, Urechis caupo, Phragmatopoma californica.

2. BIOLOGICAL METHODS

<p>AMIC-7725 (Continued) Card 2/2</p> <p>INDEX TERMS: Cultures, Limiting factors, Growth rates, Silicates, Cytological studies, Diatoms, Bioassay, Nutrients, Silica, Absorption, Phytoplankton, Marine algae, Chemostat, <i>Thalassiosira pseudonana</i>, Culture media.</p>	<p>AMIC-7723</p> <p>"EFFECT OF ZINC ON GROWTH AND DEVELOPMENT OF LARVAE OF THE PACIFIC OYSTER <i>CRASSOSTREA GIGAS</i>", Brereton, A., Lord, H., Thornton, I., Webb, J. S., <u>Marine Biology</u>, Vol. 19, No. 2, March 1973, pp 96-101.</p> <p>Following the observation of periodic high concentrations of zinc in estuarine waters used in the White Fish Authority's oyster hatchery at Conway, North Wales, two beaker trials were conducted to study the effect of zinc, over the range recorded, on the young stages of larvae of <i>Crassostrea gigas</i>. Zinc, added to sea water both as zinc sulfate and as a natural mine-adit water, was applied for a period of 5 days, after which larvae were maintained for a further 5 days in sea water alone. Increasing concentrations over the range 125 to 500 ppb Zn resulted in decreasing growth, and increasing incidence of abnormality and larval mortality. A second trial with zinc sulfate showed 50 ppb Zn to have little effect on larval development, a progressive decrease in growth at 100 and 150 ppb, and no growth at 200 ppb. It is suggested that the deleterious effect of short-term exposure to zinc may well have contributed to the intermittent failure of larvae and irregular productivity recorded at the hatchery. It is also possible that zinc contamination in estuaries may affect natural oyster breeding, and may have to be considered in the future siting of hatcheries for seed production.</p> <p>INDEX TERMS: Bioassay, Growth rates, Zinc, Mortality, Larvae, <i>Crassostrea gigas</i>, Teratogenicity, Macroinvertebrates, Zinc sulfate, England, North Wales, Teratogens, Pacific Oyster.</p>
<p>AMIC-7727</p> <p>"DISTRIBUTION OF THE CLADOCERAN <i>PODON POLYPHEMOIDES</i> IN THE CHESAPEAKE BAY", Bosch, H. F., Taylor, W. R., <u>Marine Biology</u>, Vol. 19, No. 2, March 1973, pp 161-171.</p> <p>The distribution of the cladoceran <i>Podon polyphemoides</i> (Leuckart) in the Chesapeake Bay (USA) estuarine system was determined by a quantitative pump sampling method, and the patterns of abundance were correlated with temperature and salinity distributions. The species was seasonally recurrent, with distinct population maxima in the central portion of the bay. Population densities in excess of 60,000 podonids/cu m have been recorded. The podonids first appeared in the spring in the shallow tributaries, when water temperatures near the bottom reached 6 C. The vernal populations disappeared when summer temperatures exceeded 27 C, but reappeared in the fall as the water cooled. The species was euryhaline and eurythermal in its distribution, but the greatest concentrations were attained within relatively narrow zones of temperatures between 11 and 26 C, and salinities between 0.8 and 1.8 percent. The production of males, sexual females and sexual eggs occurred both in the spring and the fall between the thermal limits of 11 and 17 C.</p> <p>INDEX TERMS: Distribution patterns, Crustaceans, Life cycles, Water temperature, Salinity, Seasonal reproduction, Dissolved oxygen, Sampling, <i>Podon polyphemoides</i>.</p>	<p>AMIC-7725</p> <p>"SILICON AND THE ECOLOGY OF MARINE PLANKTON DIATOMS. I. <i>THALASSIOSIRA PSEUDONANA</i> (<i>CYCLOTELLA NANA</i>) GROWN IN A CHEMOSTAT WITH SILICATE AS LIMITING NUTRIENT", Paasche, E., <u>Marine Biology</u>, Vol. 19, No. 2, March 1973, pp 117-126.</p> <p>Polycarbonate Erlenmeyer flasks fitted with input and output tubes were used as chemostats for culturing <i>Thalassiosira pseudonana</i>. The flasks were rocked to allow regular addition and removal of medium and diatoms. Effluent from the flasks was used as the samples for making counts and for analysis of silica content of diatoms. Silica in diatom shells was determined by a modified method of Werner (1966); cell concentrations were estimated by a combination of electronic particle counting and microscopic examination. The calculated maximum growth rates were comparable to those previously reported for this species. The silica content of the diatom shells varied with the growth rate. As the growth rate approached zero, there were still measurable quantities of residual reactive silicate in the medium. In one of the two chemostats used, silicate assimilation by the cells was inefficient due to some unknown internal or external factor. In the other chemostat, statistically calculated half-saturation constants of growth were in the range of 0.5 to 0.8 microgram-at Si/l. Half-saturation constants of steady-state mean silicate uptake per cell and hour, calculated in a similar fashion, were in the range of 1.4 to 2.6 microgram-at Si/l. These results indicate that the silicate concentrations causing a reduced silicate uptake by this species in nature do not necessarily result in a corresponding reduced growth rate. Growth in coastal waters is likely to become seriously limited by a shortage of silicate only when most of the silicate originally present has been removed in the course of a diatom bloom. (See also: AMIC 7684)</p>

3. MICROBIOLOGICAL METHODS

AMIC-7425

"A STUDY OF INORGANIC SALTS REQUIREMENTS AND EFFECT ON THE MORPHOLOGY OF MARINE BACTERIA", Colwell, R. R., Georgetown University, Department of Biology, Washington, D. C., Final Report, Contract No. N00014-69-A-0220-0006, October 15, 1972, 24 pp. NTIS Report No. AD-754 122

A review is given of studies conducted to determine the distribution of marine bacteria in coastal and deep ocean areas, in ultrastructural studies of salt-requiring, psychrophilic marine bacteria subjected to temperature and salt deprivation stresses, and in the molecular biology and numerical taxonomy of marine and estuarine bacteria. A previously unreported area deals with experiments designed to investigate the effects on fine structure during growth of seawater-requiring strains in media of reduced Na and Mg content. The fine structure studies demonstrated that profound and, in most cases, irreversible changes occurred in these cells under the given test conditions. Cultures grown in Mg deficient medium demonstrated markedly aberrant intra-cytoplasmic and cell envelope morphology. Structural effects resulting from growth in media of reduced ionic strength, i.e., concentration of NaCl, KCl, and/or MgCl₂ of 0.1 or 0.01 times that of standard seawater, were varied, depending greatly on the given strain studied. In general, without Mg, cells demonstrated walls and membranes of aberrant, "wrinkled" appearance. Much of the effort in this aspect of the work was expended in establishing the experimental conditions and 'normal' morphology of the test strains. By varying concentrations of Na, Mg, and Ca ions, it was found that *V. marinus* demonstrated marked changes in cell morphology under conditions of severe ion depletion, whereas more subtle structural changes occurred under conditions of unbalance or slightly lowered concentrations of these ions (concentrations slightly lower than normally found in seawater).

AMIC-7425 (Continued)

Card 2/2

INDEX TERMS: Marine bacteria, Deficient elements, Nutrient requirements, Electron microscopy, Magnesium, Sodium, Potassium, Cations, Ultrastructure, Cell morphology, Pure cultures, Substrate utilization.

AMIC-7444

"METABOLIC ROLE OF SULFATES AND SULFIDES PRODUCING BACTERIA IN POLLUTION OF WATERS", Aleem, M. I. H., University of Kentucky, Water Resources Institute, Lexington, Kentucky, Research Report No. 46, Contract No. 14-01-0001-1636, December 1971, 52 pp. NTIS Report No. PB 214-485.

Cytochrome electron transport particles from *Nitrobacter* catalyzed nitrite and ascorbate, as well as NADH oxidation, with concomitant phosphate esterification yielding P/O ratios of 1.0, 0.6, and 2.0, respectively. Phosphorylation coupled to nitrite oxidation was not affected by rotenone, amytal or antimycin while 50 and 70 percent inhibition of the NADH-linked phosphorylation was observed in the presence of HOQNO and rotenone, respectively. Cell-free extracts from *Nitrobacter* also catalyzed an energy-dependent reduction of NAD(plus) by nitrite. The reduction of cytochrome c by NO₂(minus) was energy-dependent which involved the reversal of electrons from cytochrome a₁. The subsequent energy-linked reduction of the flavoproteins and pyridine nucleotides occurred concomitantly with the oxidation of cytochrome c. The reduction of NAD(plus) by thiosulfate in *T. neapolitanus* was an energy-linked process and involved the reversal of electrons from ferro-cytochrome c mediated by flavoproteins. Cell-free extracts also catalyzed the reduction of NAD (plus) by sulfite at the expense of ATP and involved the participation of the flavoprotein-pyridine nucleotide segment of the respiratory chain. The NADH oxidation by *T. neapolitanus* was mediated by the flavoprotein and cytochrome systems and this process also appeared to be coupled with energy-generation. The energy-dependent metabolism of sulfate producing bacteria and nitrite oxidizing bacteria was found to be very markedly sensitive to extremely low quantities of chloro- bromo- or nitro-substituted phenols. Investigations which were conducted to assess the importance of these organisms in natural environments

AMIC-7444 (Continued)

Card 2/2

seem to be rather important in designing control measures for the biological conversion of sulfur or nitrogen compounds as well as production of acidity in acid-mine streams or spoil bank.

INDEX TERMS: Sulfur bacteria, Water pollution sources, Iron bacteria, Biochemistry, Assay, Enzymes, Cultures, Pesticides, Nitrate-reducing bacteria, Bacterial physiology, Energy metabolism, Nitrite-oxidizing bacteria, Chemoautotrophic bacteria, Substrate utilization, Characterization, Enzymatic inhibitors, Bioenergetics.

3. MICROBIOLOGICAL METHODS

AMIC-7644

"TYPING OF SALMONELLA WELTEVREDEN STRAINS BY MEANS OF LYSIS PATTERNS OF SYMBIOTIC PHAGES", Garg, D. N., Singh, I. P., Antonie van Leeuwenhoek, Vol. 39, No. 1, 1973, pp 41-50.

A typing scheme for Salmonella weltevreden using the lysogenicity and lysis patterns of their carried phages is presented. Six strains of S. weltevreden were selected for use as indicator strains for recognizing the lysis patterns of the carried phages. Two hundred and forty-five strains were examined and 207 were grouped in concurrence with the 15 lysis patterns obtained out of 64 theoretically possible. Lysis pattern I (all 6 indicator strains lysed by the carried phage) included 24.5 percent of the strains. Thirty-eight strains (15.5 percent) were grouped as untypable because their lysates did not lyse any of the indicator strains. No correlation could be established between the lysis patterns of carried phages and the host and geographic distribution of S. weltevreden.

INDEX TERMS: Bacteriophage, Hosts, Bioindicators, Isolation, Phage typing, Salmonella weltevreden, Lysogenicity, Characterization, Biochemical characteristics.

AMIC-7653

"ISOLATION OF NEW METHANOL-UTILIZING BACTERIA AND ITS THIAMINE-REQUIREMENT FOR GROWTH", Kouno, K., Oki, T., Nomura, H., Ozaki, A., Journal of General and Applied Microbiology, Vol. 19, No. 1, February 1973, pp 11-21.

Approximately 0.1 g of soil, activated sludge, sewage, compost, humus, and materials around a petroleum refinery were placed in a Monod shaking tube containing 10 ml of basal methanol medium. The tube was incubated with reciprocal shaking at 28-30 degrees for 3 days and after several subcultures methanol-utilizing bacteria were picked up after incubating for 5 days at 28 degrees. Nutrient agar and other media enriched with peptone were used to detect the presence of bacteria capable of utilizing carbon sources other than methanol. Vitamin and amino acid requirements were determined by using a minimum medium omitting yeast extract, biotin, and thiamine hydrochloride from the basal medium. These non-pigmented bacteria were capable of growing only on methanol and showed no growth on ordinary nutrient media. They were identified as a new species, Methanomonas methylovora. The organisms are gram-negative, non-sporeforming rods, 0.4 to 0.7 micron by 1.0 to 4.0 microns in size, having a single polar flagellum. GC content of DNA is 51.2 to 53.6 percent. Some of them required a relatively high concentration of thiamine as an essential factor for cell growth, and produced an intracellular yellow pigment on methanol-containing agar medium.

INDEX TERMS: Isolation, Nutrient requirements, Environment, Sewage, Activated sludge, Humus, Mud, Methanol, Biochemical characteristics, Methanomonas methylovora, Methanol bacteria, Thiamine, Substrate utilization, Culture media, Petroleum refinery.

AMIC-7646

"THE SIGNIFICANCE OF HYDROCARBON ASSIMILATION IN YEAST IDENTIFICATION", Bos, P., de Bruyn, J. C., Antonie van Leeuwenhoek, Vol. 39, No. 1, 1973, pp 99-107.

A large number of yeasts were screened for the ability to assimilate hydrocarbons. Not only representatives of the genus Candida, but also species from other perfect and imperfect genera are able to use n-alkanes as sole carbon and energy source. The significance of this feature in yeast systematics is discussed. In general, all strains of a species share either the ability to assimilate hydrocarbons or the failure to do so. Exceptions are found in species regarded as heterogeneous, like Candida sake, Candida diddensii and Candida zeylanoides. In cases where the usual criteria used in identification seem to be inadequate, the simple hydrocarbon assimilation test may be useful. Also in subgrouping the genera Candida and Torulopsis the test may be of value, because some perfect genera like Hansenula, Kluyveromyces and Saccharomyces lack hydrocarbon-assimilating representatives.

INDEX TERMS: Yeasts, Pollutant identification, Systematics, Assimilation, Hydrocarbons, Substrate utilization, n-Octane, n-Decane, n-Hexadecane.

AMIC-7655

"SLIME PRODUCTION BY PSEUDOMONAS AERUGINOSA. II. A NEW SYNTHETIC MEDIUM AND CULTURAL CONDITIONS SUITABLE FOR SLIME PRODUCTION BY PSEUDOMONAS AERUGINOSA", Goto, S., Murakawa, T., Kuwahara, S., Japanese Journal of Microbiology, Vol. 17, No. 1, January 1973, pp 45-51.

Using Pseudomonas aeruginosa culture IFO 3445, the nutritional requirements and cultural conditions suitable for slime production were investigated. A synthetic medium was established from the experimental results, which was composed of sodium glutamate, glucose, phosphate and magnesium salt. When a cellophane plate method was used, incubation at 37 C for 3 days produced the highest relative viscosity. In the presence of an oxidizable carbohydrate the relative viscosity of the culture fluid was reduced with the acidic reaction, and recovered if the reaction was adjusted to pH 7-8.

INDEX TERMS: Nutrient requirements, Growth rates, Slime, Cultures, Pseudomonas, Pathogenic bacteria, Viscosity, Pseudomonas aeruginosa, Culture media.

3. MICROBIOLOGICAL METHODS

AMIC-7656

"DIFFERENTIATION OF MYCOBACTERIUM TUBERCULOSIS FROM OTHER MYCOBACTERIA BY SUSCEPTIBILITY TO ETHYL AND METHYL ESTERS OF p-NITROBENZOIC ACID", Tsukamura, M., Japanese Journal of Microbiology, Vol. 17, No. 1, January 1973, pp 81-82.

Studies have shown that p-nitrobenzoate is useful in screening for atypical mycobacteria (other than tubercle bacilli). Since p-nitrobenzoate is not commercially available the present study was conducted to find commercial chemicals to serve the same purpose. The chemicals studied were the ethyl and methyl esters of p-nitrobenzoate. Twenty-two species of mycobacteria were cultured in Ogawa egg medium containing one of the two compounds in concentrations of 0.25 or 0.5 mg/ml. Almost all mycobacteria except Mycobacterium tuberculosis and Mycobacterium bovis were resistant to the compounds. A striking fact was that Mycobacterium bovis was able to grow on the medium containing 0.25 mg/ml of either compound whereas Mycobacterium tuberculosis usually was not. Using a medium containing 0.25 mg/ml ethyl ester of p-nitrobenzoate, 26 strains of atypical mycobacteria other than Mycobacterium tuberculosis were detected from a total of 370 unknown mycobacteria.

INDEX TERMS: Separation techniques, Cultures, Mycobacterium, Pathogenic bacteria, Growth rates, Inhibitors, Resistance, p-Nitrobenzoate, Culture media.

AMIC-7660

"PARTIAL CHARACTERIZATION OF MYCOBACTERIOPHAGE R1 PARTICLES SURVIVING CHLOROFORM TREATMENT", Fleer, M. A., Bowman, B. U., Microbios, Vol. 7, No. 25, January 1973, pp 37-44.

Approximately 99 percent of mycobacteriophage R1 is inactivated by chloroform treatment. Phage R1 surviving chloroform treatment (chloroform survivors) form smaller plaques than untreated phage when both are plated and compared on Mycobacterium smegmatis ATCC 607. However, when progeny of chloroform survivors are picked and plated they form normal plaques. DNase and RNase had essentially no effect on either untreated phage or chloroform survivors. Trypsin had no effect on untreated phage but completely inactivated chloroform survivors. Anti-R1 serum inactivated both untreated phage and chloroform survivors. However, chloroform survivors were inactivated to a greater extent. Chloroform survivors appear to be different from native phage R1 and the differences may be related to the infectious process of the virion-host cell system.

INDEX TERMS: Cultures, Pollutant identification, Enzymes, Bacteriophage, Viruses, Mycobacteriophage, Characterization, Survival, Inactivation, Phages, Chloroform, Mycobacterium smegmatis.

AMIC-7659

"FATTY ACID FINGERPRINTS OF STREPTOCOCCUS MUTANS GROWN IN A CHEMOSTAT", Drucker, D. B., Griffith, C. J., Melville, T. H., Microbios, Vol. 7, No. 25, January 1973, pp 17-23.

Streptococcus mutans D282 and Streptococcus mutans JC2 were grown in a chemostat, the latter organism being grown under various experimental conditions. Freeze-dried cells were methylated and methyl fatty acid esters examined by gas-liquid chromatography to determine the effect of experimental growth parameters on chemo-taxonomic GLC fingerprints. Changes in experimental conditions slightly altered the JC2 fingerprint, especially oxygenation which resulted in unsaturated fatty acid production. Changes in the JC2 fingerprints were less than the difference in fingerprints for JC2 and D282 grown under identical conditions.

INDEX TERMS: Cultures, Pollutant identification, Gas chromatography, Streptococcus, Pathogenic bacteria, Streptococcus mutans, Gas liquid chromatography, Chemostat, Sample preparation, Fatty acids, Characterization, Culture media, Fingerprinting, Chromatograms.

AMIC-7693

"CHARACTERIZATION OF THIOBACILLUS SPECIES BY GAS-LIQUID CHROMATOGRAPHY OF CELLULAR FATTY ACIDS", Agate, A. D., Vishniac, W., Archiv fur Mikrobiologie, Vol. 89, No. 3, February 1973, pp 257-267.

Fatty acids of 18 strains representing 10 species of Thiobacillus were extracted from whole cells and examined as methyl esters by gas-liquid chromatography. Both visual and quantitative comparison of the resulting chromatograms for the presence and relative amounts of major peaks allowed rapid differentiation between such closely related species as Thiobacillus neapolitanus and T. thioparus and of eight other species. Except for a feature common to all thiobacilli tested, T. thiooxidans, T. neapolitanus and T. thioparus each possessed a characteristic fatty acid methyl ester profile that was exhibited by all the strains of that species. Hence, the thiobacilli could be divided into three distinct groups. It was possible to use the gas-liquid chromatographic patterns of the cellular fatty acids for rapid identification or grouping of these microorganisms since the fatty acid composition of the genus Thiobacillus thus appeared to be of taxonomic significance.

INDEX TERMS: Separation techniques, Gas chromatography, Thiobacillus ferrooxidans, Pollutant identification, Cultures, Characterization, Gas liquid chromatography, Thiobacillus.

3. MICROBIOLOGICAL METHODS

AMIC-7699

"DEOXYRIBONUCLEIC ACID BASE COMPOSITION AND TAXONOMIC POSITION OF GLUCOSE FERMENTING MARINE BACTERIA OF THE GENUS *VIBRIO* AND RELATED GENERA", Bianchi, M. A. G., Archiv für Mikrobiologie, Vol. 90, No. 2, March 26, 1973, pp 131-140.

DNA base composition of marine strains of genus *Vibrio* corroborate the results obtained by the adansonian method of classification. Comparisons of phenotypic and GC percent values of genera *Photobacterium* and *Beneckea* with the genus *Vibrio* show that differentiation between these three genera is not clear. Genus *Vibrio* can be separated in four groups. The first contains free-living marine strains. The second group includes the marine strains pathogenic to poikilothermic animals. The third group is composed of strains pathogenic to poikilothermic and homeothermic animals. The last group is made up of strains which, contrary to the other groups, have shown no specific requirement of sodium for growth. We ascertain that each group has a typical ecologic localization. (In French)

INDEX TERMS: Systematics, Separation techniques, *Vibrio*, *Photobacterium*, *Beneckea*, DNA.

AMIC-7768

"DELAYED-INCUBATION MEMBRANE-FILTER TEST FOR FECAL COLIFORMS", Taylor, R. H., Bordner, R. H., Scarpino, P. V., Applied Microbiology, Vol. 25, No. 3, March 1973, pp 363-368.

A delayed-incubation membrane-filter technique for fecal coliforms was developed and compared with the immediate fecal coliform test described in 'Standard Methods for the Examination of Water and Wastewater' (13th ed., 1971). Laboratory and field evaluations demonstrated that the delayed-incubation test, with the use of the proposed vitamin-free Casitone holding medium, produces fecal coliform counts which very closely approximate those from the immediate test, regardless of the source or type of fresh-water sample. Limited testing indicated that the method is not as effective when used with saline waters. The delayed-incubation membrane-filter test will be especially useful in survey monitoring or emergency situations when the standard immediate fecal coliform test cannot be performed at or near the sample site or when time and temperature limitations for water sample storage can be met. The procedure can also be used for analyzing the bacterial quality of water or waste discharges by a standardized procedure in a central examining laboratory remote from the sample source. (Reprinted from Applied Microbiology, Vol. 25, No. 3, p 363-368, March 1973. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner).

INDEX TERMS: Pollutant identification, Monitoring, Water quality, Water pollution, Waste water pollution, Water pollution sources, Fecal coliforms, Delayed incubation membrane filter test, Data interpretation.

AMIC-7758

"MICROBIOLOGICAL QUALITY OF SURFACE DRAINAGE WATER FROM THREE SMALL IRRIGATED WATERSHEDS IN SOUTHERN IDAHO", Smith, J. H., Douglas, C. L., Journal of Environmental Quality, Vol. 2, No. 1, January-March 1973, pp 110-112.

Irrigation water applied to and leaving three small watersheds in southern Idaho was analyzed to determine the influence of surface irrigation on bacteriological quality of surface runoff water. The sites were inhabited by families raising various crops and some livestock. Presumptive, confirmed, and completed coliform counts were made according to Standard Methods, MPN's were calculated, fecal coliform counts were made by MPN analyses, and fecal streptococci were determined by micropore filtration. DO, BOD, and water temperatures were also determined. The irrigation water samples were polluted with microorganisms associated with human and animal wastes, as indicated by numbers of coliforms and by fecal coliform/fecal streptococci ratios. There was a trend toward increasing numbers of coliforms and fecal coliforms in the drainage water compared to the irrigation water, but the differences were generally within the confidence limits for MPN analyses. On two of the three watersheds, microorganisms incubated on plating agar at 20 C had higher counts in the drainage than in the irrigation water. Fecal streptococci numbers were significantly higher in the drainage than in the irrigation water on two of the three small watersheds. Even though microorganisms counts tend to be higher in drainage than in the irrigation water on these three small watersheds, irrigation use has a minimal deleterious effect on the microbiology of these waters.

INDEX TERMS: Water quality, Irrigation effects, Coliforms, Enteric bacteria, Fecal streptococci, Fecal coliforms.

AMIC-7769

"LOCATION AND CONSEQUENCES OF 1,1,1-TRICHLORO-2,2-BIS(P-CHLOROPHENYL)ETHANE UPTAKE BY *BACILLUS MEGATERIUM*", Hicks, G. F., Jr., Corner, T. R., Applied Microbiology, Vol. 25, No. 3, March 1973, pp 381-387.

No detrimental effects of 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane (DDT) were observed when cells of *Bacillus megaterium* were grown from small inocula in nutrient media containing up to 100 micrograms of DDT/ml. However, when the ratio of DDT to biomass of resting cells was held constant, levels of DDT as low as 1 microgram/ml (0.5 microgram/mg of cell dry weight) enhanced the rate of death in the population. The lethal action of DDT was both time- and dose-dependent so that higher doses required less time to effect the same killing than did lower doses. Intact cells bound a maximum of about 1.7 micrograms of DDT/mg of cell dry weight, of which about 75 percent was localized in the protoplast membrane. Much of the bound DDT was subsequently lost to the suspending medium and the aqueous stability of the returned DDT was enhanced, possibly by association with solubilized cell materials. A small quantity of bound DDT was converted to 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane, which was released from cells somewhat faster than DDT. Apparently the lethal action of DDT was related to its binding in the membrane, but respiration was not inhibited. The atypical macroscopic appearance of membranes isolated from treated cells suggested that cell death may result from altered membrane chemistry. (Reprinted from Applied Microbiology, Vol. 25, No. 3, March 1973, pp 381-387. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: DDT, Pesticide toxicity, Soil bacteria, Absorption, Chlorinated hydrocarbon pesticides, Insecticides, DDD, Respiration, *Bacillus megaterium*, Bioaccumulation, Bacterial physiology, Metabolites, Survival, Chemical recovery.

3. MICROBIOLOGICAL METHODS

AMIC-7774

"MORPHOLOGICAL, BIOCHEMICAL, AND GROWTH CHARACTERISTICS OF PSEUDOMONAS CEPACIA FROM DISTILLED WATER", Carson, L. A., Favero, M. S., Bond, W. W., Petersen, N. J., Applied Microbiology, Vol. 25, No. 3, March 1973, pp 476-483

Studies were conducted on three strains of *Pseudomonas cepacia* isolated and maintained in distilled water and on a laboratory-subcultured strain transferred to distilled water. Optimum growth rates and maximum population yields of the four strains in distilled water were obtained at 37 C, although high population levels (1,000,000 - 10,000,000/ml) were reached and maintained over extended incubation periods at temperatures from 18 C to 42 C. Two strains were able to grow in distilled water at temperatures ranging from 12 C to 48 C and to survive 48 h and 21 days at 50 C and 10 C, respectively. Cells from distilled water cultures inoculated into Trypticase soy broth showed an immediate two- to three-log drop at upper and lower temperature limits; survivors were able to initiate logarithmic growth. Results obtained in morphological, biochemical, and antibiotic tests affirmed the strain differences noted in growth studies. (Reprinted from Applied Microbiology, Vol. 25, No. 3, March 1973, pp 476-483. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Growth rates, Isolation, Pollutant identification, Cytological studies, Pesticide toxicity, Aerobic bacteria, Aquatic bacteria, Distilled water, *Pseudomonas cepacia*, Cell morphology, Biochemical characteristics, Bacterial physiology.

AMIC-7776

"IDENTIFICATION OF STAPHYLOCOCCUS AUREUS BY SIMULTANEOUS USE OF TUBE COAGULASE AND THERMONUCLEASE TESTS", Barry, A. L., Lachica, V. F., Atchison, F. W., Applied Microbiology, Vol. 25, No. 3, March 1973, pp 496-497.

The toluidene blue deoxyribonucleic acid (DNA) agar (TDA) technique was adapted to permit detection of thermonuclease (heat-stable nuclease) at the same time that a coagulase test is performed to eliminate possible errors in distinguishing *Staphylococcus aureus* from other *Micrococcaceae*. Isolated colonies were grown on brain heart infusion (BHI) broth at 35 C for 2-6 hours, divided into three parts, one for coagulase tests, one for thermonuclease tests, and one for growth if retesting were necessary. Experience using the tests showed that valid discrepancies between two tests are rare enough to permit the use of one test as a control of the other.

INDEX TERMS: Pollutant identification, Separation techniques, Cultures, Quality control, Pathogenic bacteria, *Staphylococcus aureus*, Accuracy, Tube coagulase tests, Thermonuclease tests.

AMIC-7779

"RESISTANCE TO COLIPHAGE INFECTION INDUCED IN ESCHERICHIA COLI BY GROWTH IN THE PRESENCE OF A SURFACTANT", Koransky, I. H., Anderson, D. A., Applied Microbiology, Vol. 25, No. 3, March 1973, pp 509-510.

To test the hypothesis that slime formation induced by surfactants may inhibit phage adsorption, strains of *E. coli* were streaked on nutrient agar containing sodium dodecyl benzene sulfonate (NaDDBS) and seeded with droplets of representative T-even and T-odd phage strains. The results obtained suggest that the surfactant induced slime may mechanically block phage receptor sites, inhibiting phage adsorption. The major blocking agent may well be deoxyribonucleic acid, as indicated by the high viscosity and induction of phage adsorption and replication after treatment with deoxyribonuclease.

INDEX TERMS: Surfactants, *E. coli*, Slime, Adsorption, Cultures, Bioassay, Water pollution effects, Inhibitors, Infection, Bacteriophage, Coliphage, Sodium dodecyl benzene sulfonate, DNA.

AMIC-7780

"EFFECT OF ACETATE UPON THE FORMATION OF ACETOIN IN KLEBSIELLA AND ENTEROBACTER AND ITS POSSIBLE PRACTICAL APPLICATION IN A RAPID VOGES-PROSKAUER TEST", Bryn, K., Ulstrup, J. C., Stormer, F. C., Applied Microbiology, Vol. 25, No. 3, March 1973, pp 511-512.

Acetate stimulates the formation of acetoin during 1-h incubation of Voges-Proskauer-positive strains of *Klebsiella* and *Enterobacter*. Of these organisms, 124 of 126 strains were recognized as positive in the presence of acetate, and 106 were recognized as positive in its absence. (Reprinted from Applied Microbiology, Vol. 25, No. 3, March 1973, pp 511-512. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Separation techniques, Cultures, Pollutant identification, *Enterobacter*, *Klebsiella*, Acetates, Voges-Proskauer test, Biochemical tests.

3. MICROBIOLOGICAL METHODS

AMIC-7782

"SELECTIVE SUBSTRATE UTILIZATION BY MARINE HYDROCARBONOClastic BACTERIA", Soli, G., Bens, E. M., Biotechnology and Bioengineering, Vol. 15, No. 2, March 1973, pp 285-297.

Several strains of bacteria, isolated from marine environments, were characterized by gas chromatography for their hydrocarbon oxidizing abilities using a complex synthetic mixture of hydrocarbons. Attempts were made at a broad classification of these organisms on the basis of their behavior towards four major groups of hydrocarbons, normal paraffins, iso-paraffins, cyclo-paraffins, and aromatics, known to be present in crude oils. Although bacteria appear to be able to oxidize hydrocarbons at random, this study has shown that it may be possible to recognize a rudimentary pattern if their oxidative abilities are viewed in terms of groups of hydrocarbons rather than individual compounds. A study of the action of combined strains on the synthetic hydrocarbon mixture was performed. It was found that no particular benefit could be derived as compared to the use of single strains.

INDEX TERMS: Biodegradation, Marine bacteria, Oxidation, Oil spills, Oil, Organic compounds, Gas chromatography, Classification, Microbial degradation, Crude oil, Substrate utilization.

AMIC-7784

"FACTORS INFLUENCING DETECTION OF SALMONELLAE IN RENDERED ANIMAL BY-PRODUCTS", Tompkin, R. B., Kueper, T. V., Applied Microbiology, Vol. 25, No. 4, April 1973, pp 485-487.

The purpose of this study was to develop a better understanding of the factors, such as enrichment and plating media and quantity of product tested, which influence the detection of salmonellae in naturally contaminated animal by-products. Two samples were analyzed for Salmonella, one with selenite-cystine broth and one by tetrathionate-Brilliant Green-Iodine broth, both containing Tergitol No. 7. The enrichment broths were streaked onto plates of Brilliant Green-sulfa agar and Salmonella-Shigella agar. Salmonella-like structures were picked to triple sugar iron agar slants and tested aerologically. The results confirm that a linear relationship exists between total plate counts and the detection of salmonellae in animal by-products in the total count range of 10,000 to 10,000,000 per gram.

INDEX TERMS: Pollutant identification, Cultures, Animal by-products, Enrichment, Culture media, Sample size.

AMIC-7785

"DEGRADATION OF METHYLMERCURY BY BACTERIA ISOLATED FROM ENVIRONMENTAL SAMPLES", Spangler, W. J., Spigarelli, J. L., Rose, J. M., Flippin, R. S., Miller, H. H., Applied Microbiology, Vol. 25, No. 4, April 1973, pp 488-493.

In order to investigate the possibility that organisms capable of degrading methylmercury are present in the aquatic environment, 207 organisms which were isolated from sediments and fish were screened for demethylation of methylmercury bromide (MMB). Fish and sediment samples were also analyzed for total mercury and methylmercury. Each organism to be tested for aerobic degradation was grown through 2 transfers in shaker flasks containing tryptic soy broth (TSB) without inorganic Hg or methylmercury. Hg-203-labeled MMB was added and each flask was connected to an HgBr sub 2-KBr trap containing a trapping solution to scavenge any inorganic Hg or organomercurvolatilized from the flask. Head gases were flushed to traps with a stream of vapor-saturated, sterile air. For anaerobic demethylation, O sub 2-free N sub 2 was used as the flushing gas, and 0.0025 percent cysteine was added to the TSB. The trapped gas was monitored with a gamma scintillation spectrometer; methane in head gases was analyzed by flame ionization GC. Traps and flask contents were analyzed for MMB after extraction whereby methylmercury iodide was determined in benzene extracts by electron capture gas chromatography. Of the 207 bacterial cultures, 30 were found positive for aerobic demethylation. Twenty-two were shown to be facultative anaerobes and 21 degraded methylmercury anaerobically. All positive species volatilized methylmercury aerobically, and methane was produced as a degradation product. Although methylmercury degradation was complete in most cases, material balances indicated some of the inorganic mercury formed was not volatilized and is presumed bound to the cells. All positive isolates were tolerant to at least 0.5 microgram of methylmercury per ml,

AMIC-7785 (Continued)

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and the extent of volatilization of mercury increased with concentration to the threshold value. The results indicate that demethylating species are prevalent in the environment and may be important in suppressing the methylmercury content of sediments.

INDEX TERMS: Microbial degradation, Lake sediments, Aquatic bacteria, Aerobic conditions, Anaerobic conditions, Freshwater fish, Volatility, Radioactivity techniques, Methylmercury, Demethylation, Fate of pollutants, Biological magnification, Environmental samples, Lake St. Clair.

3. MICROBIOLOGICAL METHODS

AMIC-7786

"DISCREPANCIES IN THE ENUMERATION OF *ESCHERICHIA COLI*", Ray, B., Speck, M. L., Applied Microbiology, Vol. 25, No. 4, April 1973, pp 494-498.

Stationary-phase cells of *Escherichia coli* from stock cultures, reconstituted nonfat dry milk, meat broth, crab meat and liquid whole egg, were enumerated by the pour plate method on Trypticase soy agar containing 0.3 percent yeast extract (TSYA), violet red-bile agar, and desoxycholate-lactose agar, and by the most-probable-number method in Brilliant Green-bile broth and lauryl sulfate broth. Maximum counts were assumed to be those on TSYA. In general, numbers detected were lower with the selective solid media and higher with the selective liquid media. Inhibitory effects, especially on selective solid media varied with the strains of *E. coli*. The lower detection on selective solid media was partly due to the stress induced in some cells by the temperature of the melted media used in the pour plate method. These cells apparently failed to repair and form colonies in the selective media. Improved detection on the selective solid media was achieved by using 1 percent nonfat milk solids, 1 percent peptone, or 1 percent $MgSO_4 \cdot 7H_2O$ in the dilution blanks. Higher detection on selective agar media was effected by surface plating or by surface overlay plating of the cells. The surface-overlay method appeared to be superior for the direct enumeration of *E. coli* in foods.

INDEX TERMS: *E. coli*, Foods, Cultures, Pollutant identification, Enteric bacteria, Coliforms, Enumeration, Most probable number test, Pour plate method, Culture media, Selective media, Surface-overlay method.

AMIC-7794

"EXPERIENCE WITH AN IMAGE-ANALYZING COMPUTER IN VIRUS PLAQUE MEASUREMENTS", Scheirer, W., Applied Microbiology, Vol. 25, No. 4, April 1973, pp 641-643.

A description is given of the Imanco-Quantimet 720 image-analyzing computer which has been used for counting virus plaques in different test systems. With this apparatus, an object is picked up by a TV camera and electronically resolved into 500,000 picture spots. These are scanned row by row for difference in gray density. The gray difference, which is necessary to detect the plaques against the stained cell monolayer, must be determined for each test series. The plaques detected by the instrument can also be discriminated by size, as measured in picture spots. The results can be printed out either as the number of plaques as discriminated by a certain gray difference, as the total area of plaques, or as the sum of all plaque diameters. In determining the possibility of using this apparatus in virology, three test systems were used: (1) mouse L-929 cells challenged with vesicular stomatitis virus, strain Indiana; (2) chicken embryo fibroblasts challenged with cowpox virus, strain Brighton; and (3) human phimositis cells challenged with VSV. System 1 presented no problems and the measurements obtained by hand counting corresponded well with computer results. Adjustments were made for optimal results with system 2 but good agreement was found with hand-counting values. Useful results were not obtained with system 3. The image-analyzing computer is most helpful for large screening programs, involving plaque-reduction tests, because of the extremely fast and reliable plaque-number determinations.

INDEX TERMS: Measurement, Viruses, Pollutant identification, Laboratory equipment, Research equipment, Image-analyzing computer, Plaque-counts, Plaque-reduction tests.

AMIC-7789

"POTENTIAL PATHOGENS IN THE ENVIRONMENT: ISOLATION, ENUMERATION, AND IDENTIFICATION OF SEVEN GENERA OF INTESTINAL BACTERIA ASSOCIATED WITH SMALL GREEN PET TURTLES", McCoy, R. H., Seidler, R. J., Applied Microbiology, Vol. 25, No. 4, April 1973, pp 534-538.

Bacteriological analyses were performed on fecal swabs and the aquarium water of 27 individually purchased specimens of the small green pet turtle, *Pseudemys scripta elegans*. Samples for bacteriological examination, except *Klebsiellae*, were immediately prepared from the swabs or from dilutions of the saline in which the turtle had been immersed. A second saline sample was removed for examination after 5 days. *Klebsiellae* were isolated and enumerated after turtles were maintained for several months. *Salmonellae* were enriched in tetrathionate broth, streaked onto Brilliant Green sulfa agar, picked, and subjected to biochemical and serological examination. *Enterobacter* and *Klebsiella* were isolated from saline samples by plating onto a modified nitrogen-deficient medium of Hine and Wilson. *Aeromonads* were isolated and enumerated on peptone-beef extract-glycogen agar. Biochemical examination of all enteric isolates was accomplished by the methods of the Manual of Clinical Microbiology. Representatives of *Aeromonas*, *Citrobacter*, *Enterobacter*, *Klebsiella*, *Proteus*, *Salmonella*, and *Serratia* were isolated. *Enterobacter*, *Klebsiella*, and *Salmonella* were encountered in 20 percent or more of the specimens, whereas *Aeromonas* was isolated from 63 percent. *Klebsiella pneumoniae* counts ranged from 1000 to 10,000 per milliliter of aquarium water, whereas *Aeromonas* routinely exceeded 10,000 per milliliter. *Aeromonas* cultures from turtles were identical to 7 human isolates in some 29 biochemical tests.

INDEX TERMS: Cultures, *Salmonella*, Water analysis, *Aeromonas*, *Citrobacter*, *Enterobacter*, *Klebsiella*, *Proteus*, *Serratia*, Feces.

AMIC-7803

"SPECIFIC IDENTIFICATION OF ENTEROVIRUSES BY IMMUNO-ELECTRON MICROSCOPY USING A SERUM-IN-AGAR DIFFUSION METHOD", Anderson, N., Doane, F. W., Canadian Journal Microbiology, Vol. 19, No. 5, May 1973, pp 585-589.

Rapid type-specific identification of enteroviruses was performed by immuno-electron microscopy on crude cell-culture isolates, using an agar-diffusion technique in which the typing sera were incorporated in the agar. Seventeen virus samples which consisted of 11 different enterovirus types showed no cross reaction when tested against 15 enterovirus antisera. Specific virus identification, based on the presence of visible antigen-antibody complexes, was not dependent on optimal dilutions of antiserum, but could be achieved with a variety of dilutions. The minimum amount of virus that could be detected by this method was about 100 times less than that detectable by electron microscopy in the absence of antiserum.

INDEX TERMS: Pollutant identification, Methodology, Immuno-electron microscopy, Enterovirus, Serum-in-agar diffusion method, Echovirus, Agar-diffusion technique, Cocksackievirus, Poliovirus, Serotypes, Sensitivity.

3. MICROBIOLOGICAL METHODS

AMIC-7805

"VIBRIO PARAHAEMOLYTICUS-ISOLATION, IDENTIFICATION, CLASSIFICATION, AND ECOLOGY", Colwell, R. R., Lovelace, T. E., Wan, L., Kaneko, T., Staley, T., Chen, P. K., Tubiash, H., Journal of Milk and Food Technology, Vol. 36, No. 4, April 1973, pp 202-213.

Vibrio parahaemolyticus was isolated from samples of water, sediment, blue crabs, oysters, and clams collected in several areas of Chesapeake Bay. Numerical taxonomy was used to identify and classify the bacterial isolates. Deoxyribonucleic acid (DNA) base composition, serology, isozyme, gas chromatography, bacteriophage sensitivity, and DNA/DNA reassociation analyses confirmed the identification and classification of V. parahaemolyticus and permitted establishment of genetic relationships of the Chesapeake Bay strains with isolates from victims food poisoning in Japan and from samples taken in geographically diverse areas of the United States. Isolates implicated in recent outbreaks of food poisoning, the first fully documented cases of V. parahaemolyticus food poisoning in the United States, were shown by DNA/DNA reassociation measurements to be closely related to the Japanese and other isolates collected in the United States. Fatty acid profiles of cell derivatives prepared using GLC were useful in diagnosing Vibrio spp., including V. parahaemolyticus and Vibrio cholerae. Bacteriophages isolated from ocean sediments collected off Cape Hatteras were found to be active against V. cholerae and V. parahaemolyticus. Distribution of V. parahaemolyticus appears to be restricted to coastal and estuarine regions. V. parahaemolyticus has been shown to be closely associated with zooplankton and a life cycle for V. parahaemolyticus in Chesapeake Bay is proposed.

INDEX TERMS: Chesapeake Bay, Pollutant identification, Ecology, Isolation, Sediments, Classification, Methodology, Oysters, Clams, Marine bacteria, Ecological distribution, Computer programs, Vibrio parahaemolyticus, Numerical taxonomy, Chemotaxonomy, Serology, Blue crab, Food poisons.

AMIC-7806

"PHENOTYPIC CHARACTERIZATION OF BENECKEA PARAHAEMOLYTICA: A PRELIMINARY REPORT", Raumann, P., Baumann, L., Journal of Food and Milk Technology, Vol. 36, No. 4, April 1973, pp 214-219.

Eighty-six strains which were isolated from cases of gastroenteritis and had the general properties of the genus Beneckea were submitted to an extensive nutritional, physiological, and morphological characterization. The results indicated that this collection of strains, which included the type strain of Beneckea parahaemolytica, was phenotypically homogeneous and distinguishable from the other known species of Beneckea by multiple, unrelated, phenotypic traits. When grown in liquid medium, strains of B. parahaemolytica had single, sheathed, polar flagella; when grown on solid medium, these strains had unsheathed, peritrichous flagella in addition to the sheathed, polar flagellum. Additional traits of use for differentiation of these species from the remaining species of the genus Beneckea were the ability of B. parahaemolytica to grow at 40 C, utilize D-galactose, L-leucine, L-histidine, and putrescine and the inability to utilize sucrose, DL-beta-hydroxybutyrate or give a positive Voges-Proskauer reaction. The validity of some of the traits previously used to identify B. parahaemolytica as well as the possible difficulties encountered in the identification of this organism from marine sources are considered.

INDEX TERMS: Pollutant identification, Nutrient requirements, Methodology, Marine bacteria, Enteric bacteria, Pathogenic bacteria, Isolation, Characterization, Cell morphology, Bacterial physiology, Beneckea parahaemolytica, Phenotype, Biochemical tests, Substrate utilization, Feces.

AMIC-7815

"METABOLISM OF PHENOL AND CRESOLS BY MUTANTS OF PSEUDOMONAS PUTIDA", Bayly, R. C., Wigmore, G. J., Journal of Bacteriology, Vol. 113, No. 3, March 1973, pp 1112-1120.

Mutant strains of Pseudomonas putida strain U have been obtained which are deficient in enzymes of the degradative pathways of phenol and cresols. Mutant strains deficient in catechol 2,3-oxygenase accumulated the appropriate catechol derivative from cresols. A mutant strain which would not grow on either phenol or a cresol was shown to be deficient in both 2-hydroxymuconic semialdehyde hydrolase and a nicotinamide adenine dinucleotide, oxidized form, (NAD)-dependent aldehyde dehydrogenase. When this strain was grown in the presence of phenol or a cresol, the appropriate product of meta fission of these compounds accumulated in the growth medium. A partial revertant of this mutant strain, which was able to grow on ortho- and meta-cresol but not para-cresol, was shown to have regained only the hydrolase activity. This strain was used to show that the products of meta ring fission of the cresols and phenol are metabolized as follows: (1) ortho- and meta-cresol exclusively by a hydrolase; (2) para-cresol exclusively by a NAD-dependent aldehyde dehydrogenase; (3) phenol by both a NAD-dependent dehydrogenase and a hydrolase in the approximate ratio of 5 to 1. This conclusion is supported by the substrate specificity and enzymatic activity of the hydrolase and NAD-dependent aldehyde dehydrogenase enzymes of the wild-type strain. The results are discussed in terms of the physiological significance of the pathway. Properties of some of the mutant strains isolated are discussed.

INDEX TERMS: Phenols, Metabolism, Microbial degradation, Enzymes, Assay, Cresol, Pseudomonas putida, Mutants, Bacterial physiology, Substrate utilization.

AMIC-7820

"ISOLATION AND CHARACTERIZATION OF THERMOSENSITIVE ESCHERICHIA COLI MUTANTS DEFECTIVE IN DEOXYRIBONUCLEIC ACID REPLICATION", Wechsler, J. A., Nusslein, V., Otto, B., Klein, A., Bonhoeffer, F., Herrmann, R., Gloger, L., Schaller, H., Journal of Bacteriology, Vol. 113, No. 3, March 1973, pp 1381-1388.

Thermosensitive deoxyribonucleic acid replication-defective mutants have been isolated by using an autoradiographic selection method. The mutants have been analyzed genetically and biochemically. Some of the mutants show thermosensitivity of in vitro deoxyribonucleic acid replication. These can be classified into three groups according to their behavior in in vitro complementation assays. This classification is congruent with that obtained by genetic mapping by using cotransduction frequencies with selected markers in P1 transduction analysis.

INDEX TERMS: E. coli, Temperature, Isolation, Characterization, Autoradiography, DNA replication, Mutants.

3. MICROBIOLOGICAL METHODS

AMIC-7839

"CARBON SOURCE UTILIZATION TESTS AS AN AID TO THE CLASSIFICATION OF NON-FERMENTING GRAM-NEGATIVE BACTERIA", Snell, J. J. S., Lapage, S. P., Journal of General Microbiology, Vol. 74, No. 1, January 1973, pp 9-20.

Difficulties in the use of carbon source utilization (CSU) tests for the classification and identification of bacteria prompted an investigation of some of the factors which affect the results. The classification derived by numerical taxonomy on the results of CSU tests was compared with that derived from results of conventional tests. One hundred eighty-seven strains of Gram-negative bacteria, chiefly non-fermentative, of the genera Acinetobacter, Alcaligenes, Loefflerella, Bordetella, Chromobacterium, Flavobacterium, Moraxella, Neisseria, and Pseudomonas were used in the investigation. Cultures were routinely incubated at 37 C except those of Pseudomonas fluorescens and Chromobacterium lividum which were incubated at 22 C. For a trial period, 94 strains were tested for their ability to utilize 10 different carbon sources on duplicate plates incubated at 30 and 37 C. Growth at these two temperatures was compared and results recorded as: growth developing at one temperature and not at the other; growth more luxuriant at either temperature; or no difference in growth at either temperature. There was little difference between the results at 37 and 30 C. Repetition of tests showed that 5 percent of the results were non-reproducible. The variability was more pronounced with acetate, maleate and sucrose amongst the substrates and Loefflerella mallei amongst the bacteria. Prior induction of the bacterial enzymes before testing did not reduce variability nor show any other advantage. Analysis of the results by numerical taxonomic methods revealed differences in the groups of bacteria derived from conventional biochemical test results. CSU tests readily provide a large number of taxonomic features with the advantage of a simple standardized testing procedure.

AMIC-7839 (Continued)

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INDEX TERMS: Classification, Pollutant identification, Fermentation, Enzymes, Nutrient requirements, Computer programs, Substrate utilization, Gram-negative bacteria, Biochemical tests, Carbon source utilization tests, Culturing techniques, Bacterial physiology, Numerical taxonomy.

AMIC-7850

"THE TAXONOMIC POSITION OF OBESUMBACTERIUM PROTEUS, A COMMON BREWERY CONTAMINANT", Priest, F. G., Somerville, H. J., Cole, J. A., Hough, J. S., Journal of General Microbiology, Vol. 75, No. 2, April 1973, pp 295-307.

The mole fraction of guanine plus cytosine in the DNA from Obesumbacterium proteus was 48 percent similar to that of Hafnia alvei, Salmonella gallinarum and the RM bacterium. DNA:DNA competition studies indicated that O. proteus strains fall into two groups, both of which could reasonably be included in the family Enterobacteriaceae. The same two groups were apparent from a numerical taxonomic investigation of 19 O. proteus strains which included 16 brewery isolates. The simple matching coefficients (percent S) were calculated from results of 50 biochemical and taxonomic tests, and a dendrogram was constructed. Every O. proteus isolate had the characteristics of the family Enterobacteriaceae. The two subgroups united at 86 percent S, and formed a cluster with Hafnia and Salmonella strains at 72.5 percent S. The difference between Hafnia alvei and O. proteus was almost entirely due to their different vigour rating. Furthermore, in a simulated brewery fermentation, two strains of H. alvei grew in a mixed culture with yeast. This was originally the defining characteristic of the genus Obesumbacterium. The authors propose that reference to the genus Obesumbacterium should be discontinued, and that O. proteus should be placed in the genus Hafnia as Hafnia protea comb. nov.

INDEX TERMS: Systematics, Cultures, Enteric bacteria, Pollutant identification, Growth rates, Obesumbacterium proteus, Characterization, Dendrograms, Culture media, Hafnia alvei, DNA, Salmonella gallinarum, Biochemistry.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-7300

"SOME PROPERTIES OF PROBABILITY LATTICE SAMPLING", Jessen, R. J., Journal of the American Statistical Association, Vol. 68, No. 341, March 1973, pp 20-28.

The accuracy of three estimators of sampling variance using nonreplacement probability lattice samples was determined empirically on a microuniverse. A simple split-sample scheme, although biased, was superior to the unbiased Horvitz-Thompson and Yates-Grundy estimators. A weighted ANOVA type of model for representing two-way universes with unequal cell sizes is presented and tested empirically to determine how well it can account for sources of sampling variability using 0, 1 and 2-way controls with EP (equal probability) and PNR (probability proportional to size with non-replacement) samples.

INDEX TERMS: Model studies, Properties, Estimating, Probability lattice sampling, Analysis of variance, Estimators.

AMIC-7304

"BAYESIAN ACCEPTANCE-SAMPLING SCHEMES FOR TWO-SIDED TESTS OF THE MEAN OF A NORMAL DISTRIBUTION OF KNOWN VARIANCE", Dayananda, R. A., Evans, I. G., Journal of the American Statistical Association, Vol. 68, No. 341, March 1973, pp 131-136.

This article is concerned with the problem of deciding whether the mean of theta of a normal distribution of known variance lies in a specified finite interval (theta minus, theta plus). Consideration is given to prior information on theta and to quadratic and piecewise linear utility structures. Computer-aided methods are described for obtaining the optimal decision rule given a sample of observations and for obtaining the optimal sample size when the sampling cost is a linear function of the sample size. Some simpler approximate methods are also described.

INDEX TERMS: Statistical methods, Acceptance sampling, Sample size, Hypothesis testing.

AMIC-7301

"AN EVALUATION OF TEN PAIRWISE COMPARISON PROCEDURES BY MONTE CARLO METHOD", Cramer, S. G., Swanson, M. R., Journal of the American Statistical Association, Vol. 68, No. 341, March 1973, pp 66-74.

Computer simulation techniques were used to study the Type I and Type III error rates and the correct decision rates for ten pairwise multiple comparison procedures. Results indicated that Scheffe's test, Tukey's test, and the Student Newman-Keuls test are less appropriate than either the least significant difference with the restriction that the analysis of variance F value be significant at alpha equal .05, two Bayesian modifications of the least significant difference, or Duncan's multiple range test. Because of its ease of application, many researchers may prefer the restricted least significant difference.

INDEX TERMS: Statistical methods, Computer models, Error rates, Decision rates, Analysis of variance, Least significant difference.

AMIC-7447

"ON DOUBLE SAMPLING FOR STRATIFICATION AND ANALYTICAL SURVEYS", Rao, J. N. K., Biometrika, Vol. 60, No. 1, April 1973, pp 125-133.

A simple method of double sampling for stratification is proposed and the classical non-response theory is obtained as a special case. The method leads to simple solutions for the optimal design of analytical surveys involving comparison of group means, when the groups are not identifiable in advance.

INDEX TERMS: Statistical methods, Estimating, Double sampling, Variance.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-7519

"COMPARISON OF THE PRECISION OF NORMAL AND PRECISION SPECTROPHOTOMETRIC TECHNIQUES", Ingle, J. D., Jr., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 861-868.

A general theory for the relative instrumental precision of normal and precision (transmittance ratio, trace analysis, and ultimate precision) spectrophotometric absorbance measurements is presented. The theory presented takes into account both reading error and electrical noise (photocurrent shot noise, dark current shot noise, and source flicker noise). Equations are developed which indicate the gain in relative precision expected when a precision spectrophotometric technique is used to expand the transmittance scale in order to reduce the reading error. In some cases, the relative precision is reduced by scale expansion. The precision techniques are shown to be most advantageous for measurement of high absorbance solutions. (Reprinted from Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 861-868. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Spectrophotometry, Methodology, Instrumentation, Equations, Chemical analysis, Measurement, Precision, Absorbance, Errors.

AMIC-7878

"SOME EXACT TESTS OF HYPOTHESES ABOUT GRUBBS'S ESTIMATORS", Shukla, G. K., Biometrics, Vol. 29, No. 2, June 1973, pp 373-377.

When two instruments or techniques are used to measure the same item, the measurement precisions may be estimated using a method proposed by Grubbs (1948). The present paper generalizes certain tests given by earlier authors. Using this general result, some exact tests of certain hypothesis are obtained for which only approximate results were available. The results can also be used to construct exact confidence intervals for the relative precision of two instruments.

INDEX TERMS: Instrumentation, Statistical methods, Hypothesis testing, Precision.

AMIC-7879

"GRAPHS, TABLES AND DISCUSSION TO AID IN THE DESIGN AND EVALUATION OF AN ACCEPTABLE SAMPLING PROCEDURE BASED ON CUMULATIVE SUMS", Prairie, R. R., Zimmer, W. J., Journal of Quality Technology, Vol. 5, No. 2, April 1973, pp 58-66

An acceptance sampling procedure for attributes inspection proposed by Beattie seems well suited for situations when production is continuous, sampling is destructive, a constant sampling rate is required, and discrimination between two quality levels is required with a small sample size. This paper describes the Beattie procedure, briefly presents the underlying mathematics, indicates strengths and weaknesses, and presents graphs for determining a plan.

INDEX TERMS: Sampling, Statistical methods, Acceptance sampling, Attributes.

AMIC-7880

"SHORTCUTS TO SMALL-SAMPLE STATISTICS PROBLEMS", Jackisch, P. F., Chemical Engineering, Vol. 80, No. 13, June 11, 1973, pp 107-110.

Using the nomographs presented, it is possible to easily and rapidly determine the scatter in a set of data, significant differences between two sets of data, and whether some data should be discarded. The method is useful when the number of data points does not exceed 20. Sample applications of the procedure are included.

INDEX TERMS: Data processing, Nomographs, Data scatter, Significance.

5. INSTRUMENT DEVELOPMENT

AMIC-7041

"A POLYTHENE GRAPHITE ELECTRODE FOR VOLTAMMETRY", Mascini, M., Pallozzi, F., Liberti, A., Analytica Chimica Acta, Vol. 43, No. 1, March 1973, pp 126-131.

Polyethylene graphite electrodes were made by mixing spectral graphite with finely powdered thermoplastic polymer (polyethylene or methacrylic esters), placing the mixture in a mold, and thermosealing to a rigid polyethylene tube. Internal electrical contact was ensured by mercury. Current-potential curves were recorded in various supporting electrolytes such as KNO₃, KCl, Na₂SO₄, H₂SO₄, HCl, HNO₃, and HClO₄. Results of voltammetry with iodide, hexacyanoferrate, and cerium were also recorded. Reproducibility of results with the electrodes was better than 1 percent from day to day.

INDEX TERMS: Iodides, Oxidation-reduction potential, Ion selective electrodes, Polyethylene graphite electrodes, Voltammetry, Cerium, Hexacyanoferrate, Current-potential curves.

AMIC-7331

"HETEROGENEOUS-SITE GLASS MEMBRANE POTENTIALS-A SOLID-STATE APPROACH", Buck, R. P., Analytical Chemistry, Vol. 45, No. 4, April 1973, pp 654-655.

Previously no single potential response function for glass electrodes accounted for the step-wise response of heterogeneous-site glass in mixed electrolytes (varying pH at constant pM). A new theory encompasses both of Nicolsky's variant ion exchange theories and Eisenman's n-type non-ideal behavior by introducing the assumption that only a fraction of cations in a glass membrane are mobile and contribute to the diffusion potential. Mobile defects, which may be few or nearly all cations, are presumed to be in equilibrium with lattice-like ions, defect sites, and vacancies. At low Al₂O₃ levels in a typical Na₂O-Al₂O₃-SiO₂ glass, two Nernstian pH regions are predicted, while at higher levels a shoulder followed at high pH by half Nernstian response is predicted. Experimental data are used to test theory. In the limit of zero heterogeneity, a new expression for pH electrode response is found which fits existing data and gives another meaning to n-type non-ideal behavior.

INDEX TERMS: Electrochemistry, Electrical properties, Model studies, Aqueous solutions, Hydrogen ion concentration, Glass electrodes.

AMIC-7230

"COMBINED SAMPLING AND FLOW MEASUREMENT", Carr, R. R., Public Works, Vol. 104, No. 4, April 1973, pp 71.

A sampler for wastewater treatment plant effluents, which integrates automatic sampling with flow measurement, employs a plastic pipe with a special insert as the main body with solenoid operated tapered plungers seated in rubber sleeves to provide valving. The sampler is fastened upright in an open channel and is activated with a timer and battery to allow the backed up liquid to enter the sampler. When the valve plungers drop the sample discharges into a receiving vessel. Daily flow is ascertained by multiplying the total volume collected by the formula constant for the weir or flume.

INDEX TERMS: Sampling, Automation, Mechanical equipment, Sewage effluents, Flow rates,

AMIC-7429

"WATER QUALITY DETERMINATIONS IN THE VIRGIN ISLANDS FROM ERTS-A DATA", Egan, W., Grumman Aerospace Corporation, Research Department, Bethpage, New York, Report No. RM-561J, December 1972, 72 pp. NTIS Report No. AD 754 009.

The harbor at Charlotte Amalie on St. Thomas, Virgin Islands, has a concentration of many factors affecting water quality: untreated sewage effluent, sediment from navigation and dredging operations, runoff from a garbage dump, and hot effluent from a desalination/power plant. Imagery from ERTS-A in association with aircraft imagery and ground truthing permits the characterization of water quality in terms of absolute color values. This necessitates the establishment of photometric standards resolvable by the ERTS-A sensors in order that atmospheric effects, which generally vary on sequential overpasses, may be determined and subtracted. The overall program is described together with typical numerical results.

INDEX TERMS: Water quality, Remote sensing, Aerial photography, Aircraft, Sewage effluents, Sediments, Photometry, Virgin Islands, On-site investigations, Environmental effects, Pollutants, Thermal pollution, Water cooling, Chemical analysis, Water analysis, Ocean circulation, Optical properties, Turbidity, Sensors, Data interpretation, ERTS-A sensors, Multispectral sensing system, Dredging.

5. INSTRUMENT DEVELOPMENT

AMIC-7454

"VARIABLE SAMPLING FREQUENCY - A NEW ADAPTIVE TECHNIQUE", Sutherland, A. A., Jr., Control Engineering, Vol. 20, No. 4, April 1973, pp 33-35.

An adaptive technique has been developed for sampling for control of plant processes which vary randomly with time. A simple digital algorithm samples plant status according to the frequency of variation--less frequent sampling with slow variations and more frequent sampling with increased variations. The method purportedly provides control action economy and good predictability of plant behavior.

INDEX TERMS: Sampling, Automatic control, Adaptive control.

AMIC-7508

"FEASIBILITY OF REMOTE DETECTION OF WATER POLLUTANTS AND OIL SLICKS BY LASER-EXCITED RAMAN SPECTROSCOPY", Ahmadjian, M., Brown, C. W., Environmental Science and Technology, Vol. 7, No. 5, May 1973, pp 452-453.

A simple, inexpensive optical system has been constructed for obtaining Raman spectra of samples located remotely from the instrument. The capabilities of this system were demonstrated by obtaining spectra of dilute solutions of NO₃ and of oil films on the surface of water with the samples located 21 ft from the instrument. Raman spectra were measured on a Spex Industries Model 1401 double monochromator using photon-counting detection and a CRL Model 52A argon-ion laser emitting at 4880 or 5145A. A schematic diagram is given of the optical system which utilizes a small diameter laser beam and a large diameter collimated scattered beam thus allowing both beams to traverse the same optical path between the instrument and the sample. Such an arrangement also allows an extension of the light path to almost any realistic distance.

INDEX TERMS: Remote sensing, Waste identification, Pollutant identification, Data collections, Water pollution, Oil spills, Pollutants, Water pollution sources, Spectrometers, Anions, Instrumentation, Automation, Nitrates, Laser-excited Raman spectroscopy, Raman spectra, Sensors.

AMIC-7463

"A-D AND D-A CONVERTERS FOR HIGH SPEED DATA ACQUISITION APPLICATIONS", Jackson, K., Computer Design, Vol. 12, No. 4, April 1973, pp 57-64.

New circuitry for analog-to-digital (ADC) and digital-to-analog conversion (DAC) is shown schematically and described. ADC units may be single-ended multiplexed or differential input multiplexed. High performance differential systems use a balancing cancellation technique known as common mode rejection to reduce the effects of unwanted induced voltages and currents. Submultiplexing may also be used in multiplexed ADC units to reduce settling time, crosstalk, and leakage current. Sample and hold amplifiers may be employed in some converters to increase the bandwidth capability and maintain accuracy of conversion. The development of new circuits and availability of lower cost components and production techniques have reduced the cost and increased the capabilities of ADC and DAC.

INDEX TERMS: Electronic equipment, Data transmission, Data processing, Design, Analog to digital converters, Digital to analog converters.

AMIC-7540

"CARBON PASTE ELECTRODE WITH A WIDE ANODIC POTENTIAL RANGE", Lindquist, J., Analytical Chemistry, Vol. 45, No. 6, May 1973, pp 1006-1008.

The construction is described of the carbon paste electrode which is being used widely for analytical work in the anodic region. The anodic limit is about plus 1.3 volt in acid aqueous media. In general, an improved carbon paste electrode can be obtained by removing oxygen from graphite powder in a vacuum at high temperature and then blocking the surface of the carbon against further adsorption of oxygen. Voltammograms were run in unstirred iodide, cerium (III), cobalt (II) and adenine solutions. Repeated measurements of the peak current of 0.0005 M Ce (III) in 0.1 M H₂SO₄, where a new surface was prepared in the usual way before every run, gave a relative standard deviation of 1.16 percent.

INDEX TERMS: Fabrication, Aqueous solutions, Electrochemistry, Cobalt, Anions, Cations, Anodes, Iodides, Construction, Heavy metals, Reproducibility, Carbon paste electrode, Anodic potential, Cerium, Adenine, Precision, Ion selective electrodes,

5. INSTRUMENT DEVELOPMENT

AMIC-7587

"A SUBMERSIBLE SPECTRORADIOMETER AND DATA ACQUISITION SYSTEM", Duval, W. S., Brown, T. J., Geen, G. H., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 2, February 1973, pp 313-316.

A submersible light meter that measures and records irradiance versus wavelength over the range 400-750 nm is described. A data acquisition system coupled to the radiometer permits collection and processing of large numbers of field observations. The incident spectrum is determined by an optical system incorporating a wedge interference filter monochromator and photodiode. Recorded data are converted to spectral irradiance ($\mu\text{W}/\text{sq cm/nm}$) at 5-nm intervals by applying standard lamp calibration and immersion factor corrections. Minimum detectable radiation varies from 0.05 to 0.016 $\mu\text{W}/\text{sq cm/nm}$ depending on wavelength. Response of the meter is not affected by temperature in the range of 3.5-23.0 C and angular dependence of the light collector follows Lambert's Cosine Law for incident angles less than 55 degrees from the vertical. Changes in the spectral composition of incident light with depth are demonstrated for two lakes.

INDEX TERMS: Instrumentation, Data processing, On-site data collections, Laboratory tests, Design data, Light, Calibrations, Aquatic environment, Optical properties, Water temperature, Spectroradiometer, Performance evaluation, Submersible light meter, Detection limits, Sensitivity, Reproducibility, Marine environment, Spectral data, Optical systems.

AMIC-7886

"FORMAT CONVERSION USING A FIFO BUFFER", Abellanas, C., Computer Design, Vol. 12, No. 6, June 1973, pp 84-88.

A system is described which allows for a number of different format conversions from an M-line bus to an N-line bus which is limited only by the length of the storage register. The converter's design is based on a special purpose first-in/first-out memory (FIFO) which has the ability to shift its information sideways. Operation of the system is described.

INDEX TERMS: Electronic equipment, Data processing, Format conversion.

AMIC-7885

"A FLEXIBLE, LOW COST ALPHANUMERIC DISPLAY", Dima, P. D., Gayraud, A. J., Popovici, N. N., Computer Design, Vol. 12, No. 6, June 1973, pp 77-82.

Character generation techniques, character generators, and control logic for alphanumeric displays are discussed. Design criteria are given to aid in the selection of low cost displays.

INDEX TERMS: Electronic equipment, Data displays, Alphanumeric displays.

AMIC-7889

"BEHAVIOR OF THE SILVER, SILVER CHLORIDE ELECTRODE IN CONCENTRATED AQUEOUS SODIUM CHLORIDE", Gibbard, H. F., Jr., Journal of the Electrochemical Society, Vol. 120, No. 5, May 1973, pp 624-627.

Electrochemical experiments are reported which confirm the imperfection of the silver/silver chloride electrode in concentrated aqueous sodium chloride. Further experiments and calculations (electrochemical cell measurements and x-ray diffraction) are used to explain this behavior in terms of the formation of a solid solution of silver chloride and sodium chloride. The mole fractions and activities of silver chloride in the solid solutions are calculated from solubility equilibria and are correlated with literature values of the activity coefficients of sodium chloride.

INDEX TERMS: Thermodynamic behavior, Physicochemical properties, Sodium chloride, Aqueous solutions, Solubility, Electrochemistry, Solvents, Electrolytes, X-ray diffraction, Silver/silver chloride electrode, Solute concentration, Silver electrodes, Ion selective electrodes, Silver chloride, Solutes.

5. INSTRUMENT DEVELOPMENT

AMIC-7891

"A ROTATING RING-HEMISPHERICAL ELECTRODE FOR ELECTROANALYTICAL APPLICATIONS", Chin, D. T. Journal of the Electrochemical Society, Vol. 120, No. 5, May 1973, pp 631-635.

A study has been made of the combination of a rotating hemispherical electrode with a ring electrode of a larger radius for use in investigations of reaction intermediates. Cyclic voltammetry in an acid copper solution was used to test the feasibility of the combination, and a ferricyanide/ferrocyanide redox reaction was used to measure the collection efficiency at the ring electrode. The collection efficiency was found to be independent of the rotational speed in laminar flow, and its value was comparable to that obtained from the rotating ring-disk electrode theory. The results indicate that the ring-disk theory can be used as a rough approximation for the ring hemisphere electrode if the inner radius of the ring electrode is a minimum of 1.08 times the radius of the hemispherical electrode. Easy replacement of the central hemispherical electrode is a big advantage of this new geometry. This offers electrochemists an alternative choice where the use of a ring-disk electrode would fail to give a meaningful result and where frequent replacement of the disk electrode is needed.

INDEX TERMS: Electrochemistry, Copper, Iron, Heavy metals, Design, Aqueous solutions, Cyclic voltammetry, Rotating ring-hemispherical electrode, Collection efficiency, Ion selection electrodes, Ferricyanide, Cupric chloride.

AMIC-7899

"A UNIFIED METHOD FOR THE RECONSTRUCTION OF SAMPLED DATA", Durling, A. E., Bullock, T. E., IEEE Transactions on Computers, Vol. C-22, No. 4, April 1973, pp 388-396.

Many digital systems have need for continuous-type output for oscilloscope display, process control, or hybrid computation. This paper presents a generalization and unification of the theory of extrapolation and reconstruction of sampled data. This generalization allows implementation of a recursive algorithm or digital filter in conjunction with the continuous data reconstruction. The general procedure is demonstrated for the implementation of an nth-order recursion relation using polynomial or exponential data reconstruction requiring only a single resetting integrator for the general nth-order reconstructor.

INDEX TERMS: Methodology, Systems analysis, Data processing, Model studies, Mathematical models, Mathematical studies, Sample data, Data reconstruction, Digital to analog converters, Polynomial interpolation, Digital filtering.

AMIC-7897

"HEATED SENSORS FOR FLOW MEASUREMENT", Wasserman, R., Grant, H., Instruments and Control Systems, Vol. 46, No. 5, May 1973, pp 59-61.

Heated sensors consist of electrical probes connected to a bridge circuit which provides a current flow to maintain the temperature of the probe above ambient. By knowing characteristics of the fluid to be measured and the probe, it is possible to measure temperature, viscosity, Reynolds number, thermal conductivity, and mass flow. Where fluid temperature fluctuates, errors in mass flow measurements can be compensated for by computation or by using an additional unheated sensor. Measurement circuits may employ either constant temperature or constant current bridges depending on the requirements of the system. Probes are constructed of platinum, tungsten, or platinum-iridium wire of 0.00008 to 0.001 inch diameter or of films of resistance material plated on ceramic or quartz substrates. A comparison of the performance characteristics of wire and film probes in various fluids is given.

INDEX TERMS: Water temperature, Flow rates, Viscosity, Reynolds number, Thermal conductivity, Temperature, Electrical equipment, Hot wire sensors, Hot film sensors, Sensors.

AMIC-7901

"AUTOMATIC METER READING USING EXISTING TELEPHONE CIRCUITS", Journal American Water Works Association, Vol. 65, No. 2, February 1973, pp 99-111.

Information is provided on the cost factors involved in the various possible configurations of telemetered meter reading. Specifically, this is concerned with (1) the reading of meters via telephone circuits, (2) the major cost factors involved in adopting such a system, both telephone company charges and utility costs, (3) some of the factors resulting in ranges of these cost, and (4) some of the other factors that should be considered in a decision concerning automatic meter reading. The system principles are explained for this type of telemetry. Two basic types of automatic meter reading systems are discussed: (1) the telephone company provides the data communications terminal (DCT), the meter reading access circuit (MRAC), and the line coupler or data set at the customer's premises; and (2) the utility instead of the telephone company, owns, installs, and maintains one or more of these elements. Other possible configurations are diagrammed and briefly discussed.

INDEX TERMS: Telemetry, Costs, On-site data collections, Data processing, Maintenance costs, Operating costs, Installation costs, Automatic control, Data transmission, Cost-benefit analysis, Variable costs, Operation and Maintenance, Estimated costs, Automatic meter reading, Telephone circuits, Data communications terminal, Meter reading access circuit.