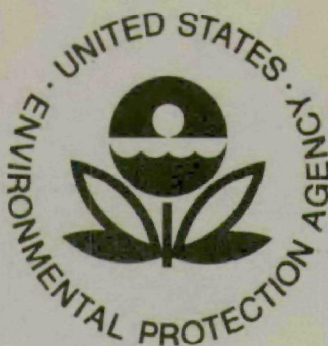


March 1973

Reviews of Current Literature on Analytical Methodology and Quality Control

No. 14



Office of Research and Monitoring
U.S. Environmental Protection Agency
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REVIEWS OF CURRENT LITERATURE ON
ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 14

By

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NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM
ANALYTICAL QUALITY CONTROL LABORATORY

REVIEWS OF CURRENT LITERATURE ON
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.

CONTENTS

1. PHYSICAL AND CHEMICAL METHODS

Page 1-32

Scope: Wet chemical methods; Nutrients; NTA; Trace metals; Helium glow; Chromatography (thin layer, gas, liquid); Spectroscopy (atomic absorption; flame emission, arc-spark, visible, UV, IR, fluorescent); Radiochemistry; Automation of methods; Ion-specific and other probes; Mass spectrometry; Mass spectra; NMR; Instrument-computer interface; Chlorinated hydrocarbons (pesticides, PCB's, other); Trace organics; Petroleum processes (reforming, hydroforming, platforming, catalysts); Petroleum additives; Reduced crudes; Sulfur isotopes; Boiling range determination; Asphatenes and carboids; Weathering; Organometallics; Elemental analysis; Paraffinic distribution; Petroleum wastes; Water quality standards; Effluent monitoring.

2. BIOLOGICAL METHODS

Page 33-57

Scope: Plankton; Periphyton; Macrophyton; Macroinvertebrates; Fish; Sample collection (grab samplers, artificial substrates); Sample processing (preservation, staining, automatic and manual sorting and counting); Organisms identification (taxonomic keys, optical and electron microscopy, gas chromatography, electrophoresis, karyosystematics); Biomass measurements (drying, freeze-drying, ashing, ATP, DNA, chlorophyll measurement, calorimetry); Metabolic rates (primary productivity, respiration, electron transport, nitrogen fixation); Culturing; Biomonitoring; Bioassay; Bioaccumulation of hazardous materials; Community structure (indicator organisms, species diversity, community stability); Mathematical models; Statistical analysis.

3. MICROBIOLOGICAL METHODS

Page 58-66

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

4. METHODS AND PERFORMANCE EVALUATION

Page 67-69

Scope: Collaborative testing; Laboratory and analyst performance evaluation; Inter- and intralaboratory quality control; Evaluation of laboratory equipment; Statistical treatment of analytical data; Experimental design.

5. INSTRUMENT DEVELOPMENT

Page 70-74

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

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-2931 "BORON FROM AN ENVIRONMENTAL POINT OF VIEW", Royal Swedish Academy of Engineering Sciences, Stockholm, Sweden, Report No. IVA-33, 1970, 21 pp. NTIS Report No. N71-30598.</p> <p>By comparison of previous measurements of boron content in river-, lake-, or seawater with today's knowledge of the same, it has been possible to identify the effect of the increase of boron in effluents on green plants and human beings. It appears that from the data so far available on the boron content in nature, boron and its pollution do not constitute an acute problem for the environment. However, a number of actions are recommended such as the investigation of the minimum toxic dose for green plants and for human beings, the average increase of boron in effluents, and so forth. (In Swedish)</p> <p>INDEX TERMS: Pollutant identification, Water pollution effects, Aquatic habitats, Toxicity, Boron, Rivers, Lakes, Sea water, Aquatic environment, Water pollution sources, Waste effluents, On-site tests, Sampling, Instrumentation, Water pollution.</p>	<p>AMIC-4124 (Continued) Card 2/2</p> <p>INDEX TERMS: Phosphothioate pesticides, Chlorinated hydrocarbon pesticides, Phenolic pesticides, Gas chromatography, Triazine pesticides, Carbamate pesticides, Triazole pesticides, Polychlorinated biphenyls, Urea pesticides, Degradation (decomposition), Metabolism, Isolation, Soil analysis, Water analysis, Structure, Mass spectrometry, Biological samples, Urine, Blood, Tissue.</p>
<p>AMIC-4124 "RECENT APPLICATIONS OF MASS SPECTROMETRY AND COMBINED GAS CHROMATOGRAPHY-MASS SPECTROMETRY TO PESTICIDE RESIDUE ANALYSIS", Biros, F. J., <u>Residue Reviews</u>, Vol. 40, 1971, pp 1-63.</p> <p>Mass spectral fragmentation studies of several classes of organic pesticidal compounds are outlined. These include the organochlorine and organophosphate classes of insecticides, carbamates, uracil, and triazine herbicides, and several miscellaneous classes including nicotinoids, rotenoids, and phenoxyalkanoic acids. The available literature relating to the application of mass spectrometry in the characterization of individual pesticide residues has been reviewed with emphasis on studies involving animal metabolism of pesticides, plant- and soil-induced chemical alteration of pesticidal materials, and the photodecomposition of pesticides. Techniques for the separation, isolation, and collection of individual pesticide residues for subsequent mass spectral analysis have been tabulated, with special reference to gas chromatographic and thin-layer chromatographic trapping devices. A discussion is presented on the various types of coupling techniques used for interfacing a gas chromatograph with a mass spectrometer. Included are methods utilizing direct coupling of gas chromatographic columns as well as those employing carrier gas separator interfaces operating on diffusion or effusion principles. Other mass spectrometric instrumental considerations are also outlined, particularly those associated with enhancement of sensitivity, identification of multicomponent gas chromatographic peaks, and the use of mass spectrometry as a gas chromatographic detector in the confirmation of chemical identity. Recent applications of the combined technique to the confirmation of pesticide residues and the characterization of metabolites and photodecomposition products are discussed.</p>	<p>AMIC-5965 "MARINE HEAVY-METAL POLLUTANT ANALYSIS BY ATOMIC ABSORPTION SPECTROMETRY", Burrell, D. C., University of Alaska, Institute of Marine Science, College, Alaska, Report No. CONF-711044-1, Contribution No. 130, Contract Nos. AT (04-3)-310 and AT (45-1)-2229, October 1971, 24 pp. NTIS Report No. RLO-2229-T-1-10.</p> <p>The principle advantage of AAS analysis for trace heavy metals in the marine environment lies in the potential for an approximation to realtime data acquisition for a large number of samples. The chief problems are associated with deletions and additions of the test elements during collection, storage, and pre-analysis treatment of the samples; problems common also to non-spectrophotometric methods. The latter source of error may be largely negated in the future by the use of flame-less AAS techniques. In any case, the portability of AAS is a major advantage over neutron activation and the latest X-ray fluorescence methods. It must be emphasized that all of the commonly utilized pre-AAS analysis concentration methods for trace metals in seawater fractionate - inadvertently or otherwise - the chemical forms of the test element. It is probably preferable at present to preface these treatments with some oxidation step and to aim for total values, although AAS is a potentially valuable tool for looking at separated organic fractions. Neutron activation analysis is currently of comparable utility for total analysis but will be superseded when direct AAS and AFS techniques have been developed for routine ship-board use. Anodic stripping voltammetry is also very suitable for the analysis of Pb, Cd, Zn, and Cu in seawater; all of major concern as potential marine pollutants. These methods are not routine at present, but ship-board use is possible. Since it appears to be difficult to electrolytically reduce Hg in a seawater medium, an amalgamation concentration, possibly coupled with specialized long path-length absorption cells, appears to offer</p>

1. PHYSICAL AND CHEMICAL METHODS

AMIC-5965 (Continued)

Card 2/2

the most promise for marine Hg detection. The accuracy and precision data quoted for marine heavy-metal analysis relates almost exclusively to the instrumental analysis operations; the major errors lie with the sampling and other pre-analysis manipulations.

INDEX TERMS: Analytical techniques, Water analysis, Sea water, Metals, Heavy metals, Zinc, Mercury, Lead, Cadmium, Copper, Separation techniques, Neutron activation analysis, Reviews, Chelation, Filtration, Manganese, Iron, Cobalt, Nickel, Atomic absorption, Atomic absorption spectrophotometry, Sample preparation, Preconcentration, Precision, Shipboard analysis, Anodic stripping voltammetry, X-ray fluorescence, Detection limits, Silver.

AMIC-6016

"G. L. C. ANALYSIS OF TRACE-METALS IN SEAWATER: SOLVENT EXTRACTION TECHNIQUES", Lee, M.-L., Burrell, D. C., University of Alaska, Institute of Marine Science, College, Alaska, Report No. RLO-2229-T1-8, 15 pp.

A chelation-solvent extraction procedure was tested for its ability to remove metals from seawater for gas-liquid chromatographic analysis. Seawater samples spiked with radioisotopes of indium, iron, cobalt, and zinc were combined at various pH ranges with equal volumes of toluene-trifluoroacetylacetone on toluene-TFA-isobutylamine to remove the metals for analysis. Extraction efficiency was determined as a function of phase ratio and time by varying initial quantities of seawater and different equilibria time. 99.5 percent of the indium may be extracted over a pH range from 6.3-10.0, and iron is effectively removed between pH 4.0-10.0. Only a trace of zinc could be extracted from seawater of any pH, qualitatively; the extractability of cobalt was also found to be very low. Trace aluminum concentrations may also be detected.

INDEX TERMS: Sea water, Solvent extractions, Efficiencies, Separation techniques, Chelation, Methodology, Heavy metals, Trace elements, Pollutant identification, Hydrogen ion concentration, Radiochemical analysis, Gas liquid chromatography, Sample preparation, Chemical interference, In-114, Fe-59, Co-60, Zn-65, Chemical recovery, Toluene-trifluoroacetylacetone, Organic solvents.

AMIC-6191

"REAGENTS FOR DETERMINATIONS OF TRACE IMPURITIES IN WATER", Abercrombie, F. N., Caskey, A. L., Antepencko, R. J., et al., Illinois University, Water Resources Center, Urbana, Illinois, Final Report, February 1972, 249 pp. NTIS Report No. PB 208 597.

Sensitive, specific, stable water-soluble reagents are needed for rapid, spectrophotometric determination of trace impurities in water. Syntheses, purifications, and characterization of the naphthol-mono-sulfonic acids are described. In addition, data essential to the quantitative evaluation of various naphtholsulfonic acids are presented. A new method for the determination of nitrate in water is described; the proposed method, which uses 2-nitroso-1-naphthol-4-sulfonic acid, is much more rapid than the presently accepted standard methods for determination of nitrate. Another method, which uses 1-naphthol-4-sulfonic acid for the determination of nitrate and proposed by another worker has been carefully and critically evaluated and found to be satisfactory only under very carefully controlled conditions. A new reagent, sodium 2-nitroso-1-naphthol-5-sulfonate, has been proposed for the rapid, specific, sensitive determination of cobalt in natural waters. Full development of water resources and the control of pollutants returned to natural-water systems are dependent upon methods of determining trace constituents; significant contributions toward meeting those needs have been accomplished in this work. The methods can readily be applied to such diverse systems as lakes where agricultural fertilizer runoff may be significant, to effluents from plants in the metallurgical industry, to natural-water systems in highly mineralized areas, and to runoff from strip-mined lands. Effective new research areas are readily identified as an extension of the work reported here; better methods for the determination of nitrate in water, and more sensitive methods for the determination of cobalt in water are envisioned.

AMIC-6191 (Continued)

Card 2/2

INDEX TERMS: Pollutant identification, Water analysis, Chemical analysis, Nitrates, Cobalt, Methodology, Gas chromatography, Separation techniques, Heavy metals, Sulfonates, Industrial wastes, Mine wastes, Agricultural runoff, Naphthol-mono-sulfonic acids, Natural waters, Reagents, Sodium 2-nitroso-1-naphthol-5-sulfonate, 2-Nitroso-1-naphthol-4-sulfonic acid, 1-Naphthol-4-sulfonic acid, Organic solvents, Sensitivity, Precision, Sample preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6257

"DETERMINATION OF LEAD IN FISH BY FURNACE ATOMIC ABSORPTION", Pagenkopf, G. K., Neuman, D. R., Woodruff, R., Analytical Chemistry, Vol. 44, No. 13, November 1972, pp 2248-2250.

A meth A method is reported for lead analysis in fish using furnace atomic absorption. One to five grams of fish muscle were obtained by dissection and freeze-dried; about 1 gram of the dried tissue was weighed, digested in a mixture of concentrated nitric and perchloric acids, and the colorless samples transferred to clean volumetric flasks. Twenty microliters of the sample were placed into graphite cups which were in turn placed under an IR light and heated until the solvent evaporated. The cups were then placed in the furnace and the peak absorbances were recorded. The detection limit of the outlined method is 0.15 ng/g with an absolute sensitivity of 5.5 picograms. The accuracy of the method was evaluated using standard addition whereby a known quantity of lead was added to approximately 1-gram equivalents of dried muscle. The resulting data indicate that virtually no lead is being lost during the procedure. The procedure appears to be free of matrix effects and should be applicable to lead analysis in any biological system.

INDEX TERMS: Lead, Heavy metals, Chemical analysis, Freeze drying, Pollutant identification, Assay, Atomic absorption spectrophotometry, Furnace atomic absorption, Graphite furnace, Detection limits, Muscle, Animal tissues, Chemical digestion, Sample preparation, Precision, Chemical interference, Absorbance.

AMIC-6270

"ENVIRONMENTAL INDICATORS FOR PESTICIDES", Strickland, J., Blue, T., Stanford Research Institute, Menlo Park, California, Final Report, Contract No. EQC217, April 1972, 123 pp. NTIS Report No. PB 210 666.

Results are presented from a study concerned with environmental indicators of pesticides. The indicators include consideration of: (1) Production, imports, exports, and consumption of pesticides by type and over time, (2) amounts of pesticides found in food, air, water, soil, wildlife, plants, and the human body, and (3) indirect measures of pesticide utilization as they relate to public health, crop quality and yield, and recreational and aesthetic values. Steps are identified which should be taken for future collection and processing of the data necessary for calculation of these indicators at appropriate intervals. A comprehensive framework was developed which characterizes the modes by which materials move, the mediums affected, the ecological phenomena that can be observed, and the environmental factors concerned. Recommendations are included for effectively orienting and managing pest control programs with maximum environmental enhancement.

INDEX TERMS: Pesticide residues, Water pollution effects, Monitoring, Transportation, Path of pollutants, Lakes, Rivers, Estuaries, Fish, Public health, Wildlife, Rain.

AMIC-6271

"NATIONAL ASSESSMENT OF TRENDS IN WATER QUALITY", Enviro Control, Inc., Washington, D.C., Final Report, Contract No. EQC214, June 1972, 48 pp. NTIS Report No. PB 210 669.

This study was performed for the Council on Environmental Quality to develop a new approach for assessing trends in national water quality. Data were analyzed from EPA's STORET system which contains input from 70,000 stations. The quality parameters examined were limited to those measured at least quarterly for most stations having at least 8 years of records. This restriction eliminated some important parameters such as pesticides and heavy metals. The parameters analyzed included organic indicators (DO, BOD, COD, TOC), nutrient indicators (total P, soluble P, ammonia plus organic N, and NO₃ plus NO₂), sediment measures (suspended solids and turbidity), and salinity measures (total dissolved solids and conductivity). Trends were analyzed as a function of flow which was felt to be the most powerful determinant of water quality. Data from 142 stations (which are not necessarily representative) satisfied the criteria established and were therefore analyzed. The analyses showed that some parameters (e.g. suspended solids and turbidity) were roughly proportional to flow, whereas others (e.g. total dissolved solids) were inversely proportional. The most significant finding was that in many cases oxygen-demanding load and nutrients were directly related to flow. Trends of the various parameters from the 142 stations are tabulated.

INDEX TERMS: Water quality, Nutrients, Suspended solids, Turbidity, Salinity, Conductivity, Flow, Forecasting, Oxygen demand, Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Phosphates, Nitrates, Nitrites, Dissolved solids, Data interpretation, Organic carbon, Trends.

AMIC-6272

"DEVELOPMENT OF ANALYTICAL PROCEDURES FOR DETERMINING CHLORINATED HYDROCARBON RESIDUES IN WATERS AND SEDIMENTS FROM STORAGE RESERVOIRS", Lyons, E. T., Salman, H. A., Bureau of Reclamation, Engineering and Research Center, Denver, Colorado, Report No. REC-ERC-72-15, April 1972, 10 pp. NTIS Report No. PB 210 639.

Analytical methods for measuring and detecting chlorinated hydrocarbon insecticides in reservoir and bottom muds are described. A semiautomatic extraction with hexane followed by gas chromatography was used to determine the presence of insecticides in water. A 16-hr Soxhlet extraction using 6 percent diethyl ether in petroleum ether followed by florisil cleanup and gas chromatography gave the most reproducible results for determining insecticides in bottom muds. For both water and sediment samples, a known volume was injected into the gas chromatography, the concentration of the insecticide determined by comparing their peak heights with those of insecticide standards, and corrected for percent of recovery. Water and sediment samples taken from Lake Mead were analyzed by these methods for numerous insecticides. The water samples contained lindane at a concentration of 0.02 to 5.00 parts per billion (ppb). No other insecticides were found. No insecticides were found in the sediments; however, gas chromatograph interferences made the sediment analysis extremely difficult even after column cleanup.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Water analysis, Sediments, Separation techniques, Gas chromatography, DDD, DDE, DDT, Heptachlor, Aldrin, Dieldrin, Sample preparation, Chemical interference, Lindane, Kelthane, Heptachlor epoxide, Perthane, Endrin, Methoxychlor.

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-6274</p> <p>"THE ROLE OF PAPER MILL ADDITIVES AS POTENTIAL STREAM POLLUTANTS DEVELOPMENT OF NUCLEAR TECHNIQUES", Chatters, R. M., Washington State University, College of Engineering Research Division, Pullman, Washington, Report No. UC 23, Annual Progress Report No. 2, Contract No. AT(45-1)-2221, March 1, 1972, 64 pp. NTIS Report No. RLO-2221-T3-2.</p> <p>The purpose of this study was to develop nuclear analytical techniques where needed for better controlling paper mill additives to prevent their release into the environment as pollutants. The results of the second year's efforts are reported in this document. A new method for the determination of glucose, and in turn starch, was developed based upon the reduction of mercury compounds by glucose followed by the use of diatomaceous earth to recover all mercury so liberated from its compound. The new technique was satisfactorily employed under actual mill operating conditions. Extensive studies were made in the laboratory and cooperatively with paper mill personnel to determine the correlation between glucose levels and BOD on the same effluent samples. An adhesive-type additive was successfully tagged with a metal element and tested twice under normal mill operating conditions. It was also found that a metallic bleach compound could be readily detected by neutron activation analysis in paper and in effluents. The metal was present in non-toxic quantities in the finished product as well as the effluent. A method was developed for tagging one of the important non-starchy sizing compounds with a metal element. The resultant product was found by a paper-chemicals company to yield identical test results on paper as did the untagged compound. One filler and whitening compound was tested and found to be satisfactory for neutron activation analysis as well as by means of x-ray fluorescence spectrometry. For neutron activation analysis, a new type of irradiation</p>	<p>AMIC-6308</p> <p>"A SURVEY OF THE SELENIUM CONTENT OF FISH FROM 49 NEW YORK STATE WATERS", Pakkala, I. S., Gutenmann, W. H., Lisk, D. J., et al., <u>Pesticides Monitoring Journal</u>, Vol. 6, No. 2, September 1972, pp 107-114.</p> <p>A survey was made of the selenium content of 438 fish of various species collected in 1969 from 49 New York State waters and a group of lake trout sampled in 1970 from Cayuga Lake only. Decapitated, eviscerated fish were chopped, mixed, and frozen in polyethylene bags prior to analysis. Selenium was determined by an adaptation of the Allaway and Cory method involving oxygen-flask combustion of dried fish and the determination of the fluorescence of the selenium 2,3-dianionaphthalene complex. The method was sensitive to about 0.1 ppm of Se in fish. Concentrations of selenium on a freshweight basis were usually below 1 ppm. There was little apparent correlation between selenium concentrations and species or sampling locations except that sturgeon from the Hudson River, lake trout from Lakes George and West Canada, whitefish from Raquette Lake, and several species from Lake Pleasant had consistently higher levels of selenium than other samples; all fish from Lakes Butterfield and Champlain and the Chenango and Salmon Rivers had consistently lower levels. No correlation was apparent between selenium levels and size or sex of fish. Selenium did not appear to be cumulative in lake trout of known age up to 12 years from Cayuga Lake.</p> <p>INDEX TERMS: Freshwater fish, Anadromous fish, Brackish-water fish, Saline water fish, New York, Lakes, Rivers, Separation techniques, Sampling, Cold-water fish, Marine fish, Pollutant identification, Chemical analysis, Selenium, Chalcogens, Sample preparation, Sample preservation, Chemical recovery, Detection limits.</p>
<p>AMIC-6274 (Continued)</p> <p>Card 2/2</p> <p>container was developed and has been adopted by other investigators. Wherever possible during the investigations to date, samples for study have been collected in cooperating paper mills under normal conditions.</p> <p>INDEX TERMS: Pulp wastes, Pulp and paper industry, Radioactivity techniques, Biochemical oxygen demand, Neutron activation analysis, X-ray fluorescence, Dyes, Bleaching wastes, Starch, Glucose, Adhesives, Whiteners, Fillers, Sugars, Sizing agents.</p>	<p>AMIC-6363</p> <p>"COMPARISON OF OXYGEN-BOMB COMBUSTION WITH STANDARD IGNITION TECHNIQUES FOR DETERMINING TOTAL ASH", Reiners, W. A., Reiners, N. M., <u>Ecology</u>, Vol. 53, No. 1, Winter 1972, pp 132-136.</p> <p>Ash was determined in a variety of plant and organic soil samples by oxygen-bomb combustion and by a simple muffle-furnace technique. The influence of using different drying temperatures was also assessed. One hundred thirty-nine plant tissue and 15 organic soil samples were collected and analyzed by oxygen-bomb combustion, muffle-furnace, char, and calorimetric techniques. Bomb combustion produced a systematic error of underestimate and a random error of variation between trials. These errors varied among the different types of material tested, but in general both types of error increased with the ash content of the material. The average systematic error of underestimate of ash content for all samples was 1.46 percent, which led to an error of 1.56 percent when adjusting caloric coefficients to an ash-free basis. Lower drying temperatures had an insignificant effect on adjusted caloric coefficients. Independent ash determinations are recommended for materials with ash content greater than 5 percent to restrict the error of adjusted coefficients below 1 percent. The muffle-furnace technique is recommended for close approximations of absolute ash content.</p> <p>INDEX TERMS: Chemical analysis, Methodology, Biomass, Soil analysis, Productivity, Plant tissues, Oxygen-bomb combustion, Muffle-furnace technique, Dry ashing.</p>

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6392

"SEPARATION OF ALDRIN FROM AROCLOR 1254", Hannan, E. J., Bills, D. D., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 6, December 1972, pp 327-328.

Two gas chromatographic methods have been found for the separating of aldrin from polychlorinated biphenyls. The most direct, quickest, and easiest method for quantification involved the use of an OV-225 column on which aldrin will precede Aroclor 1254. The second method involved the use of SE-30/QF-1 and OV-17 columns. Peaks can be trapped from either column and reinjected on the other. The latter method is more applicable to environmental samples; it can also be applied to the separation of dieldrin from PCB's only when the peak containing dieldrin is trapped from the SE-30/QF-1 column and reinjected on the OV-17 column.

INDEX TERMS: Separation techniques, Aldrin, Pollutant identification, Polychlorinated biphenyls, Dieldrin, Chlorinated hydrocarbon pesticides, Methodology, Aroclor 1254, Electron capture gas chromatography, Column chromatography.

AMIC-6397

"A SIMPLE TEST FOR ESTIMATING FREE CHLORINE", Bauer, R., Philips, B. F., Rupe, C. O., Journal American Water Works Association, Vol. 64, No. 11, November 1972, pp 787-789.

A simple device is described for determining the presence of free chlorine in water which will in turn provide a convenient means of measuring germicidal activity. Since syringaldazine reacts with free chlorine and not with bound chlorine such as chloramines, it has been used in combination with vanillinazine on paper strips for measuring free chlorine both in the laboratory and the field. With this wicking device, more chlorine can be brought into contact with the indicator, thus enhancing color production such that 0.2-2.0 ppm free chlorine can be estimated.

INDEX TERMS: Chlorine, Pollutant identification, Water analysis, Laboratory tests, On-site tests, Halogens, Color reactions, Methodology, Quantitative analysis, Chloramines, Syringaldazine, Chemical indicators, Vanillinazine.

AMIC-6395

"THE GAS CHROMATOGRAPHIC DETERMINATION OF PARAQUAT IN WATER", Soderquist, C. J., Crosby, D. G., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 6, December 1972, pp 363-368

A simple, inexpensive, and reproducible method for the resolution and specific detection of paraquat in water involves: (1) complete hydrogenation of paraquat to 1,1'-dimethyl-4,4'-bipiperidine (III) in aqueous solution, (2) extraction into organic solvent, and (3) analysis by flame ionization gas liquid chromatography. This procedure has a limit of detectability of less than 0.1 ppm but recoveries of only 36-43 percent at 0.1-1.0 ppm. The detection limit may be extended by preconcentrating a larger water sample by evaporation or hydrogenation. Although the recoveries are low, they are constant and reproducible. The analysis requires less than one hour per sample. This method may be used for the qualitative confirmation of paraquat or diquat residues.

INDEX TERMS: Paraquat, Gas chromatography, Water analysis, Chemical analysis, Pollutant identification, Herbicides, Halogenated pesticides, Diquat, Methodology, Solvent extractions, Pesticide residues, Flame ionization gas chromatography, Detection limits, Recovery, Reproducibility.

AMIC-6398

"OIL SPILL IDENTIFICATION WITH MICROENCAPSULATED COMPOUNDS SUITABLE FOR ELECTRON CAPTURE", Mitchell, B. L., Simmonds, P. G., Shair, F. H., Environmental Science and Technology, Vol. 7, No. 2, February 1973, pp 121-124.

A technique involving the microencapsulation of high-vapor-pressure compounds suitable for electron capture detection is proposed for the rapid, unambiguous identification of oil slicks. The principal steps in testing a sample are: separating all of the particulate matter, including the microencapsulated tracer, from the oil; opening the microcapsules at the desired time to release the primary compounds into the airspace overhead; and injecting a portion of the overhead gas into the gas chromatograph column. Experimental diffusion studies indicate that the tracer will remain within the microcapsules during the lifetime of an oil slick. Small-scale field studies were conducted with 30-micron diam microcapsules containing Freon 113. Initial tagging densities of about 100 particles/cu cm were adequate to permit identification for periods up to at least a month after the spill. This identification technique allows the possibility of providing over a million distinguishable mixtures from 20 primary compounds.

INDEX TERMS: Oil spills, Water pollution sources, Pollutant identification, Methodology, Tagging, Tracers, Microencapsulation, Electron capture gas chromatography.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6399

"HEAVY METAL LEVELS OF OTTAWA AND RIDEAU RIVER SEDIMENTS", Oliver, B. G., Environmental Science and Technology, Vol. 7, No. 2, February 1973, pp 135-137.

Surface sediment samples were collected with a Lane sediment sampler at 2-mile intervals along the Ottawa and Rideau Rivers near Ottawa, Canada, in 1971. Three samples were taken at each sampling station about 10 yards from each bank and in the center of the river. One gram of each air-dried sample was weighed, digested in an acid solution for 2 hr at 70-90 C and the acid extracts analyzed for Pb, Hg, Zn, Cu, Ni, Co, Fe, Mn, and Cr using atomic absorption spectrophotometry. The finer sediment samples generally contained more heavy metal than the coarser samples. Since there was such a pronounced difference in the average metal concentrations, the surface areas of the samples were measured and taken into consideration when deciding whether or not metal levels were unusually high. Some anomalously high heavy metal concentrations found in the sediments in certain locations appeared to be related to pollution of the rivers by municipal and industrial waste water discharges and waste disposal practices.

INDEX TERMS: Heavy metals, Fluvial sediments, Chemical analysis, Soil analysis, Aquatic soils, Coarse sediments, Silts, Clays, Mercury, Lead, Zinc, Copper, Nickel, Cobalt, Iron, Manganese, Chromium, Atomic absorption spectrophotometry, Ottawa River, Rideau River.

AMIC-6402

"MERCURY: SHORT-TERM STORAGE OF NATURAL WATERS", Carr, R. A., Wilkiss, P. E., Environmental Science and Technology, Vol. 7, No. 1, January 1973, pp 62-63.

Surface water samples from the Chesapeake Bay were used in a study to determine the effects of sample storage on the analysis of natural waters for mercury. Carrier-free Hg-197 was added to two 1-liter and two 19-liter samples, stored in polyethylene containers, and one of each pair was acidified to pH 1 with redistilled nitric acid. Five-milliliter aliquots were withdrawn for 8 days following storage and counted for total, filter, and filtrate portions. Use of the carrier-free Hg-197 and improved flameless atomic absorption techniques showed negligible losses to sample containers upon 8-day storage at pH 1. At the time of sampling, 80 percent of the total mercury was associated with particulates, while at the end of the storage period only 10-15 percent was associated with particulates. No vaporization losses were observed under these conditions. A similar tracer experiment was performed on acidified glacial ice meltwater obtained from a depth of 57 meters at the Camp Century (Greenland). This sample had remained frozen until just prior to the addition of the radiotracer. The Hg was almost quantitatively associated with the filterable solids but was released into solution during storage at a pH less than 1.

INDEX TERMS: Mercury, Storage, Tracers, Water analysis, Flameless atomic absorption spectrophotometry.

AMIC-6400

"TREATMENT OF EFFLUENT FROM MANUFACTURE OF CHLORINATED PESTICIDES WITH A SYNTHETIC, POLYMERIC ADSORBENT, AMBERLITE XAD-4", Kennedy, D. C., Environmental Science and Technology, Vol. 7, No. 2, February 1973, p 138-141.

Laboratory experiments were conducted in order to devise a treatment method with specific application to industrial wastes streams which contain chlorinated pesticides. The use of the adsorbent Amberlite XAD-4 was evaluated in comparison with the widely used activated carbon. Chlorinated hydrocarbon pesticide effluent samples obtained from a pesticide manufacturer were analyzed by a technique involving a liquid-liquid extraction concentration step followed by electron capture gas-liquid chromatography in order to characterize their content. Laboratory adsorption experiments were performed in 1.77-cm i.d. glass columns. A coarse glass frit in the bottom of the column was used to retain the adsorbent bed. Forty milliliters of adsorbent (ca. 32-cm bed depth) was used in each experiment. Solutions were pumped through the column with a Bach variable flow piston pump. Column effluent samples were collected periodically and analyzed for total chlorinated pesticides. The leakage of unadsorbed pesticides from the XAD-4 column was significantly lower than that from the activated carbon column. The adsorbed pesticides were efficiently desorbed from XAD-4 by eluting with isopropanol but the activated carbon could not be regenerated effectively with isopropanol.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Adsorption, Industrial wastes, Effluents, Separation techniques, Activated carbon, Pollutant identification, Amberlite XAD-4.

AMIC-6404

"REMOVAL OF HEAVY METALS FROM WATER AND BRINE USING SILICON ALLOYS", McKaveney, J. P., Fassinger, W. P., Stivers, D. A., Environmental Science and Technology, Vol. 6, No. 13, December 1972, pp 1109-1113.

A one-step method using silicon alloys has been proposed for the removal of heavy metals from waste waters and brine solutions. Silicon alloys of calcium and magnesium produced the best results both from the view of scope in the exchange (zinc thru mercury in the electromotive series) as well as replacement of heavy metals with elements common to natural waters (calcium and magnesium). Silicon alloys of aluminum, barium, iron, and titanium were also found suitable but their use may require some posttreatment (hydrolysis or sulfate precipitation). Ferrosilicon is fairly selective in removing mercury without significant iron contamination in the water. The alloys can be used in either a column or batch contact type of operation. Brine and other aqueous solutions over the pH range of 1-12 have been treated. However, to minimize acid attack and to conserve alloy, the pH should be greater than or equal to 4.0. Metals successfully removed were: Ag, As, Au, Cd, Cu, Cr, Fe, Hg, Pb, V, and Zn. Mercury has also been successfully removed from chlor-alkali brines.

INDEX TERMS: Heavy metals, Separation techniques, Waste water (pollution), Brines, Aqueous solutions, Pollutant identification, Waste identification, Pollutants, Hydrogen ion concentration, Calcium, Magnesium, Gold, Cadmium, Copper, Chromium, Iron, Mercury, Lead, Zinc, Water analysis, Methodology, Water pollution sources, Silicon alloys, Silver, Arsenic, Vanadium.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6405

"CONCENTRATION OF ARSENIC FROM WATER SAMPLES BY DISTILLATION", Parkas, E. J., Griesbach, R. C., Schachter, D., Hutton, M., Environmental Science and Technology, Vol. 6, No. 13, December 1972, pp 1116-1117.

Determination of the amount of arsenic in samples of drinking water is facilitated if the arsenic in the sample can first be concentrated into a smaller volume. The utility of the distillation method described in standard reference works was investigated. During the course of the investigation, some of the variables influencing the recovery of arsenic using the distillation method were systematically studied. Optimum conditions for application of this method were determined based on experiments in which percentage recovery of the arsenic present in the original sample was measured as a function of the amounts of the reagents added to the original sample and of the volume of distillate collected. The following improvements were made in the experimental technique: (1) a carrier gas was not used; (2) the distillation apparatus was closed to the atmosphere except for a side arm on the distillate collection flask which was connected to another flask via tubing; (3) the distillate flask was kept cold and the condensate was led into it via a short dip tube; and (4) after the completion of distillation, 100 ml of cold distilled water was added thereby diluting the HCl in order to avoid an overly violent reaction with the arsenic determination reagents.

INDEX TERMS: Water analysis, Chemical analysis, Separation techniques, Distillation, Potable water, Pollutant identification, Water quality control, Methodology, Heavy metals, Arsenic.

AMIC-6406

"DISTRIBUTION OF MERCURY IN THE SEDIMENTS OF NEW HAVEN (CONN.) HARBOR", Applequist, M. D., Katz, A., Turekian, K. K., Environmental Science and Technology, Vol. 6, No. 13, December 1972, p 1123-1124.

A study was undertaken to assess the distribution and levels of mercury in the sediments of a typical industrial harbor and to identify the probable sources of high concentrations encountered. Sediment samples were collected using a 15-cm-long gravity corer with a PVC core liner 4.8 cm in diameter. Cores were collected in water less than one meter deep using manual depression of an aluminum tube. Segments (generally the top 8-cm portion) of the cores to be analyzed were disaggregated, homogenized, and heated at 90-100 C for 2 days. Smaller aliquots were then pulverized and carried through the acid digestion and permanganate oxidation steps. The insoluble silicate residue was separated from solution to prevent loss of Hg by adsorption, and the absorption cell was wrapped with a heating tape to prevent water condensation on the quartz windows. Analysis for mercury was carried out by cold atomic absorption spectrophotometry. The concentration range of mercury in 0-8- and 8-15-cm cores from the long Wharf area was 0.06-1.35 and 0.08-2.40, respectively. There was found to be a direct correlation between the highest Hg concentrations and the location of the major municipal sewer outfalls.

INDEX TERMS: Methodology, Sediments, Soil analysis, Mercury, Water pollution sources, Heavy metals, Aquatic soils, Chemical analysis, Spatial distribution, Pollutant identification, Sampling, Cold atomic absorption spectrophotometry.

AMIC-6410

"A SIMPLIFIED METHOD OF PREDICTING DISSOLVED OXYGEN DISTRIBUTION IN PARTIALLY-STRATIFIED ESTUARIES", Ratasuk, S., Water Research, Vol. 6, No. 12, December 1972, pp 1525-1532.

The pattern of salinity and dissolved oxygen stratification in a part partially-stratified estuary was delineated from results obtained during a pollution study of the Tyne Estuary in North-east England. Salinity data showed that the estuary was normally partially-stratified but could become well-mixed at low freshwater flow. However, a two-layer flow system always existed, even under well-mixed conditions. Unlike salinity stratification, dissolved oxygen stratification existed at all freshwater flow rates due to the two-layer flow condition and the self-purification process. It is suggested that only the surface and bottom dissolved oxygen conditions are required for practical use in pollution control of partially-stratified estuaries. A simple method of determining the surface and bottom dissolved oxygen concentrations from the depth-averaged concentration was developed and found to give satisfactorily accurate results. The method was based on the finding that, in almost all cases, dissolved oxygen varies linearly with depth. The depth-averaged dissolved oxygen, C_{av} , can then be expressed as a function of the surface, C_s , and bottom, C_b , dissolved oxygen concentrations: C_{av} plus C_b equals 2 C_{av} . The data for C_{av} are obtained from the one-dimensional model. Consequently, if either C_s or C_b is known, the other remaining unknown can be readily determined.

INDEX TERMS: Dissolved oxygen, Estuaries, Stratification, Methodology, Forecasting, Profiles, Equations, Flow rates, Salinity, Tyne Estuary, England, Salinity stratification.

AMIC-6412

"TRICKLING FILTER EXPERIMENT FOR PURIFICATION OF ANTIBIOTIC-CONTAINING HOSPITAL SEWAGE", Csasady, M., Deak, Z., Water Research, Vol. 6, No. 12, December 1972, pp 1541-1547.

The purpose of this study was to determine whether antibiotics in hospital sewage inhibit biological treatment by trickling filters. Preliminary investigations of sewage treatment in tuberculosis sanatoria with trickling filters showed that in most cases purification efficiency was not satisfactory but that some technical deficiency existed in every case. For establishing efficiency of treatment 12 parameters were used. Organic matter was determined by the acid permanganate method. BOD₅, coli and bacterial counts (at 20 degrees and 37 degrees C), and Clostridium numbers were also determined. The antibiotic effect, i.e., streptomycin concentration, of sewage was determined microbiologically (Kavanagh, 1963). Experiments were performed at a tuberculosis-sanatorium where a small, separate trickling filter was operating. At the time of the experiment the treatment plant was operated and loaded as usual, and its treatment efficiency was satisfactory. The plant was loaded by sewage of 64 patients and 28 personnel; drug use in the dispensary was precisely registered throughout the experiment. Experiments were carried out under the following operating conditions: streptomycin was fed to the settled sewage in 6 and 12 g/cu m doses for 7 and 3 days, respectively, expressed as active streptomycin base. Streptomycin in a concentration of 6-7 mg/l did not affect the operation of the lowload trickling filter. As this concentration is at least 6-8 times as high as that of tuberculosis-sanatoria sewage, it is concluded that inhibition of purification by such antibiotics does not occur. At a concentration of 12 mg/l, streptomycin adversely affected the performance of the trickling filter by moderately decreasing the efficiency of organic matter removal.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6412 (Continued)

Card 2/2

and considerably reducing its efficiency in removing bacteria. Antibiotics in sewers in unregulated and high concentration may thus disturb treatment of the sewage.

INDEX TERMS: Biological treatment, Sewage effluents, Hospitals, Efficiencies, Waste water treatment, Antibiotics (pesticides), Trickling filters, Sewage bacteria, Inhibition, Streptomycin.

AMIC-6421

"DETECTION OF IONIC WATER POLLUTANTS BY LASER EXCITED RAMAN SPECTROSCOPY", Baldwin, S. F., Brown, C. W., Water Research, Vol. 6, No. 12, December 1972, pp 1601-1604.

A study was conducted in order to determine the practical minimum concentrations of inorganic anions which can be detected and identified by Raman spectroscopy, and to catalog spectra of pertinent pollutants for future identification purposes. The Raman spectra of aqueous solutions were recorded on a Spex Model 1401 monochromator using a C.R.L. Model 52A argon ion cw laser and a photon counting detection system. Emphasis was placed on the 3 anions nitrate, sulfate, and phosphate. The carbonate ion was used in several experiments to simulate actual situations. The sodium salts of the anions were dissolved in water to form 1 M solutions and their Raman spectra recorded. The samples were then diluted to 50 percent of their original concentration and their spectra recorded again. This process of dilution was continued until the minimal detectable concentration was reached. The minimal concentrations detected using the described method were 25, 50, 50, and 75 ppm, respectively, of nitrate, phosphate, sulfate, and carbonate anions. In order to determine the feasibility of Raman scattering to detect ionic pollutants in a real situation, mixtures of anions present in concentrations of 100 ppm were examined. The nitrate and sulfate anions gave stronger bands and they can be detected in even lower concentrations. Since the phosphate and sulfate bands are relatively close in frequency, they would be more difficult to distinguish. The Raman spectrum of a seawater sample taken from Narragansett Bay yielded a reading of approximately 2400 ppm sulfate. This study showed that Raman spectroscopy can be a valuable analytical tool in the detection of inorganic water pollutants.

INDEX TERMS: Chemical analysis, Water analysis, Pollutant identification, Sulfates, Nitrates, Carbonates, Phosphates, Methodology, Raman spectroscopy, Detection limits.

AMIC-6420

"AUTOMATED FLUOROMETRIC METHOD FOR DETERMINATION OF BORON IN WATERS, DETERGENTS AND SEWAGE EFFLUENTS", Afghan, B. K., Goulden, P. D., Ryan, J. F., Water Research, Vol. 6, No. 12, December 1972, pp 1475-1485.

An automated method for the determination of boron in natural waters, detergents and sewage effluents is described. The method is based on the reaction of 4'-chloro-2-hydroxy-4-methoxybenzophenone (CHMB) with boron to produce fluorescent species, in a 90 percent sulfuric acid medium. The method has been made specific to remove any interferences from all major and minor ions and other organic compounds normally present in water. The method is capable of measuring different chemical forms of boron such as boric acid, borax, sodium perborate and tetraphenyl boron. The method analyzes 10 samples per hour, in the 5-100 ppb boron range. The rate of sample analysis can be increased to 20 per hour at higher concentration ranges. The limit of detection is 1 ppb boron.

INDEX TERMS: Boron, Pollutant identification, Water analysis, Chemical analysis, Sewage effluents, Methodology, Detergents, Automation, Chemical reactions, Snow, Ions, Organic compounds, Chemical interference, 4'-chloro-2-hydroxy-4-methoxybenzophenone, Detection limits, Boric acid, Borax, Sodium perborate, Tetraphenyl boron.

AMIC-6422

"A REVIEW OF THE ARSENIC CYCLE IN NATURAL WATERS", Ferguson, J. F., Gavis, J., Water Research, Vol. 6, No. 11, November 1972, pp 1259-1274.

The occurrence and cycling of arsenic in fresh waters is reviewed. An eH-pH diagram provides thermodynamic information on a system which includes sulfur. Arsenic may be removed from the solution phase to sediments by absorption on clays or other compounds or by coprecipitation into metal ion precipitation. Possible microbially-mediated reactions of arsenic, including oxidation of arsenic, methylation of arsenic species, and reduction of arsenate, are discussed with reference to the locale of the reaction in the water column or in the sediments and to the toxicological significance of the reaction products and the rates of reaction. A cycle of reactions for arsenic in a stratified lake is proposed, and evidence is summarized relating to the occurrence and importance of particular reactions. The potential pollution hazard of arsenic is from ingestion of drinking water with high concentrations of arsenic, rather than consuming arsenic containing aquatic organisms. Although arsenic is greatly concentrated in aquatic organisms, it is evidently not progressively concentrated along a food chain. In addition, arsenic when consumed as an organically-bound species in flesh evidently has low toxicity. Investigation of the global cycle of arsenic shows that volcanic activity is the original source of much of the arsenic in sedimentary rocks. In addition, human activities including the use of arsenic, the burning of fossil fuels, erosion of land, and the mining and processing of sulfide minerals have increased the amount of arsenic entering the oceans by at least a factor of 3. This will have no effect on the concentrations for many hundreds of years. However, cultural contributions cause high localized concentrations in many fresh waters, and careful surveillance and increased knowledge of the fate of arsenic in the aquatic environment are needed to insure that no public health hazard occurs.

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-6422 (Continued)</p> <p>Card 2/2</p> <p>INDEX TERMS: Arsenic compounds, Path of pollutants, Thermodynamic behavior, Oxidation, Reduction (chemical), Aquatic organisms, Adsorption, Toxicity, Fossil fuels, Soil erosion, Fish, Bacteria, Yeasts, Fungi, Fate of pollutants, Bioaccumulation, Biotransformation, Coprecipitation.</p>	<p>AMIC-6428</p> <p>"ENVIRONMENTAL CONSIDERATIONS FOR ESTUARINE BENTHAL SYSTEMS", Bella, D. A., <u>Water Research</u>, Vol. 6, No. 11, November 1972, pp 1409-1418.</p> <p>A model of estuarine benthal systems was developed to describe the major chemical interactions and the effect of man's activities on them. Discussion is included on the effects of variation in DO and the presence of sulfates, free sulfide, heavy metals, and other constituents on the nature of the benthic deposits. Benthic samples from Toledo, Oregon; Sally's Bend, Yaquina Bay, Oregon, and Isthmus Slough, Coos Bay, Oregon were analyzed and shown to be typical of three of the five types of estuarine benthal systems. The types are characterized by variations in the amount of aerobic decomposition, sulfate reduction, interstitial free sulfide, and methane fermentation or accumulation of organics. Although benthic systems may be classed as a particular type, seasonal variations may effect significant changes. The effects of man's activities such as organic and inorganic deposition, reduction of seasonal variations, channelization, dredging, spoil disposal, and particle size changes, and the effect of transient conditions on the benthic type and the biological community are also considered.</p> <p>INDEX TERMS: Environmental effects, Estuaries, Benthos, Dredging, Channeling, Seasonal, Sulfates, Sulfides, Heavy metals, Oxidation-reduction potential, Organic matter, Model studies, Characterization, Species diversity.</p>
<p>AMIC-6424</p> <p>"NEW METHOD OF DETECTION FOR THE COMPONENT OF LOW CONCENTRATION IN WATER BY DETECTOR TUBES", Kobayashi, Y., <u>Water Research</u>, Vol. 6, No. 11, November 1972, pp 1291-1299.</p> <p>Five glass tubes, 2-3 mm in diameter, have been used for detecting minor components in water by packing them with detector reagents and exposing them to the substance to be analyzed. When the proper reagent is used, a color change occurs and the length of the stain is proportional to the concentration of the contaminant. Using the procedure, it was possible to detect sulfide at ranges of 1-100 ppm and hexavalent Cr at ranges of 5-800 ppm using silica gel supplemented with lead acetate; chloride ion at ranges of 50-2000 ppm using silica gel and silver chromate; sulfate ion at ranges of 100-3000 ppm with tetrahydroxy quinone and its barium salt with silica gel; cyanide ion at ranges of 1-50 ppm with orthotolidine hydrochloride and copper sulfate with silica gel; free chlorine at ranges of 1-40 ppm with orthotolidine sulfate and silica gel; and nickel ion at ranges of 100-3000 ppm with dimethylglyoxime and silica gel. The method is rapid and simple and may be used satisfactorily for drinking, process, or waste water examination, and air, blod, or urine examination. Results of analyses for chloride in matter from deposit guages and for chromate in plating water are included. Interfering ions are listed for each of the components detected.</p> <p>INDEX TERMS: Water analysis, Urine, Sulfides, Chlorides, Sulfates, Chlorine, Nickel, Colorimetry, Chromium, Drinking water, Air, Rain, River water, Calibrations, Color reactions, Blood, Detector tube, Cyanides, Detection limits, Chemical interference.</p>	<p>AMIC-6432</p> <p>"UNDERGROUND POLLUTION ANALYSIS AND CONTROL", Preul, H. C., <u>Water Research</u>, Vol. 6, No. 10, October 1972, pp 1141-1154.</p> <p>Criteria are presented for the evaluation of levels of underground pollution along with practical methods for the analysis of the rate of travel of underground pollution. Pollutants which may be of concern in groundwater have been categorized into 'reacting' and 'non-reacting' types for purposes of analysis in underground movement. Limits for the specific forms of these types have also been proposed. These limits are in general accord with the established requirements for drinking water such as those of the World Health Organization. For a simulation of the rate of travel of a pollutant in ground water, basic pollutant transport equations have been given. In the past, these equations have been largely of academic interest. However, these equations have now been solved using numerical and computer techniques. These techniques may be applied to practical problems such as the prediction of movement of a pollutant of a certain concentration within the influence cone of a pumping water well. In general, the methods may be used to analyze existing pollution so that rehabilitative measures may be applied or they may be used to analyze projected conditions of pollution travel where prevention is of concern.</p> <p>INDEX TERMS: Underground, Pollution abatement, Water pollution, Groundwater movement, Pollutants, Flow rates, Mathematical studies, Dissolved solids, Chlorinated hydrocarbon pesticides, Coliforms, Heavy metals, Salts, Alkali metals, Path of pollutants, Enteric viruses, Fecal streptococci.</p>

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6434

"THE USE OF ULTRA-VIOLET ABSORBANCE FOR MONITORING THE TOTAL ORGANIC CARBON CONTENT OF WATER AND WASTEWATER", Dobbs, R. A., Wise, R. H., Dean, R. B., Water Research, Vol. 6, No. 10, October 1972, pp 1173-1180.

The correlation between ultra-violet absorbance at 254 nm and total organic carbon (TOC) content has been determined for a variety of treated and untreated water samples. These samples ranged from municipal secondary sewage effluent to raw and processed river water. The river water samples were collected at 2 sites on the Great Miami River using a Mega sampler which was designed to recover organic contaminants from polluted water as a carbon chloroform extract (CCE). The effect of turbidity on the correlation between A sub 254 nm and TOC was eliminated by making all measurements on filtered samples. In order to estimate the interference caused by turbidity for municipal wastewater, two different secondary sewage effluents were filtered through five different pore-size millipore membranes in parallel filters (water-soluble components were leached from the membranes with distilled water prior to use). Absorbance and TOC values were measured for each filtrate, and corresponding turbidity values were determined. The absorbance equivalent to one Jackson Turbidity Unit (JTU) was calculated from the data obtained. An 'overall effect' was calculated by comparing the unfiltered values with those obtained for the 0.1 micron filtrates. An additional test was conducted in an effort to obtain a 'model' for the effect of turbidity on the absorbance measurement. A colloidal silica, stock solution was prepared by diluting 1.0 ml of duPont 'Ludox' to 100 ml with distilled water. A second stock solution contained 225 mg of bentonite powder in one liter of distilled water. Serial dilutions were prepared from stock solution for measurements of turbidity and absorbance. Plots of the data were linear, up to approximately 7.0 JTU, for both

AMIC-6434 (Continued)

Card 2/2

sets of synthetic solutions. The absorbance units which correspond to one JTU are 0.060 and 0.130 for silica and bentonite, respectively. High correlation coefficients were obtained for water samples which contained sufficient organic carbon to permit accurate TOC determinations. High concentrations of inorganic ultraviolet absorbers or high concentrations of organics which do not absorb in the ultraviolet will adversely affect the correlation between absorbance and TOC. Monitoring the concentration of organics in water by UV absorbance has many advantages over alternate methods. Equipment design can be either simple or sophisticated. The low-pressure mercury lamp provides a low cost monochromatic light source. Absorbance values can be displayed on a meter, or they can be recorded to provide a permanent record. Sensitivity can be adjusted to monitor a wide range of organic concentrations by varying the length of the sample cell. Application of UV monitors is simple and does not require the services of a skilled operator. The units can be completely self-contained with their own power supply so that remote locations, which would otherwise be difficult to survey, can be monitored.

INDEX TERMS: Waste water (pollution), Monitoring, Sewage effluents, Organic wastes, Waste analysis, Municipal wastes, Water sampling, Turbidity, Pollutant identification, Absorbance, Ultraviolet absorption, Total organic carbon, Mega sampler, Correlation coefficients, Great Miami River, Turbidimeter.

AMIC-6438

"ADSORPTION OF PARATHION IN A MULTICOMPONENT SOLUTION", Wang, W.-C.; Lee, G. F., Spyridakis, D., Water Research, Vol. 6, No. 10, October 1972, pp 1219-1228.

Parathion adsorption was studied with emphasis on the effect of the presence of a secondary adsorbate (rhodamine B). The adsorbent materials used included kaolinite and montmorillonite clay minerals and treated and untreated lake sediments. The adsorption experiments were conducted in a system free of organic solvent. A desired amount of clay mineral or sediment was placed in the 50 ml flask, which already contained a given amount of parathion. Thirty milliliters of distilled water were added to the flask, and the mixture was equilibrated by shaking. Depending on the experiment, an organic compound was added to the flask to make a final volume of 30 ml. The mixture was shaken in a water bath shaker at 200 strokes/min at 20 C, unless otherwise specified. It was then centrifuged at 1500 g for 1 h. The supernatant was poured out and extracted three times with 8 ml hexane, and the combined extract was made to a final volume of 25 ml in a volumetric flask prior to analysis with gas chromatography. With rhodamine B, the quantity of parathion adsorption on different clay minerals increased two- to four-fold, while methylene blue and phenol had little or no effect. Rhodamine B was readily sorbed by clay minerals, and the formed organoclay complex also enhanced the parathion adsorption capacity when the organic matter was partially extracted from the sediment particles

INDEX TERMS: Phosphothioate pesticides, Adsorption, Aqueous solutions, Pollutant identification, Separation techniques, Pesticide removal, Methodology, Lake sediments, Organic compounds, Kaolinite, Montmorillonite, Organic matter, Chemical analysis, Water analysis, Parathion, Rhodamine B, Adsorbents, Electron capture gas chromatography, Sample preparation.

AMIC-6442

"TOTAL AND ORGANIC MERCURY IN MARINE FISH", Rivers, J. B., Pearson, J. E., Schult, C. D., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 5, November 1972, pp 257-266.

Tissue from nine species of marine fish caught in Hawaiian waters were analyzed for total and organic mercury by a flameless AA technique. Samples of muscle tissue were homogenized, digested with conc. HNO₃ and oxidized with potassium permanganate. Excess oxidizing agents were reduced with hydroxylamine, and mercury ions were reduced to elemental mercury with stannous sulfate for analysis by AA. Organic mercury was determined by transferring the homogenate with distilled water to a separatory funnel containing conc. HCl and NaCl, adding benzene, shaking, and centrifuging. The benzene layer was then transferred to a separatory funnel, a 1 percent cysteine solution added, and the mixture shaken. Two ml of the aqueous layer were transferred to an Erlenmeyer flask containing conc. HCl and potassium permanganate. After standing, 5 percent sodium persulfate was added and the solution allowed to stand. The sample was then diluted with an H₂SO₄-HNO₃-distilled water solution, hydroxylamine solution added, and the flask swirled. Stannous chloride was added to volatilize the mercury for AA analysis. Recovery for total Hg ranged from 97-106 percent; for organic Hg, the range was 86-104 percent. Tissue content ranged from less than 0.05 ppm to 1.79 ppm for organic Hg and from less than 0.05 ppm to 14.0 ppm total Hg. The blue marlin had the highest content (0.35-14.0 ppm) of total Hg. However, the ratio of organic Hg to total Hg was much lower for this species than for others. Since these fish were caught from one area, it is assumed that the mercury occurred from a natural source. It is further hypothesized that at a certain mercury concentration in the tissue, muscle, or liver, the toxic organic mercury is biotransformed to a more easily excreted inorganic form.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6442 (Continued)

Card 2/2

INDEX TERMS: Mercury, Atomic absorption spectrophotometry, Marine fish, Separation techniques, Biotransformation, Sample preparation, Organomercury compounds, Chemical recovery, Biological samples.

AMIC-6444

"TOTAL MERCURY-MONOMETHYLMERCURY CONTENT OF SEVERAL SPECIES OF FISH", Kamps, L. R., Carr, R., Miller, H., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 5, November 1972, pp 273-279.

Samples of frozen swordfish steaks, canned tuna, frozen northern pike from Sweden, white bass, and perch were analyzed to determine the percentage of total mercury and methylmercury. Total mercury was determined by the method of Munns and Holland and methylmercury by the procedure of Westoo as described by Kamps and McMahon. Samples of edible tissue were chopped in a rotary food chopper and thoroughly mixed before analysis. The results showed that total mercury content of the edible portions of five species of fish ranged from 0.04 to 2.60 ppm. The portion of methylmercury was essentially all monomethylmercury, ranged from 67 to 125 percent. Sixteen laboratories also analyzed samples of white bass and perch for total mercury by cold vapor atomic absorption, the official AOAC procedure with colorimetric determination, and neutron activation analysis. The average contents compared favorably with duplicate results for methylmercury.

INDEX TERMS: Fish, Mercury, Perches, White bass, Biological samples, Methylmercury, Tuna, Swordfish, Northern pike.

AMIC-6443

"FACTORS INFLUENCING TRANSLOCATION AND TRANSFORMATION OF MERCURY IN RIVER SEDIMENT", Matsumura, F., Gotoh, Y., Boush, G. M., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 5, November 1972, pp 267-272.

Samples of sediment and water were collected from several locations in Wisconsin and subjected to several treatments to attempt to determine the factors affecting the mobilization of mercury. Samples were spiked with Hg-203 by adding HgCl₂ to a sample of sediment and water, shaking, and storing at 4 C for 30 days. The effects of pH were studied by adding HCl or Na₂CO₃ to the samples. After incubation, the water and sediment were separated. Water was extracted with toluene and sediment with acetone. After evaporation of the acetone, the residue was partitioned between toluene and water. All toluene extracts were combined and designated as the organic mercury fraction. The remaining sediment was resuspended in distilled water and directly radio-assayed. The toluene extracts were examined for alkylmercury content by thin layer chromatography. Samples were also prepared using the same procedure under anaerobic conditions. In one sample in which profuse microorganism growth occurred, analyses showed that the available mercury was absorbed by the organisms, but only small amounts of radioactivity were convertible to alkyl or aryl forms and almost no methylation occurred.

INDEX TERMS: Mercury, Sediments, Hydrogen ion concentration, Microorganisms, Absorption, Sample preparation, Mobilization, Thin layer chromatography, Biotransformation.

AMIC-6445

"GAS CHROMATOGRAPHIC DETERMINATION OF PENTACHLOROPHENOL IN HUMAN BLOOD AND URINE", Rivers, J. B., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 5, November 1972, pp 294-296.

A modified procedure for determining pentachlorophenol (PCP) in blood and urine involves combining the sample with benzene and H₂SO₄, rotating for two hours, centrifuging, and removing a portion of the benzene layer. Diazomethane solution is then added to the benzene extract, dry nitrogen bubbled through the solution to remove excess diazomethane, and isooctane added. A sample of this solution is then injected into a gas chromatograph for analysis by comparison with a known standard. The method gave recoveries of 89 to 96 percent for blood and 90 to 99 percent for urine. No interfering responses were encountered. The procedure has been found to significantly reduce the time and equipment required to perform these analyses.

INDEX TERMS: Gas chromatography, Chemical recovery, Sample preparation, Urine, Blood, Biological samples.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6453

"AN IMPROVED METHOD FOR DETERMINING ORGANICS BY ACTIVATED CARBON ADSORPTION AND SOLVENT EXTRACTION - PART I", Buelow, R. W., Carswell, J. K., Symons, J. M., Journal American Water Works Association, Vol. 65, No. 1, January 1973, pp 57-72

Details are given of research conducted to develop an inexpensive means for determining dissolved organics in water. The result of the research was the development of a small, reliable, simple-to-operate sampler that passes about 60 l of water (2-day sampling period) through 70.0 g of granular, coal-based activated carbon at a sampling rate of 20 ml/min. As a companion to the sampler, a small extraction apparatus is used to extract the dried activated carbon with about 450 cycles of chloroform followed by about 450 cycles of 95 percent ethyl alcohol. Time requirements are two days for sampling, one day for adsorbent drying, five days for solvent extraction, and two to three days for extract drying; however, manhour requirements are less than six. After desorption from the activated carbon, the organics can be quantified by gravimetry or analyzed by gas chromatography, infrared spectroscopy, or mass spectroscopy. The equipment was designed primarily for sampling drinking water, but field tests in raw river water and settled water containing carryover flox showed satisfactory performance. Sampling of various waters showed that the technique can determine extract concentrations within a tenfold range in organic content between clean water and surface water polluted with wastes. The cost for materials to build the samplers is about \$100-\$200.

INDEX TERMS: Sampling, Separation techniques, Water analysis, Research equipment, Drinking water, Dissolved organics.

AMIC-6456

"DETERMINATION OF SUB-NANOGRAM QUANTITIES OF SILVER IN SNOW BY FURNACE ATOMIC ABSORPTION SPECTROMETRY", Woodruff, R., Culver, B. R., Shrader, D., Super, A. B., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 230-234.

An analytical method for determining microtrace concentrations of Ag in snow is discussed. The method involves preconcentration of the Ag by solvent extraction and its subsequent determination by furnace atomic absorption (FAA). The extractant is a dithizone-CCl₄ solution. Snow samples were collected by (1) exposing plastic garbage cans containing new plastic liners to snowfall in several locations in the Bridger Mountain Range where orographic cloud-seeding experiments were conducted, and (2) digging pits through the entire snow pack at the end of seasonal seeding operations. The samples were kept frozen until just prior to extraction. Snow placed in a 400-ml beaker was melted on a hot plate and 0.1 N HNO₃ was added, decreasing the pH to 3. The sample was poured into a separatory funnel, a 0.00001 M dithizone-CCl₄ solution added, and the funnel shaken for 45 seconds. A quantity of the organic phases was placed onto a graphite cup and evaporated under an infrared lamp. For determination, the cup was screwed onto a 1/8-inch graphite rod and inserted into the furnace. Over 225 samples were analyzed, and a comparison among microsampling boat flame AA, NAA, and furnace A shows that the FAA method gives results comparable with those obtained by neutron activation analysis. FAA's reproducibility is much better than neutron activation analysis in the concentration ranges involved, and determinations can be performed for a fraction of the cost. The results obtained by the boat neutron activation analysis is plus or minus 15-40 percent reproducible, FAA's reproducibility is plus or minus 5 percent. The concentration ranges involved are on the order of 0.5 pg/ml. The sensitivity for the FAA method is 50 pg/ml.

AMIC-6456 (Continued)

Card 2/2

INDEX TERMS: Chemical analysis, Snow, Methodology, Pollutant identification, Neutron activation analysis, Heavy metals, Sampling, Silver, Trace levels, Furnace atomic absorption spectrophotometry, Detection limits, Reproducibility, Sensitivity, Microsampling boat, Flame atomic absorption spectrophotometry, Sample preparation.

AMIC-6457

"ATOMIC ABSORPTION DETERMINATION OF NANOGRAM QUANTITIES OF TELLURIUM USING THE SAMPLING BOAT TECHNIQUE", Beaty, R. D., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 234-238.

A method for the determination of ultra-trace quantities of tellurium has been developed, utilizing the sampling boat technique of atomic absorption. Two procedures were developed for the chemical separation of tellurium. In some types of samples, the tellurium can be directly extracted from 4M HCl solution into methyl isobutyl ketone. The relative standard deviation obtained for a typical sample treated in this manner and analyzed by atomic absorption was 5.0 percent. In samples where other constituents cause chemical interference with the extraction, a preliminary separation of tellurium by coprecipitation with selenium was employed. The relative standard deviation using this procedure increased to 6.6 percent, but few interferences are observed. Linear response occurs for a range of 5-100 ng tellurium. (Reprinted from Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 234-238. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Methodology, Chemical analysis, Aqueous solutions, Heavy metals, Separation techniques, Pollutant identification, Anions, Tellurium, Trace levels, Sampling boat method, Atomic absorption spectrophotometry, Chemical interference, Precision, Recovery, Sensitivity.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6462

"DETERMINATION OF ARSENIC(III) AT THE PARTS-PER-BILLION LEVEL BY DIFFERENTIAL PULSE POLAROGRAPHY", Myers, D. J., Osteryoung, J., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 267-271.

The determination of As(III) by differential pulse polarography has been investigated. A number of supporting electrolytes were studied, and 1M HCl was found to give the greatest sensitivity. The detection was about 0.3 microgram per liter (4 nanomoles) and the response was linear up to 60 mg/l. The inorganic ions which seriously interfered with the analytical procedure were Pb(II), Sn(II) and (IV), and Tl(I) and (III). A procedure was developed to remove the interferences, and it has proved to be satisfactory for all but the lowest concentrations of As(III). After the arsenic polarogram is recorded, Ce(IV) is added to the solution. The As(III) is oxidized to the polarographically inactive As(V), and the excess Ce(IV) is reduced by the mercury metal which has collected (from the DME) at the bottom of the cell. A second polarogram is then recorded, giving the base line. The residual current, caused by capacitance and by the reduction of Pb, Sn, or Tl, is substrated from the first polarogram to give the arsenic signal. This procedure is satisfactory at arsenic concentrations of 20 micrograms per liter and higher, but it significantly raises the position of the base line at an arsenic concentration of 2 micrograms per liter. As(V) could be determined by this method if it were reduced to As(III) and determined according to the proposed procedure.

INDEX TERMS: Chemical analysis, Aqueous solutions, Pollutant identification, Methodology, Polarographic analysis, Lead, Electrolytes, Cations, Differential pulse polarography, Arsenic, Arsenite, Chemical interference, Ionic interference, Tin, Sensitivity, Detection limits, Sulfur acid, Thallium.

AMIC-6466

"ON-LINE COMPUTER CONTROLLED MULTIPLE ION DETECTION IN COMBINED GAS CHROMATOGRAPHY - MASS SPECTROMETRY", Holland, J. R., Sweeley, C. C., Thrush, R. E., et al., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 308-314.

A system is described for on-line data collection and automated ion focusing of a single focusing magnetic deflection mass spectrometer equipped with gas chromatographic inlet and accelerating voltage alternator. A special interface consisting of an ion current amplifier, analog-to-digital converter, computer, digital-to-analog converter, and dipolar power supply permits an offset voltage to be added to or subtracted from the accelerating voltage under computer control. These units, together with two status registers, provide a control loop for continuous fine adjustment of the accelerating voltage in order to maintain optimal focusing on each of several ions selected by coarse sequential switching of the accelerating voltage. Tests of the system were performed in a static mode with perfluorokerosene and in a dynamic mode with several compounds introduced by the gas chromatographic inlet, including mixtures of fatty acid methyl esters, the tetra-O-acetyl methyl glycosides of glucose and (6,6-2 sub 2)-glucose, and the O-acetyl methyl esters of prostaglandin PGF sub 2 alpha and (3,3,4,4-22-H sub 4)PGF sub 2 alpha. The additional capabilities of continuous ion focusing during the gas chromatographic run and precise selection of integration parameters in the computer-assisted data reduction process enabled stable isotopic abundance measurements to be made with a precision of less than 1 percent on samples as small as 100 ng. (Reprinted from Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 308-314. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

AMIC-6466 (Continued)

Card 2/2

INDEX TERMS: Automatic control, Pollutant identification, Ions, Computers, Chemical analysis, Organic compounds, Data collections, Stable isotopes, Isotope studies, GC-Mass spectrometry, On-line systems, Accelerating voltage alternation, Precision.

AMIC-6468

"DIRECT GAS CHROMATOGRAPHIC ANALYSIS OF AQUEOUS SOLUTIONS OF ALIPHATIC N-NITROSAMINES", Mosier, A. R., Andre, C. E., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 372-373.

An analytical procedure has been developed which allows for the direct gas chromatographic analysis of aqueous solutions containing small amounts of aliphatic N-nitrosamines. Standard solutions of dimethyl, diethyl, dipropyl, and dibutyl nitrosamine and algal suspensions (*Chlorella pyrenoidosa*) spiked with those standard solutions were used to evaluate direct GC as applied to an aqueous biological system. Ascarite precolumns were used, and they served as a cleanup step, thus allowing for relatively interference-free chromatograms except for water. The GC system employed readily separates, DMN, DEN, DPN, and DBN when injected as an aqueous algal suspension containing 0.2 microgram/ml of each of the four compounds. The sensitivity of the direct analysis of aqueous algal suspensions is much greater than the solvent extract analysis by GC. Direct analysis of aqueous algal suspensions spiked with DMN allows the quantitative determination of DMN down to 10 ng/ml. In order that DPN and DBN can be quantitatively analyzed by this system, the carrier gas flow and column temperature must be increased over the usual operating conditions. With this modification, DPN and DBN can be recovered with about the accuracy of 10 ng/ml. The combination of the Chromosorb 103 column system, the Ascarite precolumn in the injection port, and the FID results in a sensitive qualitative and quantitative method for the direct analysis of aqueous biological systems for aliphatic N-nitrosamines. The system is about 100 times more sensitive than methods of N-nitrosamine analysis previously reported.

INDEX TERMS: Methodology, Aqueous solutions, Pollutant identification, Chemical analysis, Biological systems, *Chlorella pyrenoidosa*, N-nitrosamines, Aliphatic hydrocarbons, Flame ionization gas chromatography, Detection limits, Precision, Quantitative analysis.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6470

"CHROMATOGRAPHIC AND SPECTRAL ANALYSIS OF TERPENE AND N-ALKYL ALCOHOL CARBAMATES", Gueidner, R. C., Hutto, P. Y., Thompson, et al., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 376-378.

A description is given for the preparation of the carbamates of several terpene alcohols and other alcohols by the method of Hedin, Gueidner, and Thompson (1970) and their spectral characterization and the conditions for the separation of the carbamates by TLC and GLC. The carbamates were prepared by dissolving the alcohol in CCl_4 , adding a molar excess of trichloroacetyl isocyanate (TCAIC), allowing the mixture to stand in an ice bath for 5-10 min, and extracting it with KOH in aqueous MeOH. The MeOH phase was removed and evaporated in vacuo to an aqueous residue which was extracted with CCl_4 until TLC showed the removal of all carbamate. The CCl_4 phase was evaporated to leave the crude carbamate residue, which was crystallized from cyclohexane or cyclohexane-benzene mixtures. Samples were recrystallized to obtain a constant melting point and submitted for elemental (C,N,H) analysis. The carbamates of citronellol and linalool, which could not be crystallized, were collected for elemental and spectral analysis from column A of the gas chromatograph. The method proved to be an easy way to prepare carbamates and gave essentially quantitative yields for recrystallization. Except for the carbamates of citronellol and linalool, all the compounds were white crystalline solids that were stable for extended periods at room temperature. All the elemental analyses checked to within 0.30 percent. The melting points, TLC values, GLC values, and the IR spectra and PMR data for the CCl_4 solutions of the carbamates are tabulated.

INDEX TERMS: Separation techniques, Solvent extractions, Chemical analysis, Pollutant identification, Carbamates, Terpene alcohols, Gas-liquid chromatography, Thin layer chromatography, n-Alkyl alcohols, Sample preparation, Infrared spectra.

AMIC-6480

"APPLICATIONS OF MASS SPECTROMETRY TO TRACE DETERMINATIONS OF ENVIRONMENTAL TOXIC MATERIALS", Abramson, F. P., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 28A-33A, 35A.

Descriptions have been given of the applications of a variety of experimental approaches based on a mass spectrometer to model problems of environmental contamination. Mass spectrometry combined with gas chromatography and/or data acquisition and processing and specific ion detection can be used advantageously to determine various adulterants of interest, such as DES, chlorinated pesticides, PCB's, and organomercury in the low nanogram or even in the picogram range. Of particular importance is the flexibility in the type of analysis which the rather excellent sensitivity and selectivity of a mass spectrometer afford. In addition, the use of isotopic carrier techniques to improve quantitative accuracy where extraction efficiency is a problem or where adsorption or decomposition accompanies the analytical methodology is readily accomplished with a mass spectrometer by use of relatively inexpensive deuterium derivatives as carriers. Although the initial investment in mass spectrometry is considerable, the number of different analyses which can be performed often with less sample preparation and with higher information content than other methods provide an overall economy for laboratories which carry out such a diverse analytical function.

INDEX TERMS: Mass spectrometry, Gas chromatography, Pollutant identification, Methodology, Chemical analysis, Selectivity, Polychlorinated biphenyls, Data processing, Chlorinated hydrocarbon pesticides, Trace levels, Diethylstilbestrol, Detection limits, Sensitivity, Organomercury compounds, N-Nitrosodimethylamine, Data acquisition, Specific ion detection.

AMIC-6481

"ISOTOPE EXCITED X-RAY FLUORESCENCE", Kneip, T. J., Laurer, G. R., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 57A-58A, 60A-62A, 66A, 68A.

The continuing development of isotope excited applications of X-ray fluorescence analysis has been stimulated by (1) the ability to make a determination without time-consuming chemical manipulations in preparing a sample for analysis, and (2) instrument portability through the use of a radioisotopic source for excitation. This discussion is concerned with the interaction of certain fundamental factors in isotope source X-ray fluorescence and their exploitation in describing three recently developed systems (central source system, annular source, concentric source-sample system) with capabilities exceeding those of currently available commercial equipment. The major parameters to be considered in the development of isotope source-X-ray fluorescence systems are the following: Chemical and physical properties of the sample; Isotopic source characteristics; Detector resolution and efficiency; and Source-sample-detector geometry. Possibilities for application of the new geometrical or concentric source-sample system to sub-ppm simultaneous multielement (K, Cl, Fe, Cu, Zn, Ca, Mg, Na, Mn, Ru, and Br) analysis of blood appear promising.

INDEX TERMS: X-ray fluorescence, Chemical analysis, Instrumentation, Chemical properties, Physical properties, Aqueous solutions, Laboratory equipment, Research equipment, Isotope source, Detectors, Sample properties, Detection limits, Resolution, Biological samples, Multielemental analysis.

AMIC-6482

"SPECTROPHOTOMETRIC DETERMINATION OF COBALT WITH 2,4,6-TRIS(2'-PYRIDYL)-s-TRIAZINE", Jannohamed, M. J., Ayres, G. H., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2263-2268.

Cobalt(II) reacts rapidly with 2,4,6-tris(2'-pyridyl)-s-triazine (TPTZ) in water-alcohol solution at pH 8.5 to give a red-orange solution having absorption peaks at 485 and 404 nm. The color is stable for at least an hour. The system conforms to Beer's law. Optimum range for 1.00-cm optical path is 4 to 20 ppm of cobalt, determined with a relative standard deviation of about 1 percent. The molar absorptivity at 485 nm is 2800. Ions of several transition elements interfere. Cobalt is separated from iron and nickel by an extraction procedure using tri-n-butyl phosphate. A reaction ratio of 1 to 2 for cobalt to TPTZ has been deduced from spectrophotometric data, and the perchlorate salt of the complex has been isolated and analyzed. The ionization constant of the reagent and the formation constant of the cobalt-TPTZ complex have been evaluated. (Reprinted from Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2263-2268. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Color reactions, Cobalt, Spectrophotometry, Pollutant identification, Heavy metals, Methodology, Aqueous solutions, Separation techniques, Chemical analysis, 2,4,6-tris(2'-pyridyl)-s-triazine, Absorbance, Ionic interference, Precision, Sensitivity, Detection limits.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6483

"FLUOROMETRIC METHOD FOR DETERMINING NANOGRAM QUANTITIES OF NITRITE ION", Dombrowski, L. J., Pratt, E. J., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2268-2272.

A sensitive fluorometric method has been developed for measuring the nitrite ion. The procedure involves diazotization of p-chloroaniline (PCA) and coupling with 2,6-diaminopyridine (DAP). The resulting azo product then is further derivatized with ammoniacal cupric sulfate to produce a highly fluorescent triazole compound (excit. max. 360 nm; fl. max. 430 nm). The intensity of the fluorescence is linearly dependent upon the nitrite concentration. The procedure permits detection of 2 nanograms nitrite ion per ml utilizing a 10-ml sample. The precision at this level is 7 percent. The triazole exhibits strong fluorescence in acid media and shows fluorescence quenching by hydroxide ion suggesting radiationless deactivation of the excited triazole imine anion. The coupling reaction between DAP and PCA was examined and found to be strongly pH dependent. Greatest reaction velocity was observed near neutral pH. The determined second-order rate constant at pH 5 and temperature of 22 C was 85 plus or minus 5 liter mole/sec. Optimum conditions are presented for obtaining maximum nitrite detection sensitivity. (Reprinted from Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2268-2272. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Nitrites, Ions, Fluorometry, Methodology, Aqueous solutions, Chemical analysis, Chemical reactions, Fluorescence, Hydrogen ion concentration, p-chloroaniline, 2,6-diaminopyridine, Precision, Sensitivity, Diazotization, Detection limits, Triazole, Fluorescent spectra.

AMIC-6485

"SIGNAL ENHANCEMENT IN REAL-TIME FOR HIGH-RESOLUTION MASS SPECTRA", McLafferty, F. W., Michnovicz, J. A., Venkataraghavan, R., et al., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2282-2287.

An on-line, real-time computerized method for effectively increasing the sensitivity, resolution, and mass measuring precision of a high-resolution mass spectrometer has been developed. This method for Signal Enhancement in Real Time (SERT) utilizes the relatively large vacant areas between peaks to rescan peaks in real-time under direct computer feedback control. The ensemble-averaged rescans have an increased signal/noise ratio when compared to the signal scans and significantly increase the effective sensitivity, resolution, and mass measuring precision of the instrument without increasing the scanning time, in contrast to most methods for ensemble-averaging of spectral data. (Reprinted from Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2282-2287. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Mass spectrometry, Automation, Computers, Methodology, Automatic control, Electronic equipment, On-line systems, Signal enhancement, Mass spectra, Resolution, Sensitivity, Precision.

AMIC-6484

"DESIGN AND OPERATION OF TEMPERATURE-CONTROLLED MULTIPLE ELEMENT ELECTRODELESS DISCHARGE LAMPS FOR ATOMIC FLUORESCENCE SPECTROMETRY", Patel, B. M., Browner, R. F., Winefordner, J. D., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2272-2277.

The preparation of multiple-element electrodeless discharge lamps for Hg, Cd, In, Ga, Tl, Zn, Cu, Fe, Mg, Ag, Ge, Sn, Pb, Th, U, and Zr is described. The lamps are excited using a temperature-controlled antenna system. The spectral radiant output from each individual element in a multiple-element lamp is very temperature sensitive, but largely uninfluenced by the presence of the other elements (or compounds). Plots of the variation of spectral radiant output with temperature allow the rational choice of a compromise operating temperature for several elements in each lamp. Alternatively, the optimum temperature for each element present may be selected in turn. A comparison is made between the output stability of the multiple-element lamps and the corresponding single-element lamps. Atomic fluorescence detection limits are given, using both multiple-element and single-element lamp sources. (Reprinted from Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2272-2277. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Laboratory equipment, Instrumentation, Design, Operations, Mercury, Cadmium, Zinc, Copper, Iron, Magnesium, Germanium, Lead, Temperature, Heavy metals, Atomic fluorescence spectroscopy, Electrodeless discharge lamps, Multielemental analysis, Indium, Gallium, Thallium, Silver, Tin, Thorium, Uranium, Zirconium, Detection limits, Fluorescent spectra, Chemical interference.

AMIC-6486

"SIMULTANEOUS MEASUREMENT OF PLASMA CONCENTRATIONS OF LIDOCAINE AND ITS DESETHYLATED METABOLITE BY MASS FRAGMENTOGRAPHY", Strong, J. M., Atkinson, A. J., Jr., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2287-2290.

Lidocaine and its pharmacologically active metabolite, monoethylglycinexylidide (MEGX), have been measured in samples of blood plasma by the technique of quadrupole mass fragmentography. The standard deviation of the method was 3.1 percent for lidocaine and 7.4 percent for MEGX over the range of concentrations usually encountered in clinical practice. The technique of mass fragmentography was extended to include rigorous criteria for compound identification based on statistical analysis of the ratio of two fragment ions present in each of these compounds and in the trimecaine added to the plasma samples as an internal standard. These ratios were reproducible with a standard deviation of less than 10 percent. The quadrupole mass spectrometer was found to be a suitable instrument for quantitative mass fragmentography, and offered an important advantage over presently available magnetic instruments with respect to the range of m/e of the fragment ions that could be recorded. (Reprinted from Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2287-2290. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Methodology, Chemical analysis, Measurement, Pollutant identification, Biological fluids, Lidocaine, Monoethylglycinexylidide, Quadrupole mass fragmentography, Reproducibility, Metabolites, Body fluids, Precision, Drugs, Mass spectra, Blood plasma.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6488

"TOTAL EFFLUENT GAS CHROMATOGRAPHY - MASS SPECTROMETRY", Henderson, W., Steel, G., Analytical Chemistry, Vol.

A GC-MS system which allows introduction of a total GC effluent of up to 20 ml/min directly into the ion source of a mass spectrometer is described. The effect of flow rate on ion source and analyzer pressures, overall sensitivity, and resolving power of the system was evaluated as follows: Source and analyzer pressures were determined as a function of the chromatographic helium flow rate directly introduced to the ion source. The sensitivity of the GC-MS system was determined as a function of chromatographic flow rate in terms of the minimum detectable chromatographic peak volume as detected by the TIC beam monitor, rather than as a function of the base peak in the mass spectra. The sensitivity of the mass spectrometer alone was determined using xylene and its base peak at m/e 106 by conventional methods of determining signal/noise ratio, peak width, and mass flow rates. Minimum detectability as a function of both total ion current and evaluable spectra for cholesterol TMS ether was determined, viz., all peaks greater than 10 percent of base peak discernible. Analyses of a variety of organic compounds as mixtures were carried out to illustrate the advantages of the system. It has been shown that 0.1 ng-1.0 pg per second sample flow rates are obtained for cholesterol trimethylsilyl ether at helium flow rates of 1-7 ml/min. Within that flow rate range, only a 12 percent reduction in mass spectrometer resolving power was noted. The system has been shown to be suitable for a wide range of molecules from low molecular weight gases to high molecular weight steroid and carbohydrate derivatives.

INDEX TERMS: Gas chromatography, Mass spectrometry, Carbohydrates, Steroids, Sensitivity, Resolution.

AMIC-6489 (Continued)

Card 2/2

INDEX TERMS: Separation techniques, Methodology, Pollutant identification, Petroleum residues, Gradient elution chromatography, Oil characterization, Petroleum distillates, Aromatic hydrocarbons, Petroleum products, Crude oil.

AMIC-6489

"SYSTEMATIC APPROACH TO THE STUDY OF AROMATIC HYDROCARBONS IN HEAVY DISTILLATES AND RESIDUES BY ELUTION ADSORPTION CHROMATOGRAPHY", Jewell, D. M., Ruberto, R. G., Davis, B. E., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2318-2321.

More significant approaches to isolating aromatic hydrocarbons from heavy distillates (greater than 400 F) and residuals are being devised as a result of recently established pretreatment methods which remove the major nonhydrocarbon impurities and saturates. Exponential gradient elution absorption chromatography (GEC) coupled with multiple on-line detectors (e.g., dual-channel ultraviolet) can then be used for a rapid classification into mono-, di-, tri-, and polyaromatic subfractions. The separation procedure involves the use of 2 columns which are rapidly dry-packed with zero percent H₂O-Al₂O₃ and sealed. Traces of water are moved by in situ heating at 200 C under a nitrogen purge and pure n-hexane is pumped throughout the system in order to equilibrate each detector. The aromatic concentrate-hexane mixture is injected onto the sample column and the absorbance is read by ultraviolet monitors using spectral grade solvents (cyclohexane, chloroform, and methanol). Using the above method, (1) any overlap of saturates in the aromatic concentrates can be determined; and (2) the presence of the heteroatom does not affect the monoaromatic-diaromatic separation when high sulfur aromatic concentrates are separated. The GEC has been found satisfactory for aromatic concentrates from kerosene, cracked or virgin gas oils, FCC feedstocks, and residuals. The only limitation is volatility since chloroform and methanol must be removed from the polyaromatics. The method is rapid, flexible, and can be made analytical with appropriate micro columns and detectors. The total sequence of steps described provides an analytical and quantitative approach to the following major classes of compounds: acids, bases, neutral nitrogen compounds, total saturates, total aromatics, monoaromatics, di plus triaromatics, and polyaromatics.

AMIC-6490

"DETECTION AND VARIABLE TIME KINETIC DETERMINATION OF MICRO AND SUBMICROGRAM AMOUNTS OF NITRILOTRIACETIC ACID", Mottola, H. A., Health, G. L., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2322-2324.

The analytical use of the modifying effect of nitrilotriacetic acid (NTA) on the oxidation of Malachite Green cation by periodate ion, catalyzed by low concentrations of manganese(II) ions has been extended to the detection and determination of NTA. A variable time kinetic method of analysis has been developed which allows detection and determination of ppm and fractions of ppm of NTA. This method uses photometric monitoring and digital electronic collection of the time elapsed as the system evolves between two preestablished chemical compositions. The effect of some metal ions, other aminopolycarboxylic acids, some products of degradation of NTA, and some other species expected to be present in detergent formulations, natural water, and industrial waters was also evaluated. Iminodiacetic acid, glycolic acid, glycine, dodecylbenzene sodium sulfonate, sodium tripolyphosphate, and calcium ion did not interfere at least in molar concentrations 100 times that of NTA. Ortho- and m-cresol, and iron(III) ion did not interfere if present at the same molar level of NTA. Aluminum ion and sodium lauryl sulfate can be tolerated in molar concentrations 10 times that of NTA. Dissolved chlorine proved to be the only serious interference of all species considered. The procedure compares well in detectability, sensitivity, and selectivity with those previously published and is easily amenable to monitoring and repetitive analysis.

INDEX TERMS: Nitrilotriacetic acid, Chemical analysis, Chemical reactions, Pollutant identification, Organic acids, Industrial water, Metals, Oxidation, Detergents, Detection limits, Natural waters, Chemical interference, Sensitivity, Malachite green.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6491

"ANALYSIS OF MIXTURES OF AMINOPOLYCARBOXYLIC ACIDS BY CHEMICAL KINETICS. PARTS PER BILLION OF NITRILOTRIACETIC ACID IN WATER", Coombs, L. C., Vasiliades, J., Margerum, D. W., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2325-2331.

Aminopolycarboxylic acids are detected and determined, individually or in mixtures, by the reaction of cyanide ion with their nickel(II) complexes in basic solution. The procedure is based on the large differences in the rate of formation of tetracyanonickelate ion. Simultaneous kinetic determinations of two-component (NTA and EDDA) and three-component (NTA, EDDA, and EGTA) mixtures are accomplished by on-line regression analysis of stopped-flow spectrophotometric data. As little as 10 ppb of NTA in natural water samples can be detected. Any possible interference by metals can be eliminated by precipitating then as hydroxide or by running the solution to be determined through a cation-exchange column to remove the metals. However, the formation of mixed cyano complexes can be a source of interference. Trace amounts of NTA in EDTA and a four-component (EGTA, HEDTA, HEEDTA, and EDTA) mixture also are determined off-line.

INDEX TERMS: Chemical reactions, Nitrilotriacetic acid, Water analysis, Chemical analysis, Methodology, Spectrophotometry, Computers, Aminopolycarboxylic acids, Detection limits, Precision, Chemical interference, Reaction kinetics.

AMIC-6492

"POTENTIOMETRIC TITRATION OF SULFATE USING AN ION-SELECTIVE IRON ELECTRODE", Jasinski, R., Trachtenberg, I., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2373-2376.

A description is given by an indirect sulfate electrode which is based on the ferric ion/sulfate complex ion equilibria and is free of many of the restrictions common to other ion selective electrodes that have been used for the potentiometric titration of sulfate. The electrode used in this study was constructed by cementing slices of Fe-1173 glass (Ge26Sb12Se60) to the end of an acrylic tube. After mechanical polishing, the electrode was activated by rinsing with 1N NaOH, wiping, rinsing with distilled water and finally exposing it to 0.1 M ferric nitrate solution at pH 1.6 for 30 minutes. Since the Fe-1173 glass does respond selectively to uncomplexed ferric ion in sulfate solutions, an evaluation was made of the electrode as a monitor for sulfate ion titration. Calculations indicate that the sulfate-Fe complexes are too weak to yield a well-defined end point from titrating sulfate directly with iron. If, however, a titrant is so chosen to remove sulfate from the complexes, thus releasing ferric ion, a satisfactory titration curve is generated. The following conclusions were drawn based on the above: (1) At constant pH and total sulfate concentration, the primary effect of changing total soluble Fe is Nernstian. (2) A second-order change in sensitivity also results from changing iron content. (3) The optimum operational region for sulfate monitoring is pH 1.7-2.0 and 0.1 mM Fe. (4) The accessible sulfate concentration range is greater than about 200 ppm. (5) This electrode system will yield distinct titration end points if the titrant is chosen so as to remove sulfate ion from solution, liberating uncomplexed iron.

INDEX TERMS: Sulfates, Hydrogen ion concentration, Equipment, Selectivity, Iron, Ion selective electrodes, Potentiometric titration, Iron electrode, Sensitivity, Glass electrodes, Precision, Reproducibility, Detection limits, Metal complexes,

AMIC-6493

"DIRECT DETERMINATION OF SULFUR IN OILS BY ATOMIC ABSORPTION SPECTROMETRY USING AN INERT GAS SHIELDED NITROUS OXIDE-ACETYLENE FLAME", Kirkbright, G. F., Marshall, M. West, T. S., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2379-2382.

An experimental atomic absorption spectrometer has been used for the direct determination of total sulfur in crude and fuel oils. A sulfur microwave-excited electrodeless discharge lamp source and an inert gas separated nitrous oxide-acetylene flame were used in conjunction with a vacuum monochromator equipped with a photomultiplier and digital frequency meter to permit detection by photon counting. Oil samples (0.2-1.0g) were dissolved in isobutyl methyl ketone, diluted to volume in a 100-ml flask, nebulized in the separated nitrous oxide-acetylene flame, and the absorbance measured at 180.7 nm. Known quantities of sulfur were added to some of the samples being analyzed. Calibration curves to be used in calculations were obtained by analyzing standard solutions prepared by dissolving dibenzyl disulfide in isobutyl methyl ketone. The values obtained by AAS for the oil samples whose sulfur contents were determined by reference to the calibration curve for dibenzyl disulfide in MIBK show a small systematic negative error compared to the mean values obtained by X-ray fluorescence. No significant systematic error was observed in the values for sulfur content obtained for the oils treated by the standard additions technique. This suggests that the assumption that a mismatch between sample and standard viscosity characteristics is responsible for the error observed in the conventional calibration technique is correct. The direct nebulization of diluted oil samples into the inert gas separated nitrous oxide-acetylene flame permits the rapid direct determination of their sulfur content by AAS at 180.7 nm with acceptable accuracy and precision. The attainable sensitivity should be sufficient for the determination of sulfur in most refined oils (except motor gasoline). Dibenzyl disulfide is suitable for use in the

AMIC-6493 (Continued)

Card 2/2

preparation of standard solutions, and no errors due to the presence of different sulfur compounds in the oils are observed when this standard compound is employed. The standard additions technique provides freedom from the need to match the standard and sample compositions accurately via use of a sulfur-free base oil. The authors indicate that in spite of the efficiency of the monochromator, an AAS to permit nitrogen or argon purge might more conveniently be used.

INDEX TERMS: Oil, Chemical analysis, Sulfur, Pollutant identification, Research equipment, Laboratory equipment, Atomic absorption spectrophotometry, Fuel oil, Crude oil, Absorbance, Precision, Sample preparation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6495

"MULTICOMPONENT PATTERN RECOGNITION AND DIFFERENTIAL METHOD", Lysyj, Ihor, Newton, Peter R., Analytical Chemistry, Vol. 44, No 14, December 1972, pp 2385-2387.

Based on the theory of multicomponent pattern recognition and differentiation, a study was conducted to characterize pyrographically complex organic composition, such as found in a petroleum product and algae as separate entities, and to determine the quantity of each in a mixed solution. Dried algae and outboard motor oil were used as test material and a specific pattern, or numerical fingerprint, was obtained for each pyrographically. The algal pattern consisted of three specific and seven common (with oil pattern) peaks. The oil pattern consisted of two specific and seven common (with algal pattern) peaks. Numerical values for each peak of each substance were different and formed a specific identifiable pattern or fingerprint. Mixtures of oil and algal suspensions in water were prepared in various proportions and analyzed pyrographically. The composite pyrograms were then analyzed mathematically by a computer. The results of the completed experiments indicate that complex organic compositions can be defined in terms of pyrographic patterns, as separate entities with identities of their own, i.e., algae, motor oil. When a number of such complex organic compositions are present in an admixture, they can be differentiated qualitatively and quantitatively by solving a number of simultaneous equations in least squares mode. This technique also has a potential for identifying sources of oil spills in aquatic environment. To achieve differentiation between various sources of crude oils, far more complex pyrograms must be developed. This can be accomplished by performing pyrolysis at lower temperatures and increasing GC separation of produced derivative composition. The practical use of this method for oil spill surveillance and source identification is further compounded by the fact that the composition of spilled oil is unstable in aquatic environments.

AMIC-6495 (Continued)

Card 2/2

INDEX TERMS: Oil, Chemical analysis, Water analysis, Separation, Pollutant identification, Water pollution sources, Algae, Organic matter, Mixtures, Pyrolysis, Pattern recognition, Gas-liquid chromatography, Motor oil, Fingerprinting, Characterization.

AMIC-6497

"GAS CHROMATOGRAPHIC ANALYSIS OF AQUEOUS PHOSPHATE BY REACTION GAS CHROMATOGRAPHY", Wiese, P. M., Hanson, R. H., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2393-2394.

A reaction gas chromatographic method is described for the analysis of aqueous phosphate solutions. This method involves injecting the phosphate solution into a heated precolumn where the water is vaporized and swept away leaving the salt deposited in the reaction precolumn. N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA) containing one percent trimethylchlorosilane (TMCS) is then injected into the heated precolumn. In 2 minutes the gaseous silylating reagent converts the nonvolatile phosphate salt to the volatile compound $(TMS)_3PO_4$. The excess reagent and $(TMS)_3PO_4$ are then swept into an analytical column and separated. Total time for analysis is less than 20 minutes per sample. Solubility considerations have been eliminated. The ion exchange step was simplified by adding ammonium chloride to the sample before injection. This method has proved useful for amounts of phosphate between 10 and 100 micrograms per injection. Repetitive aliquots of an ammonium phosphate solution gave reproducible peak areas within an experimental error of plus or minus 2.7 percent. When the sodium or potassium salt was used, greatly reduced peak areas were obtained. Temperature programming is necessary to separate $(TMS)_3PO_4$ from the derivatives of other contaminant anions such as sulfate, thiosulfate, oxalate, and pyrophosphate. If these anions are not present, the chromatograms may be run isothermally.

INDEX TERMS: Phosphates, Aqueous solutions, Methodology, Chemical analysis, Pollutant identification, Anions, Reaction gas chromatography, Detection limits, Sensitivity, Chemical interference, Silylation.

AMIC-6503

"DUAL CHANNEL SYNCHRONOUS INTEGRATION MEASUREMENT SYSTEM FOR ATOMIC FLUORESCENCE SPECTROMETRY", Cordos, E., Malmstadt, H. V., Analytical Chemistry, Vol. 44, No. 14, December 1972, pp 2277-2282.

A dual channel synchronous integration measurement system is described that is easily assembled from standard circuit cards. It has been designed and optimized for application in atomic fluorescence spectrometry, specifically where hollow cathode tubes are used as excitation sources and are operated in an intermittent mode. The test results are presented which show that the percent relative standard deviation for the instrument is less than 0.1 percent over a wide dynamic range, the linearity is better than 0.1 percent, and the circuit can accurately subtract background that might exceed the sample by an order of magnitude or more, and it also averages noise over a wide frequency spectrum. The combination of the dual channel synchronous measurement system with the intermittent operation of hollow-cathode tubes provides AF sensitivities that are one to three orders of magnitude greater than by operation in the dc mode. Its usefulness in AF spectrometry is verified by over 1 year of continuous use in an automated instrument.

INDEX TERMS: Spectrometers, Spectroscopy, Laboratory equipment, Automation, Measurement Atomic fluorescence spectroscopy, Synchronous integration measurement system, Sensitivity, Precision.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6504

"COMPUTER IDENTIFICATION OF MASS SPECTRA USING HIGHLY COMPRESSED SPECTRAL CODES", Grotch, S. L., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 2-6.

In file search methods, storage is often a significant problem, particularly with mini-computers. Spectral abbreviation alleviates the problem by coding only 2 peaks/14 amu. This concept may be further exploited by noting that the mass position of any peak in a 14-amu window may be coded using only four bits. For nearly 7000 spectra in the Aldermaston collection, this code requires an average of 48 bits/spectrum. Tests indicate that this code is highly specific, and with appropriate matching algorithms will produce very effective identifications. Further improvements in identification accuracy are obtained when two bits of intensity information are added to the peak position. Using an IBM 360/44, a 7000-spectra library can be searched in less than 10 seconds. Since most computers now manufactured have word sizes which are multiples of four bits, this technique should lend itself well to most machines.

INDEX TERMS: Pollutant identification, Computer programs, Data storage and retrieval, Mass spectra, Minicomputers.

AMIC-6507

"GAS CHROMATOGRAPHIC STUDIES OF SORPTIVE INTERACTIONS OF NORMAL AND HALOGENATED HYDROCARBONS WITH WATER-MODIFIED SOIL, SILICA, AND CHROMOSORB W", Okamura, J. P., SawyeSavyer, D. T., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 80-84.

To study the persistence and movement of pesticides in soils, gas chromatography with vetted soil columns has been used to determine the retention mechanisms of pesticides and halogenated methanes (used as soil fumigants). The principal modes of interaction with the vetted soils include adsorption on the water surface and absorption by the water layer. The equilibrium constants for adsorption and absorption in model systems, water on Chromosorb W and on porous silica beads, have been evaluated and interpreted in terms of molecular parameters. These models illustrate an approach for ascertaining the state of water on soil and for the prediction of retention volumes on this complex material. Data from the model systems allow calculation of both the amount of water on the soil surface and the surface area of the aqueous layer.

INDEX TERMS: Soils, Model studies, Gas chromatography, Adsorption, Transport, Persistence, Halogenated methanes.

AMIC-6505

"APPLICATION OF PATTERN SEPARATION TECHNIQUES TO MASS SPECTROMETRIC DATA. DETERMINATION OF HYDROCARBON TYPES AND THE AVERAGE MOLECULAR STRUCTURE OF GASOLINE", Tunnicliff, D. D., Wadsworth, P. A., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 12-20.

The mass spectra of a large group of pure compounds typical of those found in gasoline have been used to derive a set of weight vectors which can be used to determine the average properties of gasoline samples. The evaluation of the results obtained on real samples is rather difficult since the true values for all the calculated properties are not readily available. A comparison of the results obtained for hydrocarbon types such as paraffins, naphthenes, and aromatics agree quite well with the results obtained by conventional mass spectrometric analysis provided the average carbon number does not exceed 8.0. This method has also been found useful for the determination of the percent weight of carbon in hydrocarbon samples from the values for numbers of carbon and hydrogen atoms obtained in the structural analyses. The computed percentages of carbon for 41 samples compared favorably with the results as determined by combustion analysis. It must be emphasized that the present work represents principally an investigation of a new approach to the analysis of very complex mixtures. This same approach may be applied to the interpretation of many other kinds of analytical data. Its principal advantage is in the analysis of very complex mixtures where the number of components exceed the number of analytical measurements. Another advantage of this method is the simplicity of its application to actual samples.

INDEX TERMS: Molecular structure, Mass spectra, Gasoline.

AMIC-6508

"EXTRACTION AND CONCENTRATION OF ORGANIC SOLUTES FROM WATER", Goldberg, M. C., Delong, L., Sinclair, M., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 89-93.

An organic extraction and concentration apparatus is described that will separate and concentrate organic materials from water. It employs any given organic solvent as long as that solvent is immiscible in water, and it will concentrate a given aqueous organic solute up to a factor of 100,000 with the stipulation that the solute partitions between water and the organic solvent. The differential in vapor pressure between solute and solvent does not seem to be a factor that regulates concentration efficiency. The dipole moment difference between solute and solvent will indicate the extraction efficiency and can be used as an index to select the extraction solvent. For broad spectrum extraction, several solvents can be used either in a series or parallel extractor trains; and with adequate dipole moment differences between solvents, the extractor train will selectively concentrate on the basis of solute-solvent dipole moment match.

INDEX TERMS: Separation techniques, Laboratory equipment, Distillation, Dissolved organics, Preconcentration, Liquid-liquid extraction.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6510

"NUCLEAR MAGNETIC RESONANCE STUDIES OF THE SOLUTION CHEMISTRY OF METAL COMPLEXES", Libich, S., Rabenstein, D. L., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 118-124.

Because of the importance of methylmercury in the environment, investigations were undertaken to study its coordination chemistry in aqueous solutions. Specifically, the aqueous solution chemistry of methylmercury and of the methylmercury complexes of eight carboxylic acids of pK sub A values ranging from 1.00 to 4.95 was investigated by proton magnetic resonance spectroscopy. Equilibrium constants for the reaction of CH₃Hg(plus) with hydroxide ion to form CH₃HgOH and with CH₃HgOH to form (CH₃Hg)2OH(plus) were determined from the pH dependence of the chemical shift of the methyl group of methylmercury. The formation constants of the methylmercury complexes of the carboxylic acids were determined from the pH dependence of the chemical shift of the methyl group of methylmercury, from the pH dependence of the mercury-proton spin-spin coupling constant of methylmercury, and from the pH dependence of the chemical shift of the ligand protons in solutions containing equimolar concentrations of methylmercury and carboxylic acid. The formation constants of the methylmercury complexes are found to increase linearly as the acid ionization constants decrease.

INDEX TERMS: Aqueous solutions, Proton magnetic resonance, Methylmercury, Carboxylic acid, Equilibrium constants, Formation constants, Ionization constants.

AMIC-6512

"ON THE SPECTROPHOTOMETRIC DETERMINATION OF DISSOLVED SILICA IN NATURAL WATERS", Fanning, K. A., Pilson, M. E. Q., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 136-140.

The precision and accuracy of methods for the determination of dissolved silica in natural waters can be greatly improved by taking account of the time courses of some of the reactions involved. The kinetics of these reactions are dependent on the concentrations of electrolytes present in the samples. Based on results from a metal-sulfite reduction method, the molar absorptivity of a reduced mixture of the alpha- and beta-isomers of molybdosilicic acid in sea water is apparently affected only by the ionic strength but not by the nature of the component salts of the solution. (Reprinted from Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 136-140. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Spectrophotometry, Sea water, Silica, Absorption, Salinity, Precision.

AMIC-6511

"SIMULTANEOUS SPECTROPHOTOMETRIC DETERMINATION OF BARIUM AND STRONTIUM USING SULFONAZO III", Kemp, P. J., Williams, M. B., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 124-129.

Sulfonazo III (2,7-bis(21-sulfonophenylazo)-1,8-dihydroxy-3,6-naphthalene-disulfonic acid), a promising reagent for barium and strontium determination, was studied for direct simultaneous determinations in the presence of diverse metal ions masked by chelons EGTA and CDTA. An absorbance study revealed that there is no pH sensitivity of the complexes of the pH range 2.6 to 7.7. The addition of the chelons EGTA and CDTA at pH 6 eliminates the interference of most cations except copper which has a light blue chelon complex. The use of EGTA at pH 6.1 and CDTA at pH 6.8 permits the determination of barium and strontium. Simultaneous equations derived from Beer's law facilitate the analysis. The working range of the method is from 1.4 to 4.1 ppm for barium and from 1.8 to 7.0 ppm for strontium. An aqueous solution of sulfonazo III shows less than 1 percent decomposition in seven days. With periodic calibration, the analytical reagent can be considered stable for several months. Under these conditions, the determination is accurate to within 2 percent of the actual concentrations. The properties of the free reagent were also investigated.

INDEX TERMS: Strontium, Aqueous solutions, Colorimetry, Absorption, Barium, Sulfonazo III, Chemical interference.

AMIC-6513

"PHENOL BLUE AS A SOLVENT POLARITY INDICATOR FOR BINARY APROTIC SOLVENTS", Kolling, O. W., Goodnight, J. L., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 160-164.

Solvent-induced shifts in the positions of electronic absorption bands for reference indicators have become the basis for empirical scales measuring solvent polarity in one-component media. Recent investigations on Phenol Blue as a model solvatochromic dye have caused the generality of this approach to solvent polarity ranking to be doubted when applied to solvent mixtures containing hydrogen bonding donors and acceptors. Since binary solvents have widespread use in analytical methods requiring nonaqueous solvents, the present study was undertaken to examine solvatochromism in purely aprotic solvent pairs. The solvents investigated were acetone, acetonitrile, benzene, carbon tetrachloride, chlorobenzene, chloroform, cyclohexane dichloromethane, dimethyl sulfoxide, p-dioxane, ethyl acetate, nitromethane, isooctane, methanol, petroleum ether, n-propanol, and mixtures of benzene with n-butanol, benzene with isopropanol, benzene with chloroform, propanol, and acetone, methyl ethyl ketone with acetic acid and isopropanol and toluene with acetic acid. From a qualitative point of view, it is possible to distinguish two classes of aprotic binary solvents: those exhibiting a regular change in polarity with changing solvent composition; and those giving evidence of specific interactions. One- and two-parameter equations relating macroscopic properties of the solvent to the transition energy of Phenol Blue were tested with the two-component solvents. The McRae equation adequately predicts the general trend in transition energy over wide ethyl acetate mole fraction intervals in regular solvent systems.

INDEX TERMS: Absorption, Polarity, Organic solvents, Dielectric constant, Refractive index, Thin layer chromatography, Phenol blue.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6515

"LASER EXCITED ATOMIC AND IONIC FLUORESCENCE OF THE RARE EARTHS IN THE NITROUS OXIDE-ACETYLENE FLAME", Omenetto, N., Hatch, N. N., Fraser, N. N., Winefordner, J. D., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 195-197.

Detection limits are reported for rare earths in aqueous solutions analyzed by laser excited atomic and ionic fluorescence. Stock solutions of Ce, Dy, Er, Eu, Gd, Ho, Lu, Nd, Pr, Sm, Tb, Tm, and Yb were prepared from reagent grade chemicals. The laser beam was focused on the nitrous oxide-acetylene flame supported by a capillary burner and located 8 cm from the entrance slit of a single-pass monochromator equipped with 1180 lines/mm grating and a photomultiplier. A boxcar integrator was the sampling detector. The atomic and ionic fluorescence transitions are listed, and detection limits are compared with those obtained by atomic absorption and flame emission in the nitrous oxide-acetylene flame. It appears that atomic emission spectrometry with the nitrous oxide-acetylene flame is preferable to atomic absorption or atomic fluorescence. However, in some cases atomic fluorescence will be adequate and simpler than other methods.

INDEX TERMS: Aqueous solutions, Atomic absorption spectrophotometry, Rare earth elements, Detection limits, Atomic emission flame spectrometry, Atomic fluorescence flame spectrometry, Ionic fluorescence flame spectrometry, Lasers.

AMIC-6521

"NATURAL PHOSPHATE SOURCES IN RELATION TO PHOSPHATE BUDGETS: A CONTRIBUTION TO THE UNDERSTANDING OF EUTROPHICATION", Colterman, H. L., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 3-17.

The author suggests that studying the problems of eutrophication resulting primarily from the presence of phosphates must include consideration of the natural resources. Natural levels of phosphates occur as a result of the presence of phosphorus in rocks which is mobilized by weathering, including leaching and erosion. Phosphorus may be transported by adsorption on clay as shown by studies of unpolluted lakes in Africa. Although these lakes contain high levels of phosphates, algal growths are not a problem either because the phosphorus is not in a form available to the algae or because some other factor is limiting. Phosphates may also originate from peat areas; however, these also may not be available to algae. Phosphates adsorbed on sediment particles may be available for algal utilization through enzyme or bacterial action. This phosphate, however, may be readsorbed and consequently be available for only a brief period of time. Recycling of phosphate by biochemical action must also be considered as a means of its being made available for algal utilization. It is concluded that the process of eutrophication is only understandable after measuring not only the P-input, but also the primary production, including its mineralization, and estimating the natural P-losses during the recycling.

INDEX TERMS: Eutrophication, Phosphates, Water pollution sources, Lakes, Cycling nutrients, Path of pollutants, Weathering, Leaching, Erosion, Adsorption, Sediments, Silt, Peat, Clays, Mobilization.

AMIC-6520

"AUTOMATIC GAP CONTROL UNIT FOR SPARK SOURCE MASS SPECTROMETRY", Magee, C. W., Harrison, W. W., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 220-224.

An Automatic Gap Unit (AGU) has been designed to automatically control electrode gap width on spark source mass spectrometers for the purpose of providing more accurate analyses. The unit monitors the RF voltage developed between the electrodes, which is proportional to gap width, and adjusts one of the electrodes in order to maintain the preset voltage between the electrodes. The unit has proved to be extremely useful for a broad range of sample types. A schematic of the unit is included.

INDEX TERMS: Automatic control, Electrodes, Electronic equipment, Spark source mass spectrometry.

AMIC-6522

"SIGNIFICANCE OF MAN-MADE SOURCES OF PHOSPHORUS: FERTILIZERS AND FARMING", Cooke, G. W., Williams, R. J. B., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 19-33.

There are three ways which phosphorus from agricultural areas can enter natural water supplies: in drainage water; in eroded soil; or from animal excreta. Study of these sources showed that in most cases runoff from agricultural lands contained less P than the receiving waters. However, where erosion occurs, P levels in water may be increased since fertilizers tend to fix themselves to topsoil which is lost first. The P in muds is solubilized in anaerobic reducing conditions and becomes available to rooted plants and microorganisms. Most animal excreta is reapplied to land as fertilizer and may occasionally pollute streams if it is improperly applied or if heavy rains occur. In addition, new methods of handling excreta as slurries increase the potential of pollution by over application or leakage of storage tanks. One source of phosphorus in natural waters which is often not considered is wild birds. These may add significantly to P levels in water. At present, it appears that agricultural sources add little P to natural waters. However, steps must be taken to assure that the three potential sources are adequately controlled.

INDEX TERMS: Phosphates, Water pollution sources, Agricultural runoff, Fertilizers, Livestock, Erosion, Leaching, Animal wastes (wildlife), Path of pollutants.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6523

"THE SIGNIFICANCE OF MAN-MADE SOURCES OF PHOSPHORUS: DETERGENTS AND SEWAGE", Devey, D. G., Harkness, N., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 35-54.

The aims of this paper are to establish the significance of detergents and sewage as sources of phosphorus to the aquatic environment. Information has been obtained as to the composition of washing powders and liquids containing phosphates and the reasons for the use of phosphates. Current and past consumption data show that the trends for detergent use are still very much upward, with a consequent increasing load of phosphates into the aquatic environment based on present formulation. Indeed in the United Kingdom it may be that the consumption of detergents will not level off for 10 yr or more if American trends are followed. The section of the paper on sewage gives details of the varying levels of phosphates that are found at differing works and the various sources from which these arose. Variations over the day of phosphorus and detergent in sewage show the expected usage pattern for households. Some data have been obtained on the phosphorus content of industrial effluents, but at present these do not appear to be a major source overall, although particular processes, e.g. anodizing, may waste appreciable concentrations of phosphates. Discussion of the total phosphorus contribution to the aquatic environment per annum shows the tremendous amount of nutrient phosphorus which is discharged to the river system from sewage, even when detergent phosphate is not taken into consideration. It appears at present that there is little or no problem due to phosphates in the aquatic environment in the United Kingdom but this is not to say it will not arise.

INDEX TERMS: Phosphates, Detergents, Sewage, Industrial wastes, Domestic wastes, Water pollution sources.

AMIC-6524

"PHOSPHATES IN SEWAGE AND SEWAGE TREATMENT", Lewin, V. H., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 55-67.

The concentration of reactive phosphate present in sewage fluctuates markedly from hour to hour; much of it is associated with particulate matter. The soluble reactive phosphate can be separated into individual moieties by an automated anion exchange elution technique involving the use of a 1.3-cm i.d. column containing de-acidite FF anion exchange resin, chloride form SRA 71 100/200 mesh. The phosphate content is desorbed from the column by gradient elution with KCl. The phosphates are colorimetrically determined as orthophosphate by reacting with ammonium molybdate in sulfuric acid and hydrazine solution. The natural hydrolysis of higher forms of phosphate to the ortho state can be arrested in samples by the addition of formalin. Molybdenum-hydrazine colorimetric determination appears superior to the molybdenum-vanadate method particularly on the chromatographically separated samples but may need confirmation of reliability for untreated samples for interference from silicates or other substances. Alternatively an automated method for the total phosphorus content capable of handling homogenized samples of sewage is essential. The phosphate load and fate during sewage treatment will require monitoring over a protracted period because of hourly and seasonal fluctuations which may be substantial. The greater proportion is, however, removed during treatment in association with particulate matter, albeit a fairly constant concentration in the order of 5-8 mg/l is discharged with the effluent.

INDEX TERMS: Colorimetry, Separation techniques, Phosphates, Sewage, Anion exchange, Chemical interference, Fate of pollutants, Orthophosphates, Pyrophosphates, Polyphosphates.

AMIC-6529

"SIGNIFICANCE OF PHOSPHORUS IN LAKES AND COASTAL WATER SEDIMENTS AND BENTHOS", Stumm, W., Water Research, Vol. 7, Nos. 1/2, January/February 1973, p 129.

The dynamics of availability of sediment phosphorus to the overlying water depends on P concentration of interstitial water which in turn depends on the redox intensity and the affinity of the solid sediment phases for P. In lakes and coastal waters substantial fractions of P become irretrievably deposited into the sediments, but in lakes the seasonal sequence of P release to the water from the sediments tends to facilitate algal blooms in shallow waters. With increasing depth of the lake the net removal of P from the water by the sediments becomes preponderant and the quantity of P released from the sediments to the epilimnion becomes small relative to other fluxes. There are essentially the following ways for P to be deposited: (1) adsorption of P on clays; (2) burying of detrital P; (3) chemical precipitation of apatite; and (4) diagenetic replacement of calcite (e.g. skeletal carbonate) by substitution of carbonate by phosphate. Accumulation of P, regenerated from detritus as it occurs most extensively in shallow waters and under conditions of counter-current systems (estuaries), does not in itself lead to an increase in the relative apatite saturation because the regeneration of one P atom is accompanied by an increase in acidity caused by the formation of ca. 106 CO₂ molecules. In order to exceed the critical ion product, the excess of CO₂ must be lost or neutralized. Such conditions are encountered in areas of upwelling, where excess CO₂ is lost to the atmosphere and under reducing conditions where denitrification and SO₄(2-)-reduction consume hydrogen ions.

INDEX TERMS: Phosphorus, Sediments, Lakes, Turnovers, Adsorption, Estuaries, Removal.

AMIC-6530

"THE ACCELERATION OF THE HYDROGEOCHEMICAL CYCLING OF PHOSPHORUS", Stumm, W., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 131-144.

By mining phosphorus in progressively increasing quantities, man disturbs the ecological balance and creates undesirable conditions in inland waters, estuaries and coastal marine waters. The civilizatory increase in phosphorus supply to the oceans, although of little consequence to the oxygen reserves of the deep sea, augments markedly the marine environments with intermittent or permanent oxygen deficient conditions. Because most aquatic food resources are produced in estuaries and coastal areas, the deterioration in water quality of these regions decreases the potential harvest of marine animal protein. Our present agricultural practice of excessively fertilizing land needs to be reexamined; our present agricultural technology must not without modification be exported to tropical areas. Our present drainage systems for sewage, industrial wastes and storm water runoff accelerate the transport of nutrients and other pollutants to the rivers and the sea; waste treatment plants are remarkably inefficient in mitigating this civilizatory flux.

INDEX TERMS: Water pollution sources, Phosphorus, Cycling nutrients, Fertilizers, Oxygen demand, Limiting factors, Sediments, Fate of pollutants.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6534

"SOIL AND FERTILIZER PHOSPHORUS IN THE IRISH ECOSYSTEM", Hanley, P. K., Murphy, M. D., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 197-210.

An attempt was made to define the sources of phosphorus in water eutrophication in Ireland, from an agricultural viewpoint. The place of soils, fertilizers, animal wastes, precipitation, crops, run-off and erosion in the overall phosphorus budget was outlined, using local data and extrapolation from findings elsewhere. It would appear that fertilizers at present play a minor part in eutrophication. The role of sediments is largely unknown because little data are available. Animal wastes, if not handled correctly, could pose problems, particularly if future plans for increasing livestock numbers are carried through. The solutions to water eutrophication involve other interests, apart from agriculture. The island aspect of the ecosystem should be helpful in defining and solving the problems of eutrophication.

INDEX TERMS: Phosphorus, Fertilizers, Eutrophication, Water pollution sources, Agricultural runoff, Farm wastes, Feedlot wastes, Erosion, Rain, Ireland.

AMIC-6536 (Continued)

Card 2/2

INDEX TERMS: Phosphorus, Eutrophication, Detergents, California, Water pollution sources, Nitrogen, Limiting factors, Industrial wastes, Municipal wastes, Agricultural runoff, Urban runoff, Fertilizers, Lake Tahoe, Clear Lake, San Francisco Bay.

AMIC-6536

"ENVIRONMENTAL IMPACT OF DETERGENT BUILDERS IN CALIFORNIA WATERS", Jenkins, D., Kaufman, W. J., McGauhey, P. H., et al, Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 265-281.

Most nationwide estimates in the United States place the point source phosphorus contributions to surface waters between 70-90 percent (in California this is between about 80-90 percent) and the point source nitrogen input to something less than 50 percent of the total nitrogen load (in California this is about 40 percent). Detergents appear to represent somewhere on the order of 20-40 percent of the total phosphorus released to waters. On an overall basis, if control of both nitrogen and phosphorus were to be necessary it would be feasible to control phosphorus because some 80-90 percent of it arises from point sources, but it would be virtually impossible to control nitrogen as well or as completely because of the high percentage contributed from diffuse sources, and because nitrogen can be fixed from the atmosphere by many algae and bacteria. Control of phosphorus input to surface waters by eliminating phosphates from detergents is not of consequence because this phosphate contribution is only some 35 percent of the total phosphate input. Most of the total phosphorus reaching the surface waters of California is contributed by two regions - the South Coastal contributing about 50 percent and the San Francisco Bay Region producing some 15 percent of the total. Of the total phosphorus reaching the waters of the State of California it is estimated that through municipal discharges alone, some 40 percent is directly to the ocean and an additional 17 percent reaches the ocean through municipal discharge to bays and estuaries. Approximately 20 percent of the nitrogen is discharged in municipal wastes directly to the ocean. Discharge from municipal wastes to bays and estuaries accounts for about 10 percent of the total discharge of nitrogen.

AMIC-6537

"AN IMPROVED METHOD OF PHOSPHORUS ANALYSIS IN SEA WATER", Hosokawa, I., Ohshima, F., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 283-289.

The method of Lucena-Conde and Prat (1957) which employs a reagent of Mo(VI) and Mo(V) for analysis of phosphorus in seawater has been improved by the use of zinc instead of mercury as the reductant of the Mo(VI). The reagent is prepared by adding 10 ml of conc. HCl to 10 ml of 2 M Mo(VI) solution and about 0.3 g of pure metallic zinc. After the zinc has dissolved, 28 ml of conc. HCl, 40 ml of conc. H₂SO₄ and enough water to make 100 ml of solution are added. The reaction is carried out by boiling for 20 minutes. The presence of phosphorus produces a heteropoly blue color with an absorption maximum at 830 nm wavelength. No interference occurs if concentrations of interfering ions are less than 100 ppm for Si-SO₃, 0.01 ppm for As-AsO₄, 10 ppm for W-WO₄, and 100 ppm for Ge-GeO₃. Nitrate ion reduces sensitivity and must be reduced to nitrite ion if more than 1 ppm is present. Salt error was about -5 percent with chlorinity of 190 percent.

INDEX TERMS: Chemical analysis, Sea water, Phosphorus, Water analysis, Chemical interference, Sample preparation, Reagents.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6538

"PROBLEMS IN THE ANALYSIS OF PHOSPHORUS COMPOUNDS", Burton, J. D., Water Research, Vol. 7, No. 1/2, January/February 1973, pp 291-307.

Water is most usually analyzed for phosphorus by converting the phosphorus to orthophosphates and using an absorptiometric method in which 12-molybdophosphoric acid is formed and reduced to phosphomolybdenum blue. Review of results from interlaboratory analyses have shown that ascorbic acid in the presence of antimony ions is an attractive reductant for this purpose. In conditions where other ions do not interfere, it is possible to measure accurately the free orthophosphate, organically combined phosphorus, and total condensed phosphates by a photo-oxidation procedure using ultraviolet radiation in which hydrolysis can be minimized. For measurement of total dissolved phosphorus, oxidative digestion with potassium persulfate or photo-oxidation followed by hydrolysis has proved suitable for a wide range of samples. Improvement in analysis must also be accompanied by improvements in filtration and sample preservation. Freezing has been found to be effective for preservation. However, in samples of high biological activity additional preservatives may be needed. Alternative methods for analysis of phosphorus in water are unlikely to compete with the phosphomolybdenum blue procedure for some time.

INDEX TERMS: Phosphorus, Chemical analysis, Water analysis, Arsenic, Filtration, Freezing, Sampling, Chemical interference, Sample preservation, Reductants, Orthophosphates, Absorptiometric methods, Detection limits.

AMIC-6540

"THE APPLICATION OF THE LEIPERT AMPLIFICATION TO INCREASE SENSITIVITY IN THE DIRECT DETERMINATION OF IODINE BY ATOMIC ABSORPTION SPECTROMETRY", Kirkbright, G. F., West, T. S., Wilson, P. J., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 113-114.

The sensitivity attainable in the direct determination of iodine by atomic absorption at 183.0 nm in a nitrogen-separated nitrous oxide-acetylene flame may be increased by as much as 38-fold by application of the Leipert amplification procedure. In the method developed, iodide in the sample solution is oxidized to iodate, each equivalent of which liberates six equivalents of iodine on treatment with excess iodide in weakly acidic solutions. The liberated iodine is extracted into methyl isobutyl ketone and nebulized directly into the flame. The presence of fifty-fold excesses by weight of Co, Ni, Mn, Cr, Zn, Mg, Na, K, Ca, Al, chloride, sulfate, phosphate and nitrate was observed to give rise to negligible effect on the absorbance produced by a 5 ppm iodide solution when present throughout the amplification and extraction procedure. The presence of cations incompatible with iodide in acidic aqueous solutions, for example Fe (III), Cu (II) or V (V), results in interference due to liberation of iodine by oxidation of the excess iodide added to effect the amplification. Under these conditions the interfering ions must be removed by preliminary treatment of the neutral sample solution with cation exchange resin. The amplification-extraction procedure is shown to be selective for iodide and to produce an effective sensitivity (for 1 percent absorption) of 0.32 iodide.

INDEX TERMS: Iodine, Aqueous solutions, Pollutant identification, Methodology, Cations, Heavy metals, Halides, Anions, Alkali metals, Leipert amplification method, Sensitivity, Atomic absorption spectrophotometry, Detection limits, Sample preparation.

AMIC-6541

"THE PRECISE DETERMINATION OF LEAD IN WHOLE BLOOD BY SOLVENT EXTRACTION - ATOMIC ABSORPTION SPECTROMETRY", Mitchell, D. G., Ryan, P. J., Aldous, K. M., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 120-121.

A solvent extraction - atomic absorption procedure is described for the determination of lead in whole blood. The sample is pipetted into a lead-free glass tube, the Triton X-APDC reagent added, and the solution mechanically mixed for 30 sec. A 10-min period is allowed to insure complete hemolysis after which methyl isobutyl ketone (MIBK) is added. The mixture is vigorously shaken for one minute and centrifuged at ca. 2000 rpm for 10 min. The organic phase is removed, and its lead content determined by atomic absorption spectrometry against blank readings of MIBK saturated with deionized water. The standards and samples are analyzed in duplicate and triplicate, respectively. The digital unit integrates the absorbance signal over 4 sec and then prints out integrated absorbance values. Results are obtained by manually keying absorbance data into the Wang calculator, which computes the net signal by averaging the background readings before and after sample aspiration and subtracting this value from the sample signal. Net signals are plotted against lead concentrations, and from the equation of the line of least squares, the concentrations corresponding to the net sample signals are calculated and printed out. The procedure routinely gives relative standard deviations of ca 5 percent at the 45 micrograms/100 ml level, corresponding to confidence limits of plus or minus 3 micrograms/100 ml for triplicate analyses. The effects of sample age, EDTA in blood, and added phosphate on analytical results are also reported.

INDEX TERMS: Solvent extractions, Lead, Heavy metals, Pollutant identification, Chemical analysis, Blood, Atomic absorption spectrophotometry, Biological samples, Precision, Sample preparation.

AMIC-6542

"DETERMINATION OF ANTIMONY IN PETROLEUM ADDITIVES USING ATOMIC ABSORPTION SPECTROPHOTOMETRY", Supp, G. R., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 122-123.

A fast, simple, and accurate method has been developed for the quality control analysis of production samples of antimony in petroleum additives. The standards and samples are dissolved in an organic solvent (MIBK) and analyzed directly by atomic absorption spectrophotometry. The two types of antimony compounds used as petroleum additives in this study were antimony dialkylthiocarbamate and antimony O,O-dialkylphosphorodithioate. They were analyzed by atomic absorption and by a wet analytical method which involved titrating a Kjeldahl mixture with potassium permanganate. Good agreement between the wet method and atomic absorption was attained. The AA results were slightly higher than the wet method, although well within experimental error. Acid breakdown and digestion are eliminated using AA analysis and sample handling is kept to a minimum.

INDEX TERMS: Methodology, Oil, Chemical analysis, Pollutant identification, Additives, Petroleum additives, Antimony, Atomic absorption spectrophotometry, Absorbance, Sample preparation, Antimony dialkylthiocarbamate, Antimony O O-dialkylphosphorodithioate.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6543

"ACCESSORY 'GROOVED' TUBES FOR THE GRAPHITE FURNACE", Fernandez, F. J., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 123-124.

Grooved graphite tubes have been shown to improve the performance of the Graphite Furnace for a number of special applications, particularly those using organic solvents. The new tube that has been designed has a shallow groove in the center of the inner tube surface. The grooved section is designed to contain the sample and prevent it from spreading along the tube. In addition, the wall thickness of the center section (0.7-mm) is larger than that of the outer sections (0.5-mm), resulting in a more even temperature distribution along the tube. With the grooved tube it is possible to utilize up to 50 microliter sample volumes of organic solvents with no loss of precision due to sample spreading. Preliminary experiments have shown that the more uniform temperature profile of the grooved tube provides more efficient charring of concentrated solutions such as whole blood and serum, as well as various types of solid samples. Additional differences between the standard and grooved tube such as different electrical resistance, attaining a different maximum temperature and poorer sensitivities make the standard tube preferable for general use with the Graphite Furnace.

INDEX TERMS: Performance, Instrumentation, Laboratory equipment, Temperature, Resistivity, Chemical analysis, Graphite Furnace, Grooved tubes, Tubes, Sensitivity, Biological samples, Blood, Serum.

AMIC-6544

"THE USE OF AN ATOMIC ABSORPTION SPECTROPHOTOMETER FOR END-POINT DETERMINATION: APPLICATION TO CHLORIDE IN WATERS", Cambrell, J. W., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 125-127.

The method of using an atomic absorption spectrophotometer for the end-point determination of chloride with a silver nitrate titrant allows for the assumption that no Ag ions are in solution until all the chloride has been precipitated. The Ag ion concentration, however, increases as further additions of the titrant are made. The linear relationship between the atomic absorbance and concentration of Ag is used in calculating the equivalence point which is then used to calculate chloride ion concentration. Synthetic and natural, treated, and waste water samples were analyzed for chloride by the following method. Two identical aliquots of the water sample are transferred to individual 100-ml volumetric flasks. Different increments of AgNO₃ are added to each. The solutions are diluted, mixed, and filtered through very retentive filter paper. The absorbance due to Ag ion in each filtrate is determined by atomic absorption and the chloride concentration calculated using equations or by graphically determining the end-point and calculating the concentration. The same samples were spiked with standard chloride solution to confirm recovery (92-108 percent). With this method (1) it should be possible to detect at least 0.5 ppm Cl using a 50-ml sample and 0.0141N AgNO₃; (2) reliable chloride assays can be performed; and (3) the end-point is ascertained with greater ease, particularly at the low chloride levels and in the presence of color and turbidity.

INDEX TERMS: Chlorides, Water analysis, Volumetric analysis, Methodology, Pollutant identification, Atomic absorption spectrophotometry, End-point determination.

AMIC-6545

"MULTI-ELEMENT MICROANALYSES BY DELVES CUP-ATOMIC ABSORPTION SPECTROPHOTOMETRY ON CHELATE/SOLVENT EXTRACTS", Joselow, M. M., Bogden, J. D., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 127-128.

The recent development of atomic absorption procedures that permit analyses with high sensitivity of microliter specimen quantities, together with the use of solvent-extraction techniques, constitute, in effect, a 2-stage system with the capability for the sequential micro determination of a wide range of metallic elements. The validity and value of this approach is demonstrated with lead and cadmium. Analyses for Pb and Cd were made using (1) an accepted macro-procedure, aspiration of the extract of concern through the nebulizer-burner and (2) the micro-sampling cup adaptation of atomic absorption spectrophotometry. For the micro analyses, the technique essentially as described by Fernandez and Kahn (1971), was followed, except that 0.02 ml of MIBK extract, instead of aqueous standards, was delivered into pre-conditioned, matched Delves sampling cups, and dried at 70 C for 5 minutes. The cups were then inserted into the flame of an atomic absorption spectrophotometer equipped with a 3-slot burner. The lead analyses were done at 283.3 nm, and the cadmium at 228.8 nm. The data indicate that the micro-sampling cup techniques are as valid as the aspiration technique, yielding quite comparable results. The aspiration technique consumed at least 0.5 ml of the specimen and the micro-sampling technique only 0.02 ml, a reflection of the considerably lower detection limits obtainable with the cup. By applying micro-atomic absorption techniques for the specific metals, sequentially, to the solvent extracts obtained from larger size samples, the concentrations of a wide-range of trace metals can be determined in many matrices, particularly where sample size may impose limitations, as with blood, urine, and tissues.

AMIC-6545 (Continued)

Card 2/2

INDEX TERMS: Cadmium, Lead, Heavy metals, Methodology, Solvent extractions, Delves cup method, Atomic absorption spectrophotometry, Microanalysis, Precision, Multielemental analysis, Detection limits, Chelated metals.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6546

"BOMB DECOMPOSITION OF BIOLOGICAL MATERIALS", Paus, P. E., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, pp 129-130.

The decomposition bomb has been used successfully in the determination of trace elements in seaweed and fish samples. Approximately 0.5 g (dry weight) of seaweed and pike fish and 0.8 g tuna fish samples were weighed and transferred to the Teflon vessel in the bomb. Known quantities of concentrated H_2SO_4 and HNO_3 were added to the bomb which was then closed and heated to about 100 C. After cooling to room temperature, distilled water was added and the solution diluted to volume in 50-ml volumetric flasks. Those metals determined using the above procedure were Hg, Cd, Zn, Cu, Fe, and Pb. The results were compared with those obtained by other workers using a hot, wet ashing procedure and neutron activation analysis. For the mercury determination the results are in good agreement with the other methods. For the other elements the present method gives results of the same order of magnitude. Bomb decomposition seems to hold promise for rapid dissolution of biological materials. One of the greatest advantages is the complete dissolution of fat.

INDEX TERMS: Chemical analysis, Trace elements, Methodology, Pollutant identification, Heavy metals, Mercury, Cadmium, Zinc, Copper, Iron, Lead, Marine algae, Pikes, Neutron activation analysis, Phaeophyta, Bomb decomposition, Biological materials, Dissolution, Wet ashing, *Ascophyllum nodosum*, Tuna.

AMIC-6548

"STRENGITE DISSOLUTION IN FLOODED SOILS AND SEDIMENTS", Patrick, W. R., Jr., Gotch, S., Williams, B. G., Science, Vol. 179, No. 4073, February 9, 1973. pp 564-565.

To investigate the conditions under which phosphorus is released from strengite in flooded soil and sediments, suspensions of a rice soil were incubated at oxidation-reduction potentials of 300, 100, -100, and -250 mv and at pH values of 5.0, 6.0, 7.0, and 8.0. The strengite ($FePO_4 \cdot H_2O$) was synthesized with Fe-59. After incubation for 7-10 days, samples of the suspensions were removed without contact with the air, and iron and orthophosphate were extracted with ammonium acetate solution. Iron was analyzed by the alpha-alpha prime-dipyridyl method and phosphate by the chlorostannous-reduced molybdophosphoric blue color method. Fe-59 was determined with a deep well gamma counter. The results show that strengite partially dissolves under reducing conditions such as those that exist in flooded soils deprived of oxygen. A close relationship existed between the amount of strengite dissolved and both the redox potential and the pH of the soil suspension. There is a marked interaction between acidity and redox potential, with strengite reduction and solubilization being more pronounced under conditions of low pH combined with low redox potential.

INDEX TERMS: Phosphorus, Oxidation-reduction potential, Hydrogen ion concentration, Sediments, Reduction (chemical), Strengite, Dissolution.

AMIC-6547

"MODIFICATION OF QUARTZ ABSORPTION TUBE FOR DELVES CUP-ATOMIC ABSORPTION SPECTROPHOTOMETRY", Joselow, M. M., Atomic Absorption Newsletter, Vol. 11, No. 6, November-December 1972, p 131.

Positioning the quartz absorption tube so that the entrance hole is exactly over the micro-crucible can be considerably aided by a simple modification of this tube, easily made with a file or grinding wheel. By making indentations at both ends of this tube so as to fit the attaching clips of the burner head tube supports, the absorption tube can be clipped or reclipped readily into a fixed position without need for further rotational adjustment. These grooves can be made with any suitable file. It has been found that a small dental grinding wheel, attached to a dental drill or chucked into an electric hand drill, provided a quite satisfactory tool for forming properly sized grooves in the quartz tube.

INDEX TERMS: Laboratory equipment, Research equipment, Delves cup method, Atomic absorption spectrophotometry, Quartz absorption tube.

AMIC-6555

"MERCURY METHYLATION IN AN AQUATIC ENVIRONMENT", Langley, D. G., Journal Water Pollution Control Federation, Vol. 44, No. 1, January 1973, pp 44-51.

Samples of sediment and water from a mercury polluted river were collected with a Jenkins sampler, a Phleger-type gravity core sampler, and a Kemmerer sampler and returned to the laboratory for chemical characterization and study of mercury methylation. Sediment was analyzed for mercury by flameless AA and for organic sediment index by the Ballinger-McKee procedures. Each Jenkins tube was stocked with 10 goldfish in an experiment to concentrate methylmercury from the underlying mercury-contaminated sediments. DO, temperature, and pH were regularly monitored. Fluorospas tailings were added to four test cells to evaluate their effectiveness in inhibiting methylation. At weekly intervals, two fish from each cell were analyzed for methylmercury by GLC, and the results compared with those from a control group. Results showed that methylation rates varied from 0.12 to 4.83 ng Hg/wk/sq cm. The cell with the highest methylation rate also had a large bacteria population which may have been responsible for the methylation. Other factors affecting methylation include temperature, pH, redox potential, mercury concentration, and organic concentration. However, under certain conditions, methylation can occur with low Hg concentrations. Methylation is too slow a process to permit natural rehabilitation of contaminated sediments, but sealing off the sediments appears to be a promising measure.

INDEX TERMS: Mercury, Bacteria, Sediments, Organic matter, Hydrogen ion concentration, Oxidation-reduction potential, Goldfish, Methylation, Bioaccumulation, Sediment overlays, Biotransformation.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6563

"SOURCES OF NUTRIENTS IN CANADARAGO LAKE", Hetling, L. J., Sykes, R. J., Journal Water Pollution Control Federation, Vol. 45, No. 1, January 1973, pp 145-156.

A study of the nutrient balance of Canadarago Lake in east-central New York State revealed that approximately 52 percent of the phosphorus input came from land runoff, 46 percent from wastewater, and 2 percent from rainfall. Detergents, represented approximately 56 percent of the wastewater phosphorus load. Approximately 23 percent of the total phosphorus was trapped in the lake. Of the soluble phosphorus, 72 percent came from wastewater. Of total nitrogen, 91 percent was from land runoff. Wastewater loadings of chlorides, magnesium, and potassium were minor. Phosphorus and nitrogen contributions were 4.8 and 10.3 g/day/cap, respectively. Control measures might reduce phosphorus load by two-thirds and improve the lake, perhaps even to the mesotrophic state, in 2 to 3 years.

INDEX TERMS: Nutrients, Water pollution sources, Detergents, Rain, Waste water (pollution), Surface runoff.

AMIC-6566

"CONTROL OF MERCURY POLLUTION IN SEDIMENTS", Smith, I. C., Midwest Research Institute, Report No. EPA-R2-72-043, EPA Contract No. 68-01-0087, September 1972, 55 pp.

Results are reported of exploratory studies to develop methods for controlling pollution from mercury-laden sediment deposits on the bottoms of streams and lakes. The results of exploratory studies to develop such methods are reported here. Five sediment samples containing from 6 ppm to 500 ppm mercury were investigated. Two samples were taken from the St. Clair River below the outfall of a chloroalkali plant; one sample from the Detroit River below a chloroalkali plant; one sample from a stream which empties into the San Francisco Bay; and one sample from an industrial holding pond used for disposing of waste from a chloroalkali plant. The geochemical nature of these sediments varied considerably from sample to sample. The major differences were in organic content, sand or silicate content, carbonate content and particle size distribution. Although no effort was specifically directed to determining the chemical form of mercury in the sediment samples, the results of these studies indicate that mercury was present in a variety of chemical forms. The use of an iron overlay in the form of crushed automobile bodies topped with sand should, on the basis of results obtained in this program, be an inexpensive and effective method of isolating mercury-containing sediments from a water overlayer. An important attraction of using iron as an overlay is its ability to reduce methylmercury ions as well as mercuric ions to elemental mercury. A variety of methods for recovering the mercury values from dredged sediments were explored. Density fractionation, particle size fractionation, flotation, roasting and leaching were the methods studied. Roasting and chemical leaching afford the greatest promise for inexpensive removal and recovery of the mercury. A possible method for in-place leach of sediment deposits is presented. Field tests of the iron overlay and the chemical leach method are recommended.

AMIC-6564

"DEVELOPMENT OF METHOD FOR NTA ANALYSIS IN RAW WATER", Taylor, J. K., Zielinski, W. L., Jr., Maienthal, E. J., Durst, R. A., Burke, R. W., National Bureau of Standards, Washington, D.C., Report No. EPA-R2-72-057, September 1972, 27 pp.

The free acid form of nitrilotriacetic acid is readily esterified by N,O-bis(trimethylsilyl)acetamide and gas chromatographic analysis is directly applicable to this derivative. The response characteristic of NTA-trisilylester was 2,200 sq mm peak area per microgram of NTA at maximum sensitivity of the hydrogen flame ionization detector. Accordingly, gas chromatography has the potential for detecting NTA concentrations of practical interest providing that suitable NTA isolation techniques can be developed. The cupric ion-selective electrode provides the basis for a sensitive electrochemical detector for NTA. Apparatus for the on-stream determination of uncomplexed NTA has been developed. This may be used for determination of total NTA, after the latter is separated from bound metal ions and other complexing agents by a suitable means, such as ion-exchange chromatography. Polarographic studies have shown that the bismuth-NTA complex is a suitable method for the determination of NTA in most waters. While some metal ions may interfere, a pre-electrolysis step and/or a standard addition technique seems feasible to eliminate this problem. Potentiometric titration with cupric ion should provide a rapid and reliable referee method for the determination of NTA in detergent formulations. Such a method would appear to be superior to the spectrophotometric methods presently used, since the latter are affected by turbidities which are encountered in many of the samples.

INDEX TERMS: Nitrilotriacetic acid, Water analysis, Polarographic analysis, Pollutant identification, Ion selective electrodes, Potentiometric titration, Flame ionization gas chromatography.

AMIC-6566 (Continued)

Card 2/2

INDEX TERMS: Mercury, Pollution abatement, Bottom sediments, Chemical analysis, Isolation, Separation techniques, Methodology, Pollutant identification, Testing procedures, Heavy metals, Methylmercury, Recovery, Dimethylmercury.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6568

"IDENTIFICATION OF POLYCHLORINATED BIPHENYLS IN THE PRESENCE OF DDT-TYPE COMPOUNDS", Brownrigg, J. T., Eastwood, D., Hornig, A. W., Baird-Atomic, Incorporated, Bedford, Massachusetts, Report No. EPA-R2-72-004, EPA Contract No. 68-01-0082, October 1972, 62 pp.

Polychlorinated biphenyls (PCB's) interfere with gas chromatographic analyses of DDT and related compounds, necessitating a simple independent method for PCB determination. The purpose of the present study was to determine the applicability of low temperature (77 K) luminescence methods to this problem. Basic studies included documentation of excitation/emission spectra of 6 pesticides (p,p'- and o,p'-DDE, DDD, and DDT), 7 PCB isomers, and 5 PCB mixtures (Aroclors). Although phosphorescence spectra of the DDD and DDT compounds are very similar, possible differences in lifetime and polarization measurements may aid in differentiation. Emission from DDE is at least 100X less intense than that of DDD or DDT, and is therefore more difficult to determine with adequate sensitivity. Spectral differences among various Aroclors are sufficient to allow those studied to be differentiated. Emission from solvent impurities presently limit detection sensitivities to about 1.0 ppm for DDT/DDD and about .01 ppm for Aroclors. By removing interference, detection sensitivities should be improved by two orders of magnitude. Low temperature luminescence studies in various binary mixtures of Aroclor 1254 and p,p'-DDT indicate Aroclor 1254 may be identified and quantitated in the presence of DDT concentrations 100X greater.

INDEX TERMS: Polychlorinated biphenyls, Pollutant identification, Chemical analysis, Chlorinated hydrocarbon pesticides, Methodology, Separation techniques, Gas chromatography, Water analysis, Phosphorescence, Luminescence, Detection limits, Chemical interference, Sensitivity, Mixtures, Quantitative analysis, Emission spectra, Isomers.

AMIC-6569

"LIQUID CHROMATOGRAPHY OF CARBAMATE PESTICIDES", Thruston, A. D., Jr., Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, Georgia, Report No. EPA-R2-72-079, October 1972, 15 pp.

Standard solutions of 23 carbamate pesticides prepared in isopropanol were analyzed using a DuPont Model 820 liquid chromatograph equipped with an ultraviolet photometric detector. Stainless steel columns (1 m x 2 mm i.d.) packed with either Permaphase ODS (octadecyl silane) or Permaphase ETH (ether) were used with the following mobile phases: 6 and 30 percent MeOH in water, hexane, one percent isopropanol/hexane, and 4 percent isopropanol/hexane. The retention times of the pesticides are given. The UV detector required 20-1500 ng for the pesticides studied to give a 25 percent full-scale recorder response.

INDEX TERMS: Carbamate pesticides, Pollutant identification, Liquid chromatography, Retention time, Baygon, Furadan, Matacil, Mobam, Sevin, UC 10854, UC 8454, Carbanolate, RE 5305, Mesurol, Zectran.

AMIC-6570

"CHARACTERISTICS OF RAINFALL RUNOFF FROM A BEEF CATTLE FEEDLOT", Kreis, R. D., Scalf, M. R., McNabb, J., Environmental Protection Agency, Robert S. Kerr Water Research Center, Ada, Oklahoma, Report No. EPA-R2-72-061, September 1972, 43 pp.

A study was conducted at a 12,000-head capacity beef cattle feedlot in order to determine the characteristics of rainfall runoff and to evaluate the efficiency of the treatment process in operation at the time of the investigation. Sampling equipment used in the study included a recording rain gauge, an automatic, float-actuated, pump-type liquid sampler, a water level recorder, and a vacuum-type refrigerated sequential sampler. Sample flow and composite and grab samples from ditch influent and effluent preserved in H2SO4 were analyzed for COD, total organic C, phosphate, organic N, ammonia, and chloride. Unpreserved samples were analyzed for total solids, dissolved solids and suspended solids, volatile suspended solids, Ca, Mg, Na, and K. Those unpreserved flow samples processed on the same day as collected were analyzed for BOD5; those from the farm pond effluent were analyzed for BOD5, nitrite, orthophosphate, pH, conductivity, and total alkalinity. Microbiological grab samples were collected from the direct feedpen runoff during three rainfall events, and from the holding pond ditch influent and effluent and the farm pond effluent during the first two pumping periods to determine densities of coliform, fecal coliform, and fecal streptococci. COD, TOC, BOD5 concentrations were high, averaging 7,210, 2,010, and 1,075 mg/l, in direct feedpen runoff. BOD5 concentrations were about four times the concentration typical for raw domestic sewage. Direct feedlot runoff contained high and variable concentrations of solids and nutrients. Total suspended solids and total solids averaged 5,900 and 11,429 mg/l, respectively. Total phosphate concentrations ranged from 21 to 223 mg/l which is 3 to 20 times concentrations normally found in municipal wastes. Essentially all of the nitrogen was in the total organic and

AMIC-6570 (Continued)

Card 2/2

ammonia form which averaged 228 and 108 mg/l, respectively. Dilution from direct rainfall and a few days of sedimentation in the runoff collection ponds reduced the concentrations of the pollutants up to 90 percent. The total weight of solids and oxygen demanding materials was reduced by about one-half, but the total weight of nutrients was not significantly reduced. Bacterial counts from holding pond samples collected one day following rainfall were higher than counts from direct feedpen runoff, indicating possible aftergrowth. The remainder of the treatment disposal system produced no appreciable improvement in the quality of the waste water. Final discharges still contained pollutant concentrations two to three times those of untreated municipal sewage.

INDEX TERMS: Runoff, Feed lots, Cattle, Efficiencies, Waste water treatment, Physical properties, Chemical properties, Biological properties, Farm wastes, Confinement pens, Equipment, Sampling, Rainfall-runoff relationships, Characterization.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6573

"EVALUATION OF WASTE WATERS FROM PETROLEUM AND COAL PROCESSING", Reid, G. W., Streebin, L. E., Rummfeldt, D. W., Sweazy, R., Oklahoma University, Research Institute, Norman, Oklahoma, Report No. EPA-R2-72-001, December 1972, 205 pp.

This report presents an evaluation on pollution problems, abatement procedures and control techniques relevant to the petroleum and coal industries. Petroleum wastes are discussed under three broad sections: Drilling-Production, Transportation and Storage, and Refining. Each section is introduced with background information. Within each section, petroleum wastes are identified as to their source, volume, and composition, and waste treatment methods are discussed. The results of a field study of three small refineries are reported, providing additional information which delineates the characteristics of waste streams from individual processes within the refinery. Coal mining, coal processing, and coal utilization, the wastes associated with each, and the corresponding control measures are discussed. Acid mine drainage, the most significant pollution problem from coal mining, and possible control measures are presented. The major pollution problems associated with coal processing originate from coal cleaning, the coking process, and refuse disposal. The principal pollutants in water discharged from the processing of coal are suspended solids usually in the form of fine clay, black shale, and other minerals commonly associated with coal. Coal and coke are used as sources of carbon for technical reduction and energy sources in the metallurgical and power industries. The production of coke by carbonization of coal produces a waste water that is high in phenols, ammonia, and dissolved organics. Biological treatment processes appear to be very promising for the control of these pollutants.

AMIC-6574

"EFFECTS OF IMPOUNDMENT ON THE WATER QUALITY OF THE BIGHORN RIVER", Soltero, R. A., Wright, J. C., Horpestad, A. A., Water Research, Vol. 7, No. 3, March 1973, pp 343-354.

Analyses of water samples from Bighorn Lake show that the water flowing through this new impoundment on the Bighorn River has undergone certain physical and chemical changes. Turbidity was greatly reduced and most dissolved constituents lost concentration. Potassium was unchanged over 2 yr, and magnesium, sodium and sulfate diminished one year and increased the next. Nitrate was augmented in the reservoir but other nitrogen compounds suffered reduction. Photosynthetic reduction of alkalinity was not detected and the alkalinity decrease is assumed to reflect dilution. Passage through the reservoir delayed conductivity changes evident in the river above, and the mass of stored water was much more resistant to seasonal temperature changes.

INDEX TERMS: Multiple-purpose reservoirs, Water quality, Physicochemical properties, Water properties, Chemical analysis, Montana, Heavy metals, Water chemistry, Alkaline earth metals, Alkali metals, Bighorn Lake.

AMIC-6573 (Continued)

Card 2/2

INDEX TERMS: Oil, Oil wastes, Coal mine wastes, Water pollution effects, Water analysis, Gas chromatography, Mass spectrometry, Acid mine water, Brines, Waste disposal, Hydrogen sulfide, Phenols, Heavy metals, Characterization, Crude oil, Absorption spectroscopy, Refractometry, GC-mass spectrometry, Fingerprinting, Oil dispersants, Gasoline, Kerosene, Diesel fuel, Fuel oil, Asphalt, Mercaptans.

AMIC-6576

"INVESTIGATION ON THE RIVER WATER POLLUTED WITH ACIDIC HOT SPRING WATER", Ariizumi, A., Water Research, Vol. 7, No. 3, March 1973, pp 385-394.

Tamagawa hot spring in Akita Prefecture gushes hot water of 1 pH hydrochloric acid at some 140 l/s. This quantity flows into the River Tama with the result that the river has been denied use for any significant hydropower development thus far. For the purpose of mitigating the acidity of the river water, the hot spring water is carried away through channels and infiltrated into the soil of a mountainside for chemical neutralizing through seepage before flowing into the river. The following facts have been obtained by field geochemical investigation (1951-1963). The neutralization effect following the injection of hot-spring water into the soil is about 80 percent, the larger part of which effect is due to the function of dissolution of Al(3 plus); the pH values of the water in the reservoir of Yoroibata dam to be constructed downstream of the river do not exceed 5; and even in the absence of hot-spring water injection treatment there is acidity reduction due to the alkalinity of the tributary waters as well as due to the dissolution of river-bed components by the acid during seepage.

INDEX TERMS: Heated water, Thermal pollution, Hot springs, Acidic water, Water analysis, Chemical analysis, Hydrogen ion concentration, Neutralization, Geochemistry, Acidity, Calcium, Magnesium, Sodium, Potassium, Aluminum, Iron, Chlorides, Sulfates, Silica, Efficiencies, Water sampling, Discharge (water), Tama River, Tamagawa Hot Spring, Japan, Hydrochloric acid, Yoroibata Dam.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6580

"A TRANSPORT MECHANISM IN HOLLOW NYLON FIBER REVERSE OSMOSIS MEMBRANES FOR THE REMOVAL OF DDT AND ALDRIN FROM WATER", Abbron, L. A., Osburn, J. O., Water Research, Vol. 7, No. 3, March 1973, pp 461-477.

The DuPont hollow nylon fiber reverse osmosis membranes were investigated for use in the removal of DDT and Aldrin from aqueous solution. Because these membranes were developed for the demineralization of brackish waters the removal characteristics for the pesticides were compared with the removal characteristics for the ions commonly found in brackish and hard waters. These membranes rejected 85-95 percent of the brackish-producing ions. Such inorganic ions with respect to the membrane were classified as membrane-non-interacting solutes. DDT and Aldrin were classified as membrane-interacting solutes, and thus the concept of solute rejection by the membrane was different from that which had been developed for the inorganic ions.

INDEX TERMS: DDT, Aldrin, Pesticide removal, Aqueous solutions, Semipermeable membranes, Reverse osmosis, Chlorinated hydrocarbon pesticides, Membrane processes, Separation techniques, Water quality control, Infiltration, Solubility, Diffusivity, Adsorption, Pollutant identification, Physical properties.

AMIC-6585

"ORTHOPHOSPHATE DETERMINATIONS USING PREMEASURED REAGENTS", Baskett, R. C., Water and Sewage Works, Vol. 120, No. 1, January 1973, p 47.

A simple and convenient method for determining orthophosphate in water involves using a spectrophotometer, premeasured powder pillows of reagent (Murphy and Riley formula), and 5 ml water samples. The spectrophotometer is operated at a wavelength setting of 710 millimicrons. The percent transmittance can be converted to mg/l phosphate by means of a standard curve. The test has proved to be rapid and well within the established limits of accuracy for conventional orthophosphate measurements.

INDEX TERMS: Spectrophotometry, Water analysis, Accuracy, Orthophosphates.

AMIC-6583

"CONTROL OF MERCURY CONTAMINATION IN FRESHWATER SEDIMENTS", Feick, G., Johanson, E. E., Yeaple, D. S., JBF Scientific Corporation, Report No. EPA-R2-72-077, October 1972, 156 pp.

Methods for controlling the release of mercury from sediments have been developed, and the effects of dredging on the redistribution of mercury have been evaluated. A program of laboratory studies was conducted concurrently with a field survey where the extent of mercury contamination at a typical site was evaluated. Laboratory studies consisted of both partitioning and aquarium experiments using artificially contaminated sediments as well as sediments from the polluted field site. Inorganic sulfides and long-chain alkyl thiols with suitable modifications were found to be the most effective binding agents. A number of factors were identified which affect the decision to decontaminate a polluted sediment or to remove the material by dredging. If the material is to be dredged, precautions must be taken when land disposal methods are used. The field survey consisted of determining both the horizontal and vertical extent of the mercury contamination as well as pertinent hydraulic parameters. From results of the laboratory and field work, a pilot field project is described whereby techniques for controlling mercury contamination can be evaluated at a site where the field conditions have been fully established.

INDEX TERMS: Mercury, Bottom sediments, On-site investigations, Pollution abatement, Water quality control, Laboratory tests, Freshwater, Sediment discharge, Sediment control, Soil contamination, Chemical analysis, Soil analysis, Absorption, Fish, Water analysis, Methodology, Sediment treatment, Complexing agents, Partition coefficients.

AMIC-6588

"HYDROGEN PEROXIDE AIDS IN MEASURING SLUDGE OXYGEN UPTAKE RATES", Young, J. C., Baumann, E. R., Water Pollution Control Federation Highlights, Vol. 10, No. 1, January 1973, pp 4-5.

The use of hydrogen peroxide to increase DO in sludge samples allows for more meaningful measurements of oxygen uptake rates. Activated sludge mixed liquor samples were collected from an operating plant. Two to three drops of 10 percent H2O2 were added to samples placed in 300-ml BOD bottles. A calibrated DO probe was immediately inserted into the bottle and sealed. The DO indicated by the probe was allowed to decrease to about 8 to 10 mg/l before measurements were recorded. This was done so that the DO reading would be in the range used to calibrate the probe. This is also approximately the range of DO's to which the organisms normally would be accustomed. Also, the DO probe would stabilize during this initial period. Straight-line changes in DO were measured in all cases. The slope of the DO versus time line represents the rate of uptake of oxygen by the microorganisms in the sample. In all cases, the straight-line relationship extended to below 0.5 mg/l. This test procedure requires less time for analysis than does the measure of total and volatile suspended solids. It is simple, and the amount of hydrogen peroxide added is not extremely critical, so that the sources of error are minimized. Applications of this test are discussed.

INDEX TERMS: Dissolved oxygen, Activated sludge, Measurement, Methodology, Biochemical oxygen demand, Sewage bacteria, Aquatic microorganisms, Sewage sludge, Hydrogen peroxide, Absorption rates, Volatile suspended solids, Total suspended solids.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6591

"FLUORESCAMINE: A REAGENT FOR ASSAY OF AMINO ACIDS, PEPTIDES, PROTEINS, AND PRIMARY AMINES IN THE PICOMOLE RANGE", Udenfriend, S., Stein, S., Bohlen, P., et al, Science, Vol. 178, No. 4063, November 24, 1972, pp 871-872.

Fluorescamine is a new reagent for the detection of primary amines in the picomole range. Its reaction with amines is almost instantaneous at room temperature in aqueous media. The products are highly fluorescent, whereas the reagent and its degradation products are nonfluorescent. An important application has been the assay of proteins during protein purification procedures. Assays carried out manually can be used to determine 0.5 microgram of protein. With a semi-automated procedure (similar to the one for amino acid assay) and a Bio-Gel column to separate nonprotein material, as little as 0.05 microgram of protein can be assayed. Fluorescamine can be used as an amine reagent not only in aqueous solution but also in organic solvents and on solids. It has been used as a spray to detect amino acids and peptides on thin layer chromatograms. As little as 20 pmole of each can be detected. Fluorescamine yields intense fluorescence with other primary amines of biological importance. Thus, gamma-aminobutyric acid, beta-alanine, histamine, catecholamines, amphetamine, amino sugars, spermine, and spermidine also yield the characteristic fluorophore. Procedures for extracting and assaying the two polyamines in milligram quantities of tissue have been found feasible.

INDEX TERMS: Amino acids, Proteins, Peptides, Assay, Aqueous solutions, Fluorescence, Pollutant identification, Hydrogen ion concentration, Primary amines, Fluorescamine, Reagents, Organic solvents.

AMIC-6592

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

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

INDEX TERMS: Nitrites, Methodology, Water analysis, Natural streams, Pollutant identification, Chemical analysis, Spectrophotometry, Anion exchange, Reliability, Diazotization, Azo dyes, Ion exchange resins, Detection limits, Sample preparation, Absorbance, Sensitivity, Preconcentration.

AMIC-6612

"TURBULENT DIFFUSION OF OIL IN THE OCEAN", Murray, S. P., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 651-660.

On-site observations of oil slick geometries and current speeds during the Chevron spill of March, 1970, in the Gulf of Mexico have allowed a comparative evaluation of the role of large-scale turbulence (in the form of a horizontal eddy diffusivity) and surface tension effects in the spreading of oil from a continuously emitting well into a steady current. The initial outline of the slick (roughly the first 50 percent of slick length) follows the laws of expansion as predicted by Taylor's turbulent diffusion theory. The gross size and overall shape (neglecting details of outline) of this type of slick are well represented by a solution of the Fickian diffusion equations which predict approximate slick geometry as a function of current speed, horizontal eddy diffusivity, the oil discharge rate, and an empirically determined constant (the boundary concentration). Under the conditions observed the effect of surface tension seems confined to within the first few hundred meters downslick and can probably be neglected for practical purposes under moderate oil discharge rates and current speeds as low as even 5 cm/sec. (Reprinted from Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 651-660. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Oceans, Oil wells, Mathematical studies, Oil spills, Theoretical analysis, Oceans, Marine environment, Oil wastes, Eddies, Diffusivity, Equations, Water pollution sources, Dispersion, Currents (water), Turbulent diffusion, Petroleum oil, Diffusion coefficients, Surface tension theory, Taylor turbulent diffusion theory, Fickian diffusion theory.

AMIC-6613

"A pH-DEPENDENT MODEL FOR THE CHEMICAL SPECIATION OF COPPER, ZINC, CADMIUM, AND LEAD IN SEAWATER", Zirino, A., Yamamoto, S., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 661-671.

A pH-dependent model for the speciation of divalent Cu, Zn, Cd, and Pb ions in seawater was constructed with available and estimated thermodynamic stability constants and individual ion activity coefficients. This model was used to calculate the degree of interaction between each of the metal ions and the anions chloride, sulfate, bicarbonate, carbonate, and hydroxyl as a function of pH. Interactions between a cation and an anion were assumed to result only in the formation of complexes with coordination numbers of 1 to 4; polynuclear and mixed-ligand complexes were not included in the model. The calculations showed the following: All four metals are complexed to a considerable extent in seawater; with the exception of Cd, the distributions of chemical species of the metals vary greatly with changes in pH; Cu interacts primarily with hydroxyl and carbonate, Zn with hydroxyl, Pb with carbonate and chloride, and Cd with chloride; complexes with high coordination numbers (i.e. 3 and 4) are not formed to any appreciable extent in seawater. (Reprinted from Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 661-671. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Mathematical models, Cations, Anions, Heavy metals, Hydrogen ion concentration, Sea water, Model studies, Copper, Zinc, Cadmium, Lead, Chlorides, Halides, Sulfates, Bicarbonates, Carbonates, Trace elements, Distribution, Marine environment, Speciation (chemical), Complexation, Hydroxyl, Metal complexes, Ion activity, Thermodynamic stability constants.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6621

"DISSOLVED FREE AMINO ACIDS IN SOUTHERN CALIFORNIA COASTAL WATERS", Clark, M. E., Jackson, G. A., North, W. J., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 749-758.

The dissolved free amino acids (DFAA) in seawater samples from an inshore area near a large submarine sewage outfall and from an inshore area relatively remote from any major outfall were compared. Twenty samples were analyzed; all were collected from a small boat and immediately filtered on board using Millipore HA (0.45-micron) membrane filters to remove bacteria, plankton, and sediments. Precautions were taken to avoid contamination by ninhydrin-positive materials. Samples were stored on dry ice for transit to the laboratory, then frozen at minus 60 C to await analysis. Surface samples were taken directly over the side of the boat. Bottom and interstitial waters were collected by SCUBA divers using cylindrical Plexiglas containers of about 6 liters capacity. The amino acids were initially separated from salts by ligand exchange on Chelex-100 resin (BioRad) converted to the Cu-NH₃ form, and analyzed by thin-layer chromatography after complete desalting and eluting with NH₄OH. Individual amino acids were estimated by the method of Clark (1968). After two-dimensional separation and color development with ninhydrin, individual spots were identified, cut out, and eluted in 2 ml of 50 percent aqueous n-propanol. Optical densities were determined at 570 nm on a microsample spectrophotometer. Quantities of amino acids were estimated from standard curves of chromatograms of a mixture of amino acids (Cal Biochem). Subsamples (1 ml) were taken for scintillation counting at each step in the procedure, so that overall loss of amino acids at each step was known. At both sites, surface waters contained DFAA levels of about 115 micrograms/liter (ca. 1 micromole/liter), about twice the value

AMIC-6629

"DIRECTION OF DRIFT OF SURFACE OIL WITH WIND AND TIDE", Ridgway, N. W., New Zealand Journal of Marine and Freshwater Research, Vol. 6, Nos. 1 and 2, June 1972, pp 178-184.

The directions of surface oil slicks spreading from the wreck of t.e.v. Wahine during April 1968 are compared with predicted movements of surface water obtained by the vectorial addition of wind-induced surface currents and tidal currents. Wind factors of 1 percent, 2 percent, 3 percent, 4 percent, and 5 percent of recorded surface wind speeds were used to calculate wind-induced currents which were assumed to be in the same direction as the wind. The observed oil slick movements correspond best with the resultants obtained using a 3-5 percent wind factor, 60-64 percent of these falling within plus or minus 20 degrees of the observed directions of the oil slicks. Possible sources of error in the method are discussed and an example is given to illustrate how the method might be used to predict movements of surface oil resulting from an oil spillage.

INDEX TERMS: Oil spills, Movement, Wind velocity, Surface waters, Forecasting, Methodology, Currents (water), Vectorial addition.

AMIC-6621 (Continued)

Card 2/2

found in surface waters at both sites, with significantly more (290 micrograms or ca. 2.4 micromoles/liter) near an outfall than away from one (170 micrograms or ca. 1.6 micromoles/liter). Interstitial waters near the outfall contained about 350 micrograms or 3.0 micromoles DFAA/liter. The composition of the DFAA in all samples was similar to that obtained by other workers elsewhere.

INDEX TERMS: Amino acids, Outlets, Sewage effluents, Water analysis, Sea water, Pollutant identification, Water sampling, Surface waters, Hypolimnion, Scuba diving, Separation techniques, Spectrophotometry, Chemical analysis, Connate water, Coastal water, Sample preparation, Thin layer chromatography, Scintillation counting.

AMIC-6742

"MERCURY REMOVAL FROM FISH PROTEIN CONCENTRATE", Regier, L. W., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 12, December 1972, pp 1777-1779.

The potential reclamation of mercury contaminated proteinaceous food by an extraction procedure such as employed in marking fish protein concentrate was investigated. Pieces of frozen swordfish (Xiphias gladius) known to contain high levels of mercury were thawed in air at room temperature, chopped, and deboned. A portion of the deboned meat was refrozen in polyethylene bags and kept at -18 C. The remainder of the meat was used to make FPC in the pilot plant by the Halifax Isopropanol (IPA) extraction method (Power 1962). Samples were taken of the filter cake after each of the three extractions and of the product after drying. These samples, together with a sample of the deboned meat, were analyzed for mercury by the atomic absorption method (Uthe et al., 1970). Since the regular process did not remove the Hg, the complete FPC was re-extracted with alcohol acidified with HCl. The addition of hydrochloric acid to the isopropanol extractant was found to give removals as high as 93 percent from dry swordfish protein concentrate. Preliminary studies of the variables indicated acid concentration, kind of alcohol (ethanol and isopropanol), alcohol concentration, extractant volume, and number of extractions were important in the extraction.

INDEX TERMS: Mercury, Solvent extractions, Separation techniques, Methodology, Heavy metals, Alcohols, Fish, Marine fish, Fish protein concentrate, Swordfish, Halifax propanol extraction method, Organic solvents, Ethyl alcohol, Isopropyl alcohol, Biological samples, Xiphias gladius, Hydrochloric acid.

2. BIOLOGICAL METHODS

AMIC-6210

"EFFECTS OF HYDROSTATIC PRESSURE ON PHOTOSYNTHESIS AND GROWTH OF UNICELLULAR MARINE ALGAE AND DIATOMS", Berger, L. R., Hawaii University, Department of Microbiology, Honolulu, Hawaii, Final Report, Contract No. N00014-67-A-0387-0008, June 1, 1972, 41 pp. NTIS Report No. AD 742 509.

Carbon dioxide assimilation and light-dependent oxygen evolution have been measured at 25 C with a variety of algae under various conditions of light intensity, bicarbonate concentration, oxygen tension, and hydrostatic pressure. Unicellular green, and blue-green algae, diatoms, and filamentous algae have been studied. A new device which permits the measurement of oxygen evolution in closed culture at fixed oxygen tension is described. The apparatus may also be used at hydrostatic pressures up to 1000 atmospheres. It permits growth of algae in closed containers without gas phase at constant pO₂. A pressure vessel was also designed which permits enzyme kinetics to be done rapidly at increased hydrostatic pressures up to 1000 atmospheres and 40 C. The system can be brought to the desired pressure and monitored spectrophotometrically about 10 seconds after reaction components are mixed. This permits studies of enzyme kinetics at limited substrate concentrations, on a time scale commensurate with in vivo reactions.

INDEX TERMS: Marine algae, Photosynthesis, Chrysophyta, Hydrostatic pressure, Chlorophyta, Environmental effects, Growth rates, Cyanophyta, Diatoms, Water pressure, Bicarbonates, Dissolved oxygen, Instrumentation, Spectrophotometry, Kinetics, Enzymes, Chlorella, Light intensity, Primary productivity, Carbon dioxide, Absorption, Substrate concentration, Anacystis nidulans, Cricosphaera spp, Oxygen tension, Axenic cultures, Pure cultures.

AMIC-6216

"UPTAKE AND METABOLISM OF DDT AND DIELDRIN BY MARINE ALGAE", Sikka, H. C., Rice, C. P., Syracuse University Research Corporation, Life Sciences Division, Syracuse, New York, Annual Report No. 1, Contract No. N00014-72-C-0010, June 1972, 39 pp. NTIS Report No. AD 744 034.

The uptake and metabolism of DDT and dieldrin by six species of marine phytoplankton was studied. Uptake of DDT by the various species increased linearly with an increasing concentration of DDT but non-linearly with an increasing concentration of cells. The species with higher numbers of cells per unit of mass took up greater amounts of DDT per unit weight than species with lower numbers of cells. All species concentration DDT to levels many times higher than the original concentration in the medium. DDT was accumulated by the six species in the following order: Skeletonema costatum greater than Cyclotella nana greater than Isochrysis galbana greater than Olisthodiscus luteus greater than Amphidinium carteri greater than Tetraselmis chuii. All the species converted small amounts of DDT to DDE. After 24 days of treatment, the amount of DDE produced by different species ranged from 0.03-11 percent of the total DDT in the cells. Maximum conversion of DDT to DDE was observed in cultures of Tetraselmis. In addition to DDE, Skeletonema also produced a small amount of an unknown polar metabolite from DDT. Six marine algae were found to remove dieldrin from the surrounding medium in the following order: Skeletonema costatum greater than Tetraselmis chuii greater than Isochrysis galbana greater than Olisthodiscus luteus equal to Cyclotella nana greater than Amphidinium carteri. The uptake of dieldrin increased linearly with an increasing concentration of the pesticide. With an increase in cell concentration, the amount of dieldrin accumulated by the cells increased linearly in Amphidinium but non-linearly in Isochrysis, Skeletonema, Tetraselmis, Olisthodiscus, and Cyclotella. All species concentrated dieldrin to

AMIC-6216 (Continued)

Card 2/2

levels many times higher than its original concentration in the medium. None of the species was found to metabolize dieldrin.

INDEX TERMS: DDT, Metabolism, Marine algae, Bioassay, Gas chromatography, Dieldrin, Biological magnification, Bioaccumulation, Sample preparation.

AMIC-6269

"A PROXIMATE BIOLOGICAL SURVEY OF PEARL HARBOR, OAHU", Evans, E. C., II, Peeling, T. J., Murchison, A. E., Stephen-Hassard, Q. D., Naval Undersea Research and Development Center, Ocean Sciences Department, San Diego, California, Report No. NUC TP 290, June 1972, 65 pp. NTIS Report No. AD 744 233.

During the months of May and June, 1971, a biological survey of Pearl Harbor was conducted by members of the Ocean Sciences Department, NUC. The major thrust of this effort was to determine the heavy-metal (Cd, Cu, Hg, Pb, and Zn) body burdens for marine organisms characteristic of the harbor. In addition, the general aspect of piling communities in all major lochs is described and schematically illustrated, constituting the only such description for the region in nearly three decades. It was found that the body burdens of toxic metals (Cd, Hg, and Pb) in Pearl Harbor organisms (fish: Kuhlia sandvicensis, Abudefduf abdominalis, and Upeneus arge; crabs: Thalamita crenata and Podophthalmus vigil) tend to be higher near known sources of industrial effluent. Of these, two (Hg and Pb) slightly exceed concentrations normally expected in marine animals; the burdens in swimming crabs tend to be highest (0.395 ppm wet weight for Hg and 1.8 ppm wet weight for Pb). For Cu and Zn, burdens tend to be greatest near Ford Island. Again, the Cu content of some swimming crabs exceeded that normally expected in marine animals (highest burden found was 241 ppm wet weight). None of these burdens, however, is considered cause for concern. The distinct differences observed in the structure of piling communities in the various lochs, and at nearby locations suggest that many complex environmental factors are at work in Pearl Harbor. While the detrimental effects of oil exposure are evident in the intertidal communities in all lochs, the major degrading factor to the marine environment as a whole appears to be silt. Curiously, water clarity and relative marine community health are greatest in those parts of the

2. BIOLOGICAL METHODS

<p>AMIC-6269 (Continued) Card 2/2</p> <p>harbor receiving more intensive utilization by the Navy. Thus, on the basis of this proximate survey, it is by no means obvious that the Navy is the principal polluter of Pearl Harbor.</p> <p>INDEX TERMS: Cadmium, Copper, Mercury, Lead, Zinc, Fish, Crabs, Crustaceans, Absorption, Industrial wastes, Biological communities, Mollusks, Neutron activation analysis, Periphyton, Silting, Oil spills, Domestic wastes, Sediments, Chlorinated hydrocarbon pesticides, Annelids, Isopods, Amphipoda, Voltammetry, Biological samples, Bioaccumulation, Sponges, Bryozoa, Hydroids, Pelecypods, Decapoda, Chordates, Echinoderms.</p>	<p>AMIC-6277 (Continued) Card 2/2</p> <p>the biomass and the arsenic in the influent. The biota had the ability to assimilate and adsorb arsenic species in proportion to the amount available in the influent.</p> <p>INDEX TERMS: Activated sludge, Biomass, Arsenic compounds, Biota, Chemical oxygen demand, Heavy metals, Adsorption, Neutron activation analysis, Chemical analysis, Kinetics, Path of pollutants, Bioconcentration, Arsenic, Biological magnification, Assimilation, Substrate utilization, Fate of pollutants.</p>
<p>AMIC-6277</p> <p>"BIOCONCENTRATION OF ARSENIC BY ACTIVATED SLUDGE BIOMASS", Johnson, W. F., Hindin, E., <u>Water and Sewage Works</u>, Vol. 119, No. 10, October 1972, pp 95-97.</p> <p>A study was instituted at Washington State University to determine the extent to which arsenic species are removed by the activated sludge process through bioconcentration of arsenic compounds by the biota. The response of activated sludge biota to three concentration levels was investigated: (1) the background concentration or that concentration of arsenic species present in the primary settled sewage feed; (2) an arsenic fortified feed having a concentration of approximately 40 micrograms As/l; and (3) a fortified feed having a concentration of approximately 130 micrograms As/l. The influent to the aeration basin, effluent from the clarifier and the return activated sludge were sampled every other day. All samples were digested to liberate arsenic from organically bound arsenic compounds using the method described in Standard Methods. The total arsenic content of each sample was analyzed using the silver diethyldithiocarbamate method. In order to check the validity of the data using the acid digestion and silver diethyldithiocarbamate methods, a portion of every fourth sample was analyzed by neutron activation. Only the biomass samples were acid-digested prior to neutron activation analysis. The chemical oxygen demand was determined by the Acid-Dichromate method. A decrease in the chemical oxygen demand (COD) of the influent occurred during the second concentration level period because of a modification in the sewage treatment plant's operation. The activated sludge biota removed arsenic species from the influent through assimilation and adsorption. As the total arsenic concentration of the influent increased so did the quantity of arsenic in the biomass. It can be concluded that for each microgram of total arsenic per liter of influent, approximately 0.7 to 2 micrograms of total arsenic will be found per gram of dried weight biomass. A correlation exists between the concentration of total arsenic in</p>	<p>AMIC-6337</p> <p>"EFFECTS OF AN ORGANOPHOSPHORUS INSECTICIDE ON THE PHYTOPLANKTON, ZOOPLANKTON, AND INSECT POPULATIONS OF FRESH-WATER PONDS", Hurlbert, S. H., Mulla, M. S., Willson, H. R., <u>Ecological Monographs</u>, Vol. 42, No. 3, Summer 1972, pp 269-299.</p> <p>Dursban, an organophosphorus insecticide, was applied on June 3, June 18, and July 1, to eight shallow (24-cm) experimental ponds near Bakersfield, California. Four ponds were treated at 0.028 kg/ha, four were treated at 0.28 kg/ha, and four were kept as controls. Phytoplankton, zooplankton, and insect populations were sampled on 21 dates. Insect larvae and nymphs were more reduced in numbers than were insect adults. Twenty-four-hour posttreatment samples for the second and third, but not first, treatments showed greater reductions of predaceous (Notonectidae, Dytiscidae, Coenagrionidae, larval Hydrophilidae) and much slower recovery to control-pond levels than of 'herbivorous' (Corixidae, Baetidae, adult Hydrophilidae) insect populations. Initially, <u>Cyclops vernalis</u> and <u>Moira micrura</u> were the only crustacean zooplankters present, and both experienced high mortality due to treatments. Recovery in low dose ponds was variable, requiring 1-3 weeks, and in high dose ponds occurred only 3-6 week after the final treatment. Populations of <u>Diaptomus pallidus</u> seemed unaffected by the lower rate of treatment, but became large only after <u>Cyclops</u> populations had been reduced by the insecticide or other factors. <u>Ceriodaphnia</u> sp. became abundant in late July or early August in all four control ponds but not in any treated ponds. Herbivorous rotifers, principally in the genera <u>Brachionus</u>, <u>Polyarthra</u>, <u>Hexarthra</u>, <u>Filinia</u> and <u>Tripleuchlanis</u>, increased dramatically, often five- to twentyfold, within 1-3 days after <u>Moira</u> and <u>Cyclops</u> populations were decimated by Dursban, but became abundant in control ponds only during the brief absence of <u>Moira</u> in early July. All planktonic rotifers, except <u>Polyarthra</u>, were more abundant in treated than in control ponds; all</p>

2. BIOLOGICAL METHODS

<p>AMIC-6337 (Continued) Card 2/2</p> <p>benthic-littoral rotifers (e.g., <u>Lecane</u>, <u>Monostyla</u>, <u>Tripleuchlanis</u>, <u>Platylas</u>, <u>Lepadella</u>, <u>Testudinella</u>) were more abundant in control than in treated ponds. The predaceous rotifer <u>Asplanchna brightwelli</u> was 35 times more abundant in treated than in control ponds, feeding primarily on herbivorous rotifers, sometimes on <u>Cyclops</u>, <u>Diaptomus</u>, <u>Moina</u> and large algae, and rarely on small mayfly (<u>Baetidae</u>) nymphs and chironomid larvae. <u>Asplanchna</u> populations were composed of three morphotypes, ampulliform, cruciform, and campanuliform, the last of which tended to be highly cannibalistic. The reduction of herbivorous crustaceans by Dursban and the restraint of herbivorous rotifers by <u>Asplanchna</u> predation permitted the rapid increase of phytoplankton populations in treated ponds and, even 6 weeks after the last treatment, the phytoplankton was two and 16 times more abundant in low dose and high dose ponds, respectively, than in control ponds. Blooms of blue-green algae (<u>Anabaena</u>, <u>Anabaenopsis</u>) developed in three high dose and one low dose pond, and a bloom of the diatom <u>Synedra</u> developed in one low dose pond. The long-spined alga <u>Schroederia setigera</u> seemed favored by high <u>Moina</u> and <u>Diaptomus</u> populations and low <u>Cyclops</u> populations. The significance of these results for insect-control programs is discussed.</p> <p>INDEX TERMS: Phytoplankton, Zooplankton, Aquatic insects, Ponds, Water pollution effects, Phosphothiate pesticides, Pesticide toxicity, Rotifers, Crustaceans, Herbivores, Predation, Eutrophication, Benthic fauna, Sediments, Animal populations, Plant populations, Animal physiology, Mortality, Resistance, Aquatic algae, Plant physiology, Dursban, Recovery, Macroinvertebrates.</p>	<p>AMIC-6338 (Continued) Card 2/2</p> <p>Adult <u>O. sigma</u> (but not <u>B. bicaudatus</u>) undertook a definite upstream migration estimated at 2-3 km. This flight of adults resulted in a concentrated deposition of eggs in the upper reaches of the stream. The advantage of the upstream flight may be that it stores reproductive products in areas where they are relatively safe from effects of anchor ice during winter and of floods in late winter and early spring.</p> <p>INDEX TERMS: Aquatic insects, Secondary productivity, Environmental effects, Aquatic drift, Life history studies, Limiting factors, Growth rates, Spatial distribution, Migration, Mayflies, Caddisflies, Animal populations, <u>Oligophlebodes sigma</u>, <u>Baetis bicaudatus</u>, Drift organisms.</p>
<p>AMIC-6338</p> <p>"DRIFT AND PRODUCTION OF TWO AQUATIC INSECTS IN A MOUNTAIN STREAM", Pearson, W. D., Kramer, R. H., <u>Ecological Monographs</u>, Vol. 42, No. 3, Summer 1972, pp 365-385.</p> <p>The relationships between drift rates, population density, production rates, key environmental factors, and movements of adults were studied in two populations of stream insects, the caddisfly <u>Oligophlebodes sigma</u> and the mayfly <u>Baetis bicaudatus</u>. Samples of benthic invertebrates (424 total) were collected every 28 days at four stations on Temple Fork of the Logan River, Utah, from October 1967 to September 1969. Samples of drift invertebrates (181 total) were collected every 14 days at three stations on Temple Fork during the same period. During June-September a day and a night drift sample (681 total) were collected every other day. Drift rates of <u>O. sigma</u> larvae were greatest (5,987 g/year) when biomass in the benthos (2.56 g/sq m) and production (4.30 g/sq m per year) were greatest. Total production (dry weight) of <u>O. sigma</u> larvae in the stream (bottom area equals 29,487 sq m) was 89.0 kg in 1968 and 80.8 kg in 1969. Total production of <u>B. bicaudatus</u> nymphs was 41.3 kg in 1968 and 39.8 kg in 1969. Drift rates of <u>O. sigma</u> larvae were related directly to biomass in the benthos over an entire year. Drift rates of <u>O. sigma</u> and <u>B. bicaudatus</u> were not related directly to density expressed as numbers/area in the benthos. Drift rates were correlated positively and significantly (r equals 0.78 and 0.55 for day drift of <u>O. sigma</u> and <u>B. bicaudatus</u>, respectively) with density during the months of June-September for both <u>O. sigma</u> larvae and <u>B. bicaudatus</u> nymphs. Discharge, distance below the spring source of Temple Fork, and densities of competing aquatic insects were other factors of significance in the multiple-regression analyses of factors affecting drift rates of two insects. The 17 or 18 independent variables used in the multiple-regression analyses accounted for 65 percent and 55 percent of the variability in day drift rates of <u>O. sigma</u> and <u>B. bicaudatus</u>, respectively.</p>	<p>AMIC-6362</p> <p>"ANALYSIS OF INSECT TROPHIC DIVERSITY IN TWO SALT MARSH COMMUNITIES", Cameron, G. N., <u>Ecology</u>, Vol. 53, No. 1, Winter 1972, pp 58-73.</p> <p>This study analyzes trophic relationships of the insect component of two intertidal salt marsh communities dominated by <u>Salicornia pacifica</u> and <u>Spartina foliosa</u>, respectively. Seasonality of that component is determined and influence of physical microenvironmental factors on trophic diversity is assessed. Adult insect populations were monitored weekly, trophic diversity was computed, and relationships with primary production and litter accumulation were quantified. Temporal diversity trends were similar in both communities although the amplitude was slightly greater in <u>Salicornia</u>. In both communities, herbivore diversity was highest during the spring months while saprovo diversity was highest during midwinter. Predator diversity responded to both herbivore and saprovo diversity, although it was more closely tied to herbivore fluctuations in <u>Salicornia</u>. Standing crop biomass was maximum during October and litter accumulation was highest during January. Two classes of adult insects occurred: persistent species, representing a low percentage of the total species compliment, were present as adults throughout the year in both marsh communities; seasonal species, on the other hand, were present as adults only during the growing season. Seasonal succession in species of herbivores and saprovores reflected productional and transformational changes in plant matter; predators responded likewise, but more impressive was the numerical response to prey populations by particular predators. Correlations were high between each trophic group and its respective resource. Physical microenvironmental factors, especially temperature and vapor pressure deficit, seemed to be important in cuing larval development, but did not exert a dramatic effect on adult diversity trends. Several strategies of habitat utilization are considered. It is hypothesized that the</p>

2. BIOLOGICAL METHODS

AMIC-6362 (Continued)

Card 2/2

persistent and seasonal species have evolved as specialists to avoid competitive interactions and maximize resource utilization. During annual expansion of resource states, the salt marsh insect component undergoes 'species packing' wherein additional species enter the system temporarily to utilize the expanded resource base.

INDEX TERMS: Insects, Trophic level, Salt marshes, Food habits, Tidal marshes, Biological communities, Primary productivity, Biomass, Predation, Bioindicators, Intertidal areas, Herbivores, Standing crops, Systematics, Secondary productivity, Species diversity, Saprovores, *Salicornia pacifica*, *Spartina foliosa*, Seasonal variations, Macrophytes.

AMIC-6394

"PCB RESIDUES IN ATLANTIC ZOOPLANKTON", Risebrough, R. W., Vreeland, V., Harvey, G. R., Miklas, H. P., Carmignani, G. M., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 6, pp 345-355, December 1972.

The results of measurements of PCB and other chlorinated hydrocarbons are presented for zooplankton samples from the Atlantic Ocean. The samples were obtained during 3 cruises of the R/V Atlantis II of the Woods Hole Oceanographic Institution with a No. 6 mesh plankton net. Immediately after collection, the plankton was transferred to polycarbonate or glass jars and frozen. Samples were prepared for gas chromatographic analysis by extraction in hexane. Dry and lipid weight determinations were also made. PCB in the zooplankton from the stations on the continental shelf and slope ranged from 2.4 to 260 ppm, with a median value of approximately 40 ppm. Median percent lipid weight of dry weight was 3.8 percent. On a dry and wet weight basis, representative concentrations in zooplankton from the shelf and slope areas would be in the order of 1.5 ppm and 0.15 ppm, respectively. Collections from the North Atlantic contained high concentrations of PCB, ranging from 0.007 to 0.45 ppm on a wet weight basis. Residues of p,p'-DDT and p,p'-DDE were found to be in the range of less than 0.00001-0.08 ppm and 0.00007-7.0 ppm, respectively.

INDEX TERMS: Polychlorinated biphenyls, Pesticide residues, Zooplankton, Atlantic Ocean, Pollutant identification, Chemical analysis, DDT, Chlorinated hydrocarbon pesticides, Absorption, Marine animals, Insecticides, Gas chromatography, Sampling, Solvent extractions, p,p'-DDT, p,p'-DDE, Isomers, Sample preparation.

AMIC-6393

"INSECTICIDE TOLERANCES OF TWO CRAYFISH POPULATIONS (*PROCAMBARUS ACUTUS*) IN SOUTH-CENTRAL TEXAS", Albaugh, D. W., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 6, p 334-338, December 1972.

Five consecutive bioassays were carried out on *Procambarus acutus* to determine levels of tolerance to DDT, toxaphene, and methyl parathion, and to compare the tolerance of specimens from an area of intensive insecticide use with that of specimens from an area where use was minimal. Equal numbers of male and female specimens were subjected to each insecticide treatment and crayfish from both areas were tested at 3-5 concentrations of each pesticide in each bioassay. The 48-hr LC50 values for DDT, methyl parathion, and toxaphene were 2.4, 1.4, and 1.5 times greater, respectively, for animals from the area of high use than for those from the area of low insecticide use. For crayfish from the clean area, DDT and methyl parathion had similar toxicity, but the LC50 for toxaphene was more than 20 times greater.

INDEX TERMS: Bioassay, Crayfish, DDT, Resistance, Pesticide toxicity, Water pollution effects, Crustaceans, Invertebrates, Insecticides, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Phosphothioate pesticides, Aquatic animals, Texas, Toxaphene, Methyl parathion, *Procambarus acutus*, Macroinvertebrates, Decapods, Arthropods.

AMIC-6396

"MIREX RESIDUES IN WILD POPULATIONS OF THE EDIBLE RED CRAWFISH (*PROCAMBARUS CLARKI*)", Markin, G. P., Ford, J. H., Hawthorne, J. C., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 6, December 1972, pp 369-374.

Red crawfish from southcentral Louisiana were analyzed in order to determine if mirex residues in specimens from treated areas are beginning to reach those levels found to affect crawfish under laboratory conditions. Crawfish samples were washed to remove adhering materials, ground and mixed in a blender, a 50-gram subsample extracted in organic solvents, and analyzed by electron capture gas chromatography. Samples were also analyzed for DDT and its metabolites (TDE, DDE), chlordane, toxaphene, and Aroclor 1260. The level of detection was 0.01 ppm. DDT residues ranged from 0.02-0.44 ppm while mirex residues were barely detectable. PCB residues were detected in few instances and 0.11 ppm chlordane was detected in one sample. No results are given for TDE, DDE, toxaphene or Aroclor 1260. There is no real evidence that the insecticide mirex has any significant effect on crawfish populations.

INDEX TERMS: Crawfish, Pesticide residues, Crustaceans, Invertebrates, Insecticides, DDT, Gas chromatography, Chlorinated hydrocarbon pesticides, Polychlorinated biphenyls, Solvent extractions, Chemical analysis, Pesticide toxicity, Water pollution effects, TDE, DDE, Mirex, *Procambarus clarki*, Aroclor 1260, Sample preparation, Chlordane, Toxaphene, Detection limits, Arthropods, Macroinvertebrates, Decapods, Electron capture gas chromatography, Metabolites.

2. BIOLOGICAL METHODS

AMIC-6401

"HETEROTROPHIC NITRIFICATION IN SAMPLES OF NATURAL ECOSYSTEMS", Verstraete, Willy, Alexander, Martin, Environmental Science and Technology, Vol. 7, No. 1, January 1973, pp 39-42.

Since studies of axenic cultures of a nitrifying stain of *Arthrobacter* revealed that hydroxylamine, hydroxamic acid, 1-nitrosoethanol, nitrate, and nitrite were excreted, an investigation was begun to determine whether this or physiologically related species could bring about the same type of nitrification in natural environments. Products of the reaction and their persistence in samples taken from several different ecosystems were also determined. Samples (200 ml) of different aquatic environments (sewage, river water, lake water, soil) were enriched with sodium acetate and ammonium sulfate to concentrations of 3.0 mg C/ml and 1.0 N/ml and incubated on a rotary shaker (120 rpm). Hydroxylamine, 1-nitrosoethanol, nitrite, and nitrate were formed in samples of sewage, river water, lake water, and soils amended with ammonium and acetate. A carbon source was needed for the occurrence of this pattern of nitrification, which is apparently heterotrophic. Of the carbon sources tested, only acetate and succinate supported this newly described kind of nitrification. The data suggest that the active microorganisms nitrify at neutral pH values under conditions which do not promote abundant growth of other heterotrophs, but in environments that allowed luxuriant microbial proliferation, these microorganisms competed successfully and nitrified only at alkaline pH values. Hydroxylamine was rapidly inactivated in sewage and in soil, whereas 1-nitrosoethanol was quite persistent in aqueous solutions but disappeared rapidly from soil.

INDEX TERMS: Nitrification, Ecosystems, Aquatic bacteria, Aquatic environment, Nitrogen compounds, Sewage sludge, Freshwater, Enrichment, *Arthrobacter*, Heterotrophic bacteria.

AMIC-6403

"GROWTH RATE DETERMINATIONS OF THE MACROPHYTE *ULVA* IN CONTINUOUS CULTURE", Waite, T. D., Spielman, L. A., Mitchell, R., Environmental Science and Technology, Vol. 6, No. 13, December 1972, pp 1096-1100.

Continuous culture experiments were run with the benthic macrophyte *Ulva lactuca*. Using oxygen evolution as a monitor of photosynthesis and dry weight determinations for biomass synthesis, growth rates and stoichiometric growth constants were evaluated. The data showed that the ratio of oxygen production to algal mass synthesis is relatively independent of nutrient concentration and growth rate, but is affected by light intensity. The data also showed that the amount of oxygen evolved per unit of algal material was almost a factor of 10 higher than is predicted from carbohydrate synthesis. It appears that *Ulva* is capable of synthesizing compounds with carbon oxidation states of plus 1 or plus 2, thus estimates of biomass synthesis may be in error when the average algal material is assumed to be carbohydrate.

INDEX TERMS: Marine algae, Chlorophyta, Growth rates, Cultures, Plant growth, Photosynthesis, Biomass, Growth kinetics, *Ulva lactuca*, Continuous cultures, Macrophytes.

AMIC-6408

"REFLECTANCE AND TRANSMITTANCE CHARACTERISTICS OF SELECTED GREEN AND BLUE-GREEN UNIALGAE", Gramms, L. C., Boyle, W. C., Water Research, Vol. 6, No. 12, December 1972, pp 1433-1444.

An evaluation was made of the reflectance and transmittance characteristics of *Selenastrum*, *Chlorella*, *Microcystis*, and *Anabaena* in the spectral region between 0.375 and 0.8 micron. Specifically, the reflectance properties were evaluated to determine the feasibility of using selected wavelengths for differentiation between the selected green and blue-green algae. In addition, efforts were made to establish selected wavelengths and ratios which would delineate relative concentrations of the algal suspensions. Attenuation coefficients were calculated at selected wavelengths under conditions of the experiment. The effects of nutrient stress and suspended silica dioxide (SiO₂) particles on the reflectance and transmittance properties were also examined. Three of the unialgal cultures were suspended in Gorham's media and placed in front of two 40W-120V daylight fluorescent lamps; Allen's media was used for *Chlorella*. The two spectral properties were measured using a Gamma Scientific 2020 SR spectrophotometer system. Suspended solids were obtained by volumetrically filtering the algal suspensions through tared pre-dried Millipore filters and prefilter pads. Turbidity was measured and chlorophyll a and phosphorus analysis were made. It was possible to qualitatively differentiate blue-green unialgae from green unialgae by using the ratio of the reflectance at 625 and 650 nm. The value of this ratio was less than 1.0 for the blue-green algae and greater than 1.0 for the green algae. The quantitative assessment of algal concentration, based on the spectral reflectance characteristics, requires that specific calibration curves be developed in the normal range of concentration expected for each species, because of the unique spectral reflectance

AMIC-6408 (Continued)

Card 2/2

properties exhibited by each alga. The addition of SiO₂ resulted in false reflectance readings. Removal of phosphorus from the growth media resulted in a loss of chlorophyll a in the test algae. It was not possible to differentiate between the phosphorus-poor blue-green and green algae by using the ratio, 625:650 nm.

INDEX TERMS: *Chlorella*, *Anabaena*, Physical properties, Aquatic algae, Chlorophyta, Cyanophyta, Cultures, Spectrophotometry, Turbidity, Suspended solids, Chlorophyll, Phosphorus, Nutrient removal, *Selenastrum*, *Microcystis*, Reflectance, Transmittance, Culture media, Chlorophyll a, Spectral reflectance, Interference.

2. BIOLOGICAL METHODS

AMIC-6411

"REEDS CONTROL EUTROPHICATION OF BALATON LAKE", Toth, L., Water Research, Vol. 6, No. 12, December 1972, pp 1533-1539.

As part of a study on the eutrophication of Lake Balaton, information is presented on the sewage discharged from the sewage purification plants at Tihany, Balatonfured, and Keszthely into Lake Balaton directly and through stands of reed. Samples of effluent were filtered through Sartorius membrane with a pore size of 0.45 micron, and determinations were made of organic nitrogen and phosphorus. The measurements performed at Balatonfured and Tihany show that in July, i.e. in the period of small load (Balatonfured: total P equals 5.28 ppm, total N equals 30.4 ppm, Tihany: total P equals 4.50 ppm, total N equals 19.97 ppm) and in August, in the period of maximum load (Balatonfured: total P equals 6.25 ppm, total N equals 45.4 ppm) the phosphorus and nitrogen content of the sewage effluent which flows through the reeds is consumed by the organisms living there (the living coating of reed stalks, algae, bacteria, etc.) and only small amounts of it get into the lake from the side of the reeds bordering on open water (Tihany: total P equals 0.081 and 0.01 ppm, total N equals 0.81 and 0.78 ppm). With regard to lake protection two conflicting observations were made. The lake is said to be protected by the reeds only during one season, as in the autumn when the reeds die down. The materials retained by them are mixed with lake water by waveaction. On the other hand, the food materials discharged into the reeds and stabilized in the bodies of the living organisms there which are either eaten by fish or leave the water for dry land, might decrease the trophic grade of the lake. The optimal quantity of reedy areas in Lake Balaton should be determined because the reeds are important in protecting the water quality of the lake.

AMIC-6411 (Continued)

Card 2/2

INDEX TERMS: Sewage treatment, Effluents, Water pollution control, Aquatic plants, Water pollution sources, Nitrogen, Phosphorus, Eutrophication, Water quality control, Reeds, Balaton Lake, Hungary, Macrophytes.

AMIC-6416

"TOXICITY OF CHEMICALS IN PAPER FACTORY EFFLUENTS", Norup, B., Water Research, Vol. 6, No. 12, December 1972, pp 1585-1588.

Pentachlorophenol (PCP), a common toxic substance discharged from pulp and paper factories, was compared with mercuric compounds, and its effect on fish resistance was investigated at sublethal PCP-levels. Female guppies (*Lebistes reticulatus*), acclimated for at least 5 days at 24 plus or minus 0.5 C, were placed in aerated glass tanks in groups of 5-10 per mg Na-PCP. The resistance of the guppy to the sodium salt, Na-PCP, has been shown to increase after acclimation to sublethal levels (1 ppm). The mean survival time of the guppy placed in 5 ppm Na-PCP after acclimation changed significantly from 65 min to 104 min. Such resistance may lead to increased tolerance of accumulated PCP in the organism where severe metabolic distortions, delayed sexual maturity and increased mortality may result. The guppy has been shown to have the fastest reaction and the greatest tolerance among fish. It has been demonstrated by this research that PCP is as toxic to fish as the dangerous, previously used slimicides containing mercury, and less efficient as a controllant of slime organisms and that the use of PCP should be restricted in a manner similar to mercuric compounds to ensure the survival of fish life downstream from paper manufacturing processes.

INDEX TERMS: Effluents, Pulp and paper industry, Water pollution effects, Industrial wastes, Toxicity, Fish, Freshwater fish, Resistance, Bioassay, Laboratory tests, Mercury, Fish physiology, Pentachlorophenol, *Lebistes reticulatus*, Sodium pentachlorophenolate, Guppy, Slimicides, Phenols, Chlorinated hydrocarbons, Sodium pentachlorophenate, Mercury compounds, Median survival time.

AMIC-6418

"A NEW SIMPLE WATER FLOW SYSTEM FOR ACCURATE CONTINUOUS FLOW TESTS", Granmo, A., Kollberg, S. O., Water Research, Vol. 6, No. 12, December 1972, pp 1597-1599.

A new simple water flow system is described for use in tests on living organisms in which a continuous controlled flow of water must be utilized. The entire system is made of Perspex plastic. A constant water level is maintained via an overflow and the outlets consist of nozzles screwed onto threaded tubes. By screwing a tube up or down the distance changes and also the velocity of discharge. By this method it is possible to make an adjustment of up to approximately 10 per cent in the rate of flow. Other rates of flow can be obtained simply by replacing the nozzles by others with a cross-section area corresponding to the desired rate. The system can be used for rate of flow ranging from millilitres to litres, and has proved to be accurate and easy to handle. A diagram and description of construction of the water flow system are provided.

INDEX TERMS: Bioassay, Laboratory equipment, Design, Construction, Flow, Research equipment, Flow rates, Continuous flow system, Accuracy.

2. BIOLOGICAL METHODS

AMIC-6423

"QUANTIFICATION OF THE EFFECTS OF RATE OF TEMPERATURE CHANGE ON AQUATIC BIOTA", Speakman, J. N., Krenkel, P. A., Water Research, Vol. 6, No. 11, November 1972, pp 1283-1290.

Tests were conducted with bluegills to determine the effect of various rates of temperature change such as might result from heated water discharges. After acclimatization to temperatures ranging from 5-30 C, groups of ten fish were subjected to various rates of temperature rise. The test chamber consisted of a shell and tank arrangement which kept the heat transfer medium isolated from the test medium to avoid heavy metal contamination. A heat pump cooler and an immersion heater positioned inside a 3-inch pipe discharging into the shell and controlled by a proportional-integral-derivative controller provided the proper temperatures. The controller was also equipped with a cam-type programmer which allowed the programming of any rate of temperature change. The rate of temperature change at which 50 percent of the fish survived, for a given combination of acclimation and final temperatures, was defined as the median rate limit, KL sub m. Values were also obtained for 99 percent survival. The results show that rate of temperature is an important factor in the survival of bluegills subjected to rises from 5-30 C, 10-30 C, and 5-25 C and decreases from 30-5 C, 30-10 C, and 25-5 C. Lethal rates of temperature increase were at least 20 times the corresponding lethal rates for decreases, thus corroborating prior conclusions that rapidly onsetting low temperatures constitute an important threat to fish survival. The results of these tests were combined with shock and chronic data to produce a three-dimensional representation of the temperature tolerance of bluegills. The figure can be used to determine situations in which fish may encounter lethal rates of temperature change.

AMIC-6423 (Continued)

Card 2/2

INDEX TERMS: Bioassay, Thermal pollution, Sunfishes, Thermal powerplants, Laboratory equipment, Lethal limit, Control systems, Rate of temperature change, *Lepomis macrochirus*.

AMIC-6425

"THE EFFECTS OF FLUORIDE ON ESTUARINE ORGANISMS", Hemens, J., Warwick, R. J., Water Research, Vol. 6, No. 11, November 1972, pp 1301-1308.

Experiments to determine the possible effects of fluoride discharged in the effluent from an aluminum smelter on the fauna and flora of the receiving estuary in Zululand, South Africa showed no toxic effects on three species of fish (juvenile mullet, *Ambassis safga*, and *Therapon jarbua*) and two species of penaeid prawns (*Penaeus indicus* and *Penaeus monodon*) during 96 h exposure at concentrations up to 100 mg F per liter. The brown mussel *Perna perna* showed evidence of toxic effects after 5 days exposure at a concentration of 7.2 mg per liter. Long-term (72 days) exposure in recirculated outdoor laboratory estuary models without external food supply and with 2.0 percent salinity and 52 mg F per liter showed physical deterioration and increased mortality in the mullet *Mugil cephalus* and the crab *Tylosidiplax blephariskios* and the reproductive processes of the shrimp *Palaeomon pacificus* appeared to be adversely affected. Eel grass and algae grown in the models showed no evidence of fluoride accumulation but all the introduced animals accumulated fluoride, the highest concentration of 7743 microns F per g ash being reached in the mullet compared to 148.1 in the control system. It was concluded that fluoride was accumulated mainly from the water and not via the food materials.

INDEX TERMS: Bioassay, Toxicity, Fluorides, Industrial wastes, Crabs, Mulletts, Mussels, Algae, Eel grass, Prawns, Bioaccumulation.

AMIC-6426

"BACTERIAL AND ALGAL CHLOROPHYLL IN TWO SALT LAKES IN VICTORIA, AUSTRALIA", Russainy, S. U., Water Research, Vol. 6, No. 11, November 1972, pp 1361-1365.

Water samples were collected at depths of 1, 2, 3, 5, 10, and 20 m from Lake Gnotuk and at 10 m from Lake Keilambete (Australia) and analyzed for total dissolved solids, algal chlorophyll, and bacterial chlorophyll. Solids were estimated gravimetrically; algal chlorophyll was determined by filtering the sample, extracting with acetone, and recording the optical density; bacterial chlorophyll was estimated by applying a provisional equation derived by Takahashi and Ichimura to the optical density data. Total dissolved solids concentrations were 59.3 and 60.2 g per l for Lakes Keilambete and Gnotuk, respectively. The standing crops of autotrophic sulphur bacteria in terms of bacterial chlorophyll were found to be in larger quantities than algal chlorophyll a. Both at the surface and at the bottom, bacterial chlorophyll was about ten times as much as algal chlorophyll a. Their population in smaller quantities at other depths may be due to the heavy grazing by the zooplankton. It is suggested that the bacteria may be a good food source for the zooplankton. It is also suggested that the deep orange pigmentation in the Copepoda may be due to their grazing on the pink bacteria.

INDEX TERMS: Water analysis, Chlorophyll, Algae, Bacteria, Dissolved solids, Distribution patterns, Optical density, Gravimetric analysis.

2. BIOLOGICAL METHODS

AMIC- 6433

"EFFECT OF INDUSTRIAL WASTES ON OXIDATION POND PERFORMANCE", Moshe, M., Betzer, N., Kott, Y., Water Research, Vol. 6, No. 10, October 1972, pp 1165-1171.

Cadmium, copper, nickel, zinc, and hexavalent chromium ions were tested in a bench-bioassay experiment for toxicity limits and possible application to experimental oxidation ponds. Domestic sewage was placed into test tubes where predetermined concentrations of metal ions were added together with known initial concentrations of *Chlorella sorokiniana*. The test tubes were incubated under controlled illumination (1500 lx) at 29 C. Before and after incubation coliform counts (MPN) were carried out according to Standard Methods (1965). Algal counts were performed using a haemocytometer. Experimental ponds of 50-70 l volume were fed with diluted domestic sewage (BOD equal 200 mg/l). Predetermined quantities of metal salts had been previously added to give the desired concentration of metal ions in the inflowing sewage. At the final stage of the study, an aquarium of 80 l capacity was operated as experimental pond. To this pond a mixture of metal ions (Cr, Cd, Cu, Ni, and Zn) was introduced, beginning with 3 mg/l and increasing to 12 mg/l of each ion. Samples taken from the ponds were subjected to the following tests: pH, dissolved oxygen, BOD, MPN, algal count and determination of metal ion concentration. The samples were taken from the influent, effluent and bottom sludge. It was found that the metal ions are toxic, inhibiting *Chlorella* growth. However, when added at concentrations of 0.5-1.5 mg/l to influent of oxidation ponds, the ponds continued to operate normally. Higher concentrations of 3 and 6 mg/l did not affect adversely pond performance - not even a concentration of 6 mg/l of each ion (a total metal ion concentration of 30 mg/l). A mixture of 60 mg/l metal ions brought about a decrease in algal numbers and caused a sharp drop in dissolved oxygen concentration. It is believed that since high pH causes metal ions

AMIC-6433 (Continued)

Card 2/2

to precipitate, oxidation ponds operating normally above pH 8.0 will tolerate metal ions in sewage containing industrial wastes for a long time before sludge accumulation will effect pond performance.

INDEX TERMS: Bioassay, Heavy metals, Oxidation lagoons, Toxicity, Industrial wastes, Cadmium, Copper, Nickel, Zinc, Chromium, Aquatic algae, Laboratory tests, Water pollution effects, Inhibition, Growth rates, *Chlorella sorokiniana*, Pollutant effects.

AMIC-6435

"BIOLOGICAL EFFECTS AND PHYSICAL PROPERTIES IN THE MARINE ENVIRONMENT OF ALIPHATIC CHLORINATED BY-PRODUCTS FROM VINYL CHLORIDE PRODUCTION", Jernelov, A., Rosenberg, R., Jensen, S., Water Research, Vol. 6, No. 10, October 1972, pp 1181-1191.

EDC-tar, a mixture of short-chained aliphatic hydrocarbons formed as a byproduct of vinyl chloride production, has been dumped into the North and Norwegian Seas. A study was conducted to determine the behavior of some components of the EDC-tar in the marine environment. Results are presented for physical properties, biological accumulation from water and food and excretion in fish, as well as some biological effects (e.g. genetic effects and sensitivity of some organisms during different stages of their life cycle). Dumped into the sea, EDC-tar has a tendency to disperse and to adhere to particles. The accumulation in marine animals via EDC-contaminated seawater is rapid and an accumulation factor of 2900 was estimated for shrimps (*Leander adspersus*) exposed to 0.01 ppm EDC-tar for 48 h. Accumulation via water has been found to be higher than via a food chain. On the other hand, accumulation of the low molecular compounds of the EDC-tar is highest via water, whereas the high molecular compounds show the highest accumulation via a food chain. Accumulation in cod fed with EDC-contaminated shrimp was higher in liver than in muscle. Excretion was rapid when feeding was discontinued.

INDEX TERMS: Physical properties, Bioassay, Food chains, Marine environment, Water pollution effects, Animal physiology, Cytological studies, Shrimp, Mussels, Absorption, Adsorption, Animal behavior, Dispersion, Hatching, Bioaccumulation, Pollutant effects, EDC-tar, Biological effects, Excretion, Aliphatic hydrocarbons, Plaice, Cod (fish), Half-life, Barnacles, Starfish, Polychaetes.

AMIC-6436

"SOME ASPECTS OF THE QUANTITATIVE ECOLOGY OF MERCURY", Fagerstrom, T., Jernelov, A., Water Research, Vol. 6, No. 10, October 1972, pp 1193-1202.

The principal ways of transformation of mercury in aquatic ecosystem are discussed. The mercury transformations include: (1) formation of HgS, (2) conversion of HgS, (3) formation and oxidation of elementary Hg, (4) formation of complexes between divalent mercury and organic substances and the release of Hg therefrom, (5) formation of mercury-inorganic material complexes of the silica- and ferro-manganese-type, (6) release of soluble mercury from complexes, and (7) formation and degradation of methylmercury and dimethylmercury. The quantitative influences on these processes of some physico-chemical and biological factors are demonstrated from field investigations and laboratory experiments. A dynamic model for the transport of methylmercury in a simplified limnic food-chain is outlined.

INDEX TERMS: Mercury, Path of pollutants, Ecosystems, Aquatic environment, Model studies, Heavy metals, Chelation, Organic matter, Oxidation, Oxidation-reduction potential, Clay minerals, Physicochemical properties, Environmental effects, Reduction (chemical), Transformation, Organomercury compounds, Mercury compounds, Mercuric sulfide, Metal complexes, Methylmercury, Dimethylmercury, Fate of pollutants, Biotransformation, Transport.

2. BIOLOGICAL METHODS

AMIC-6439

"DIVERSITY IN SOME SOUTH AFRICAN DIATOM ASSOCIATIONS AND ITS RELATION TO WATER QUALITY", Archibald, R. E. M., Water Research, Vol. 6, No. 10, October 1972, pp 1229-1238.

Diversity in diatom associations from some South African rivers was examined in relation to water quality. Samples of diatom populations were collected by scraping the diatom film from the mud surface, rocks, and submerged vegetation. These samples were preserved in 4 percent formalin and prepared for analysis by cleaning using an acid technique described by Hustedt (1930). After cleaning, the diatom sample was spread evenly on a cover slip, dried at room temperature, and finally mounted on a slide in hyrax. The sample was then examined under oil immersion and approximately 400 diatom individuals counted, recording the species and number of individuals per species for each sample. The following diversity indices were compared: Simpson's Index, Menhinick's Index, and Margalef's Index. Diversity per individual in the sample and redundancy, as a measure of the degree of dominance of one or more species in the populations, were calculated. The simplest index in application, which was as effective as the others, was the sequential comparison index. Diversity in the diatom associations did not consistently follow water quality, and was therefore regarded as a dubious and sometimes misleading parameter of water quality. The specific composition of the communities and the autecology of the component species, particularly the dominants, still remain as the most important criteria in assessing water quality from the diatom associations.

INDEX TERMS: Diatoms, Chrysophyta, Biological communities, Plant populations, Water quality, Aquatic algae, Dominant organisms, Aquatic plants, Chemical properties,

AMIC-6439 (Continued)

Card 2/2

Species diversity, Species diversity index, Sequential comparison index, Simpson's index, Menhinick's index, Margalef's index, Redundancy, Autecology.

AMIC-6440

"RIFPLE ZOOBENTHOS IN STREAMS RECEIVING ACID MINE DRAINAGE", Koryak, M., Shapiro, M. A., Sykora, J. L., Water Research, Vol. 6, No. 10, October 1972, pp 1239-1247.

The bottom fauna of a stream polluted by acid mine drainage was studied using the standard methods of sample collecting. In localities immediately influenced by mine drainage where very low pH values and high acidities prevail, the effect of acid mine wastes on the ecology and composition of the benthic fauna is, in general, similar to the effect of organic pollution. In these areas high numbers of individuals comprised of a few species were found. In the zones of active neutralization where iron hydroxides are deposited, species diversity slightly increases but the biomass is very low. The most numerous invertebrates in the stream sections exhibiting high acidity and low pH are midge larvae, especially *Tendipes gr. riparius*. The number of insect groups present increases steadily with progressive neutralization until Crustacea (Amphipoda) and Oligochaeta appear, indicating considerable improvement in water quality. The supply of desirable benthic fish food (*Tendipes* spp.) is very high in the parts of the stream where low pH, high acidity, and high ferrous iron concentrations prevail. Unfortunately, fish cannot survive under these conditions to utilize this abundant food supply. On the other hand, in the less acidic zones where fish could possibly survive, the deposition of ferric iron drastically diminishes the total biomass of benthic organisms and therefore severely limits fish populations.

INDEX TERMS: Benthic fauna, Mine drainage, Acid streams, Invertebrates, Aquatic animals, Coals, Water pollution effects, Amphipoda, Oligochaetes, Biomass, Bioindicators, Aquatic insects, Larvae, Bottom sampling, Chemical analysis, Water analysis, Receiving waters, Macroinvertebrates.

AMIC-6446

"EFFECTS OF OXATHIIN SYSTEMIC FUNGICIDES ON VARIOUS BIOLOGICAL SYSTEMS", Mathre, D. E., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 5, November 1972, pp 311-316.

Several bacteria, a slime mold, and *Chlorella pyrenoidosa* were exposed to carboxin (5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxanilide) and its oxidized products to determine their toxic effects. In the presence of .0001 M carboxin, the following bacteria were inhibited in growth from 0.10 percent: *Proteus vulgaris*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Nocardia rubra*, *Lactobacillus casei*, and *Azotobacter chroococcum*. *Streptomyces* sp., *Sarcina lutea*, and *Mycobacterium phlei* were inhibited from 10-20 percent. The metabolism of C-14-acetate was somewhat more sensitive to .0001 M carboxin in that the release of C-1402 was inhibited by 34 percent in *P. vulgaris* and 37 percent in *S. lutea*. The development of sporangia by the slime mold *D. discoideum* was not affected by .0001 M carboxin, F831, or oxycarboxin. Metabolism of C-14-acetate by *Chlorella* cells was not inhibited by .0001 M carboxin, F831, or oxycarboxin. However, photosynthesis was inhibited by 52 percent with .0001 M carboxin but not with .0001 M F831 or oxycarboxin.

INDEX TERMS: Toxicity, Enteric bacteria, Fungicides, *Chlorella*, Growth rates, Metabolism, Molds, Photosynthesis, Carboxin, Oxycarboxin, *Proteus vulgaris*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Nocardia rubra*, *Lactobacillus casei*, *Azotobacter chroococcum*, *Streptomyces*, *Sarcina lutea*, *Mycobacterium phlei*.

2. BIOLOGICAL METHODS

<p>AMIC-6526 "PHOSPHORUS IN PRIMARY AQUATIC PLANTS", Fogg, G. E., <u>Water Research</u>, Vol. 7, Nos. 1/2, January/February 1973, pp 77-91.</p> <p>A review of the relationships between algae and phosphorus shows that many species can absorb orthophosphate from solutions containing less than 1 ppm P and, when phosphorus-deficient, most species are capable of producing powerful surface or extracellular phosphatases which enable them to obtain phosphate from a great variety of inorganic and organic phosphorus compounds, including synthetic detergents. In the presence of sufficient phosphate algal cells are able to accumulate a store of polyphosphate which suffices for several cycles of cell division in the absence of a further supply. As a result of excretion of phosphates at certain stages of the life cycle and extracellular phosphatase activity there is rapid recycling of phosphorus so that algal activity may be high even when the concentration of free phosphate in the water is low. Nor must it be forgotten that behavioral patterns may impose further complexity. There is evidence that planktonic blue-green algae possess a buoyance control mechanism operating via their gas vacuoles that may enable them to descend at night to phosphate-rich water at the bottom of the photic zone and rise nearer the surface in the morning. Because of these complications no clear relationships between the amount of algal growth and the concentration of phosphate in an aquatic environment is to be expected. Because different species have different requirements for and tolerances towards phosphate, the prevailing concentration of this ion in a water body may play an important part in determining the composition of the flora it contains. Various simple methods for determining whether phosphate is limiting the growth of algae are now available and results obtained with these, together with knowledge of the minimum phosphorus requirements of algae and estimates of the</p>	<p>AMIC-6527 "PHOSPHORUS IN MARINE ZOOPLANKTON", Corner, E. D. S., <u>Water Research</u>, Vol. 7, Nos. 1/2, January/February 1973, pp 93-110.</p> <p>In the euphotic zone, phosphorus compounds dissolved in sea water are utilized by growing plants, many of which are subsequently eaten by herbivorous zooplankton and the dietary phosphorus invested partly in growth and egg production, partly released in insoluble form as faecal pellets and partly metabolized. The fraction metabolized is excreted back into the sea water mainly as inorganic phosphate, which is again available as a nutrient for the plants. Quantitative aspects of this cyclic process are reviewed with particular reference to the Calanoid copepods, animals of central importance to the marine food web in several sea areas. The review shows that most of the studies made so far have been concerned with animals feeding on algal diets. However, it is necessary to know more about the nutrition and metabolism of carnivorous zooplankton; and there is also a need for further work on the nutritive value of detritus. Much work has been done on the percentage assimilation of dietary phosphorus by zooplankton, and the values obtained are generally high. However, there is a need for further assimilation studies using particularly large algal cells, as well as microzooplankton, as the diets; and more information is needed concerning the assimilation of different phosphorus fractions and individual phosphorus compounds present in the food. There have been several investigations of the levels of soluble phosphorus compounds excreted by zooplankton. However, the precise way in which these substances, particularly 'organic' phosphorus compounds, are released by the animals deserves more detailed investigation as does the chemical nature of these 'organic' phosphorus compounds and their possible use as nutrients by phytoplankton. The successful culturing of several species of zooplankton in the</p>
<p>AMIC-6526 (Continued) Card 2/2</p> <p>phosphorus budget, may enable predictions to be made of algal crops in a given water body.</p> <p>INDEX TERMS: Algae, Phosphates, Limiting factors, Growth rates, Absorption, Orthophosphates.</p>	<p>AMIC-6527 (Continued) Card 2/2</p> <p>laboratory will doubtless pave the way for further studies of the factors affecting the gross growth efficiency of these animals in terms of phosphorus; and the data obtained could be useful in the formulation of mathematical models related to the production of zooplankton in the sea. However, there is also a need for work of a more biochemical nature, particularly the use of artificial diets in detailed investigations of zooplankton nutrition and the development of suitable methods for studying phosphorus metabolism at the tissue and cellular level.</p> <p>INDEX TERMS: Copepods, Food habits, Food chains, Phosphorus, Absorption, Metabolism, Excretion, Calanids, Macroinvertebrates.</p>

2. BIOLOGICAL METHODS

AMIC-6528

"ROLE OF PHOSPHORUS IN EUTROPHICATION AND DIFFUSE SOURCE CONTROL", Lee, G. F., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 111-128.

Many lakes and some streams and estuaries are showing signs of excessive fertilization due to the input of aquatic plant nutrients from man-associated sources. The key element often found limiting aquatic plant populations is phosphorus. The attempt to control phosphorus input to natural waters as the overall approach for controlling excessive fertilization is technically sound and economically feasible for many natural waters. However, a much better understanding of the relationship between the phosphorus input to a lake and the excessive growths of aquatic plants within the lake must be developed. This development will require a combined biological and chemical approach toward assessing the role of phosphorus in eutrophication for a specific water body. The biological approach will use tissue content, enzymatic and kinetic uptake analysis of phosphorus limitations as well as bioassays of phosphorus availability in order to determine the limiting nutrient for a body of water. The chemical approach will utilize amounts of each of the forms of phosphorus present in the lake and the rates of interchange of phosphorus between these various forms. There will be some waters where control of phosphorus from treatment of domestic waste water input and removal of phosphorus from detergents will not result in significant improvement in water quality. This is because these waters derive their phosphorus from diffuse sources, such as urban and rural stormwater drainage, the atmosphere and ground waters. In these instances, it may be necessary to initiate in-lake control of phosphorus by the addition of alum or iron salts.

AMIC-6528 (Continued)

Card 2/2

INDEX TERMS: Eutrophication, Phosphates, Lakes, Limiting factors, Water pollution control, Bioassay, Cycling nutrients, Detergents, Algae, Arsenic, Sediments.

AMIC-6531

"THE ROLE OF PHOSPHORUS IN THE GROWTH OF CLADOPHORA", Pitcairn, C. E. R., Hawkes, H. A., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 159-171.

An examination of river survey data showed standing crops of Cladophora to be correlated with phosphorus concentration. In general, river water containing less than 1.0 mg/l total inorganic P produced only modest growths of Cladophora. Culture experiments with supplemented river water confirmed the importance of phosphorus by showing that growth of Cladophora in waters upstream of sewage discharges, could be increased to downstream levels by addition of phosphorus. Growth experiments in synthetic media containing levels of phosphorus from 1 to 7 mg/l indicated no significant growth increase above 1 mg P/l but a significant reduction below 1 mg P/l. In natural water, the maximum level of phosphorus for growth was found to vary, being 2.5 mg P/l at 3.2 mg N/l NO₃ and 0.95 mg P/l at 5.25 mg N/l NO₃. A 3 x 4 factorial experiment utilizing synthetic media, confirmed an interaction between nitrogen and phosphorus. The highest level of NO₃ (7.7 mg N/l) enhanced growth at the lowest phosphorus level (0.5 mg P/l) but at higher levels of phosphorus, growth was reduced. The importance of such interactions is discussed briefly in connection with eutrophication and nutrient stripping.

INDEX TERMS: Phosphorus, Growth rates, Bioassay, Eutrophication, Limiting factors, Water pollution effects, Nitrogen, Standing crops, Cladophora, Culture media.

AMIC-6532

"EUTROPHICATION AND LOUGH NEAGH", Wood, R. B., Gibson, C. E., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 173-187.

Comparison of biological and chemical characteristics of Lough Neagh (Ireland) with those of other lakes shows that Lough Neagh is among the most eutrophic of the world's major lakes. Phosphorus appears to be the key factor which limits the growth of algae. It is estimated that Lough Neagh receives 300 tons of P per year, 70-80 percent of which is probably from urban and industrial sewage. It is concluded that reduction of P content of effluents from sewage works could have a beneficial effect on the eutrophic condition of the lake.

INDEX TERMS: Eutrophication, Water quality, Phosphorus, Limiting factors, Diatoms, Primary productivity, Industrial wastes, Municipal wastes, Cyanophyta, Lough Neagh, Chlorophyll a, Macroinvertebrates.

2. BIOLOGICAL METHODS

AMIC-6533

"STIMULATION OF PHYTOPLANKTON GROWTH BY MIXTURES OF PHOSPHATE, NITRATE, AND ORGANIC CHELATORS", Jordan, R. A., Bender, M. E., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 189-195.

An in situ nutrient enrichment experiment was conducted in which mixed treatments of nitrate, phosphate, and EDTA were applied to natural lake phytoplankton communities. Changes in community productivity and species composition in response to the treatments revealed strong interactions among the components of the treatment mixture. On the community level, phosphate exerted a stimulatory effect that was reduced by EDTA, enhanced by nitrate, and enhanced even more by nitrate and EDTA together. Examination of 15 individual species revealed that the treatment effects were highly variable from species to species. Seven of the 15 species were stimulated by the nutrient treatments, and the growth patterns of 5 of these accounted for essentially all of the features of the productivity response patterns. The eight other species either failed to respond to any treatment or declined in response to containment or treatments. Phosphate was the key substance in all of the positive treatment effects, and its omission from the treatment mixture essentially eliminated all growth responses.

INDEX TERMS: Nitrates, Phosphates, Growth rates, Bioassay, Primary productivity, Algae, Diatoms, Crystal Lake, *Synedra nana*, *Fragilaria crotonensis*, *Synedra radians*, *Achnanthes*, *Synechocystis aquatilis*, *Rhodomonas minuta*, *Cyclotella ocellata*, *Cryptomonas ovata*, *Cyclotella stelligera*, *Pediastrum boryanum*.

AMIC-6535

"EXPERIENCE WITH ALGAL BLOOMS AND THE REMOVAL OF PHOSPHORUS FROM SEWAGE", Simmonds, M. A., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 255-264.

Based upon observations of algal blooms in water treatment plants during the period 1930-1940 when phosphate occurred primarily from natural sources, the author concludes that the mechanism which triggers algal blooms may be neither nutrient concentration nor the concentration of organic matter. Instead the pH, alkalinity, carbon dioxide equilibrium condition is a major factor, not only in promoting, but also in maintaining algal blooms. The mechanism involved is the conversion of bicarbonates to carbonates at high pH and the consequent release of carbon dioxide which is utilized by algae. He also discusses the use of algae for removing phosphates from sewage sludge. Algae were capable of removing large amounts of phosphate, but were themselves difficult to remove from the sewage.

INDEX TERMS: Algae, Hydrogen ion concentration, Alkalinity, Carbon dioxide, Limiting factors, Growth rates, Waste water treatment, Absorption, Australia.

AMIC-6549

"LOWER pH LIMIT FOR THE EXISTENCE OF BLUE-GREEN ALGAE: EVOLUTIONARY AND ECOLOGICAL IMPLICATIONS", Brock, T. D., Science, Vol. 179, No. 4072, February 2, 1973, pp 480-483.

Observations on a wide variety of acidic environments, both natural and man-made, reveal that blue-green algae (Cyanophyta) are completely absent from habitats in which the pH is less than 4 or 5, whereas eukaryotic algae flourish. By using enrichment cultures with inocula from habitats of various pH values, the absence of blue-green algae at low pH was confirmed. The ecological implications of the conclusions are clear. Blue-green algal blooms should never occur in acid lakes, and the pollution of lakes and streams with acid mine drainage should eliminate blue-green algae from these waters. Since even in mildly acidic waters (pH 5 to 6) blue-green algae are uncommon, mild acidification of lakes may control or eliminate blue-green algal blooms.

INDEX TERMS: Hydrogen ion concentration, Cyanophyta, Limiting factors, Plant growth, Cultures.

AMIC-6551

"BLUE-GREEN ALGAE: WHY THEY BECOME DOMINANT", Shapiro, J., Science, Vol. 179, No. 4071, January 26, 1973, pp 382-384.

Mixed populations of algae were subjected to a variety of treatments including high concentrations of nitrogen plus phosphorus, high concentrations of CO₂ and high or low pH (5-6) to test the hypothesis that blue-green algae become dominant because they are more efficient at obtaining CO₂ from low concentrations than green algae. The algae were put in plastic bags suspended from a raft in Lake Emily, Minnesota. Although initially the populations consisted of blue-green algae, samples subjected to CO₂ plus nutrients were dominated by green algae. Somewhat similar results occurred with lowered pH and nutrients. It appears that the addition of free CO₂ or lowering the pH make more CO₂ available to green algae and allow them to become dominant. Since green algae are more desirable than blue-greens, injection of CO₂ in lakes may be a way of controlling blue-greens where nutrient sources cannot be controlled.

INDEX TERMS: Chlorophyta, Cyanophyta, Limiting factors, Carbon dioxide, Hydrogen ion concentration Nitrogen, Phosphorus, Dominant organisms.

2. BIOLOGICAL METHODS

AMIC-6552

"DEEP-SEA BENTHIC COMMUNITY RESPIRATION: AN IN SITU STUDY AT 1850 METERS", Smith, K. L., Jr., Teal, J. M., Science, Vol. 179, No. 4070, January 19, 1973, pp 282-283.

In situ measurements of oxygen uptake, as a measure of metabolic activity, were made on undisturbed deep-sea benthic communities by placing respirometers (bell jars) at a depth of 1850 meters on the continental slope south of New England. The respirometers consisted of two capped Plexiglas cylinders which enclosed 48 sq cm of sediment. A polarographic oxygen electrode in each chamber fed a signal to a Rustak recorder housed in a glass sphere atop the unit. Each chamber was stirred by a magnetically driven stirrer. Uptake measurements were made over periods of 48-72 hours. Formalin injection was used to poison the biological oxygen demand. Additional measurements of total oxygen uptake and chemical oxygen demand were made from a research vessel using a drill rig equipped with a 2000-m drill pipe, a television camera pod, and a hook apparatus. Oxygen uptake under the bell jars ranged from 0.39-0.55 mg/sq m/hr. Values obtained from the research vehicle were 0.62 ml/sq m/hr. These values were two orders of magnitude lower than values from shallow depths. After treatment of the sediments with formalin there was no measurable chemical oxygen uptake which shows that the total uptake is biological (community respiration). It is concluded that metabolic activity of deep-sea benthic communities is low.

INDEX TERMS: Biochemical oxygen demand, Respiration, Metabolism, Benthos, Research equipment, Biological communities, Continental slope, Respirometers.

AMIC-6553

"NITROGEN FIXATION BY A BLUE-GREEN EPIPHYTE ON PELAGIC SARGASSUM", Carpenter, E. J., Science, Vol. 178, No. 4066, December 15, 1972, pp 1207-1209.

Nitrogen fixation by Dichotrix fuscicola, an epiphyte on pelagic Sargassum, was measured by acetylene reduction in May and June, 1972, in the western Sargasso Sea and the Gulf Stream. This is the first report of nitrogen fixation by a heterocyst-bearing blue-green alga in the open ocean, and also the first observation of nitrogen fixation in the genus Dichotrix. Cellular carbon/nitrogen ratios suggested that the Dichotrix was nitrogen-starved. In dense aggregations of Sargassum, such as rafts or windrows, the enrichment of surface seawater with combined nitrogen from nitrogen fixation may be pronounced.

INDEX TERMS: Nitrogen fixation, Nitrogen cycle, Dichotrix fuscicola, Sargasso Sea, Acetylene reduction.

AMIC-6556

"MARINE WASTE DISPOSAL - A COMPREHENSIVE ENVIRONMENTAL APPROACH TO PLANNING", Norris, D. P., Birke, L. E., Jr., Cockburn, R. T., Parker, D. S., Journal Water Pollution Control Federation, Vol. 45, No. 1, January 1973, pp 53-70.

The city of San Francisco undertook a comprehensive study of the marine environment (San Francisco Bay and the Pacific Ocean) to determine where and in what quantities it is feasible to dispose of the city's dry- and wet-weather wastewater effluents. The first phase of the study defined oceanographic characteristics of potential discharge sites and the fate of the discharges. This included determination of mass water movement, drift of particulate matter on the water surface, dispersion characteristics, and water characteristics by aerial photography, shipboard instrumentation, in situ equipment, and tracer studies. The second phase of the study was an ecological study which included plankton studies, benthic studies, diving studies of near-shore areas, intertidal studies, in situ bioassays with fish, static and continuous-flow bioassay with fish and macroinvertebrates, microcosm studies, stickleback blood studies, and biostimulation studies. The results of the two phases indicated that marine disposal is feasible and that the marine environment can be adequately protected by discharging chlorinated primary effluent through one or more submarine outfalls with properly designed diffuser systems. The study indicated that additional treatment is not necessary to protect the marine ecosystem.

INDEX TERMS: Bioassay, Toxicity, Pacific Ocean, Worms, Sticklebacks, Sewage, Sculpins, Sea basses, Crabs, Shrimp, Snails, Clams, Mussels, Estuaries, Dispersion, On-site studies, Plankton, Benthos, Species diversity.

AMIC-6560

"NUTRIENT STUDIES IN TEXAS IMPOUNDMENTS", Huang, V. H., Mase, J. R., Fruh, E. G., Journal Water Pollution Control Federation, Vol. 45, No. 1, January 1973, pp 105-118.

The objective of this study was to determine the limiting nutrients in two distinctly different reservoirs in Texas, Lake Livingston on the Trinity River and Lake Travis on the Colorado River. The former is laden with relatively high organic and inorganic nutrient concentrations; the other has a low nutrient loading. Phytoplankton and water quality samples were collected and returned to the laboratory for nutrient enrichment tests as well as C-14 and nitrogen fixation tests. The latter two tests were also conducted in situ. Enrichment tests were conducted with natural populations and with inoculations of Chlorella pyrenoidosa. Growth rates were determined every 2 days by optical density measurements. C-14 tests were made with scintillation counts of laboratory and in situ samples with and without added nutrients. Nitrogen fixation was determined by the acetylene reduction method. The results showed that in the high-nutrient system, nitrogen was the limiting nutrient in summer; blue-green nitrogen-fixing algae became dominant in the late summer and from laboratory tests seem to be regulated by the available phosphorus. In the low-nutrient system, nitrogen, phosphorus, or iron could limit phytoplankton growth at different times of the year. With phosphorus enrichment of this system, algae with nitrogen-fixing capabilities could develop.

INDEX TERMS: Limiting factors, Nutrients, Photosynthesis, Bioassay, On-site tests, Cyanophyta, Nitrogen fixation, Dominant organisms, Chlorophyta, Carbon, Nitrogen, Phosphorus, Iron, Growth rates, Acetylene reduction.

2. BIOLOGICAL METHODS

AMIC-6575

"CELL REPLICATION AND BIOMASS IN THE ACTIVATED SLUDGE PROCESS", Speece, R. E., Engelbrecht, R. S., Aukamp, D. R., Water Research, Vol. 7, No. 3, March 1973, pp 361-374.

Because of the inherent difficulty in enumerating cell numbers in a flocculent suspension, deoxyribonucleic acid (DNA) was chosen as an indicator of cell numbers in the activated sludge process. A direct relationship between the concentration of DNA in the sludge and plate count was found with a dispersed growth of mixed culture microorganisms. Therefore, it was assumed that a direct relationship existed between cell numbers and DNA concentration in the sludge in a flocculent suspension of mixed culture microorganisms as found in activated sludge. An increase in DNA was therefore assumed to be an indication of cell replication. An increase in biomass before an increase in DNA indicated a storage of substrate in some form and not replication of organisms. The average increase in the weight per cell was determined by dividing the weight of biomass just prior to an increase in DNA by the initial weight of organisms present. Storage was a function of the loading rate to which the organisms were acclimated. A sludge acclimated to a loading rate of 2.0 per day increased 270 percent in biomass before replication. Sludges acclimated to lower loading rates showed an extended time lag before cell replication occurred, while higher loading rates maintained the sludges in a more active state having shorter time lags before replication occurred. Increased frequency of feeding also resulted in less time before replication occurred. Replication commenced as long as 4 h after the external substrate was exhausted and the maximum biomass was reached in the F/M equal 0.4 system. Thus, in the contact stabilization process, cell replication would be expected in the stabilization tank with only substrate storage taking place in the contact tank, due to low loading rates used.

AMIC-6575 (Continued)

Card 2/2

INDEX TERMS: Activated sludge, Biomass, Microorganisms, Suspended solids, Growth kinetics, Methodology, Organic loading, Organic matter, Sewage bacteria, Bioindicators, Substrate utilization, Cell replication, Deoxyribonucleic acid, Substrates, Optical density, Nucleic acids.

AMIC-6578

"A PROPOSAL FOR THE APPLICATION OF MONOD'S MATHEMATICAL MODEL TO THE BIODEGRADATION OF MINERAL OIL IN NATURAL WATERS", Fasoli, U., Numann, W., Water Research, Vol. 7, No. 3, March 1973, pp 409-418.

This study was designed to obtain a set of results that would serve as a means of: (1) investigating the possibility of employing the formula of Monod's model in the interpretation of mineral oil biodegradation; (2) evaluating the coefficients or constants used in the formula in terms of their influence on the course of biodegradation; and (3) determining the part played by evaporation and re-oxygenation in the overall process of oil removal by comparison with the biological process, and the effect of the possible onset of anaerobic phenomena. Oil emulsions were prepared using Aghajari oil and two series of experiments were run in half-filled and in completely filled bottles. The oily water was extracted with CCl_4 , and infrared analyses and the (1958) API 733 method were used to determine hydrocarbon content; oxygen determination was made using the Winkler method; and bacterial counts were made after filtration on a Sartorius 14005 membrane containing a nutritive substrate. It can be concluded from the results that 2 mechanisms are primarily involved in forecasting natural hydrocarbon pollution phenomena: evaporation and biodegradation. Evaporation is very important in perfectly still water and may be a primary factor when mixing takes place. Biodegradation is always involved in the natural elimination of mineral oil. Monod's model gives a good approximation for the forecasting of its course, provided it is recognized that certain oil components, which are in fact oxidized much more slowly, must be treated as non-biodegradable. It seems safe to assert that anaerobic conditions will arise when initial hydrocarbons levels are around 20 ppm, except in cases where the water is already markedly oxygen-deficient and all forms of aeration are excluded.

AMIC-6578 (Continued)

Card 2/2

INDEX TERMS: Biodegradation, Evaporation, Forecasting, Water pollution, Mathematical models, Microbial degradation, Oxygen, Anaerobic conditions, Monod's model, Mineral oil, Hydrocarbons.

2. BIOLOGICAL METHODS

AMIC-6579

"UTILIZING METAL CONCENTRATION RELATIONSHIPS IN THE EASTERN OYSTER (*CRASSOSTREA VIRGINICA*) TO DETECT HEAVY METAL POLLUTION", Huggett, R. J., Bender, M. E., Stone, H. E., Water Research, Vol. 7, No. 3, March 1973, pp 451-460.

A total of 495 oysters were collected during February-May, 1971, at various sites in the Chesapeake Bay area, removed from the shell without puncturing, digested in concentrated HNO_3 , and analyzed for Cd, Cu, and Zn using atomic absorption spectrophotometry. Examination of the data showed that oysters from the same sampling location often differed in metal concentration as much as 100 percent and occasionally 300 percent. These variable concentrations are assumed to be normally distributed around some population mean, therefore the sample mean from each location should approximate the population mean. Means were used only to ascertain the areal distribution of metals in the various river systems. The means showed that a concentration gradient existed in all systems and that each metal increased in concentration as fresh water was approached. Several assumptions were made. (1) The metals (Cu, Cd, and Zn) available to oysters in non-industrialized areas are from the natural weathering of rocks. (2) The ratio of copper to zinc in the weathering rocks is relatively constant within a drainage basin. (3) Oysters accumulate a constant percentage of each element available to them. Statistical analysis of the metal concentration data showed that a linear relationship exists between Cu and Zn, and Cd levels in contaminated and uncontaminated oysters. No single concentration for an action level can be set for cadmium, copper or zinc in oysters which will definitely indicate pollution sources. However, the approach described has been proven valid in the Chesapeake Bay and may be of use elsewhere.

AMIC-6579 (Continued)

Card 2/2

INDEX TERMS: Oysters, Pollutant identification, Heavy metals, Water pollution sources, Mollusks, Invertebrates, Salinity, Sampling, Cadmium, Copper, Zinc, Least squares methods, Virginia, Industrial wastes, Chesapeake Bay, Sediments, Estuaries, Saline water-freshwater interfaces, Statistical methods, *Crassostrea virginica*, Macroinvertebrates, Atomic absorption spectrophotometry, James River, Hampton Roads, Elizabeth River, Data interpretation.

AMIC-6581

"PHYTOPLANKTON AS A BIOLOGICAL INDICATOR OF WATER QUALITY", Villegas, I., De Giner, G., Water Research, Vol. 7, No. 3, March 1973, pp 479-487.

The magnitude of ecological variations observed in the San Pedro River, Northcentral Venezuela, was studied in relation to water quality. Routine sampling and analyses were carried out over a consecutive 12-month period with samples being taken 3 times per week. The parameters measured were: coliform, fecal coliform, bacterial density, dissolved oxygen, oxygen demand, organic nitrogen, ammonia nitrogen, nitrates, nitrites, pH, detergents, and total fixed, volatile, filterable and nonfilterable residues. A qualitative and quantitative study was made of the phytoplankton oriented towards the calculation of the abundance of a group as its percentage of the total phytoplankton population from each sample (Armstrong, 1969), and phytoplankton samples were collected from the same stations and at the same time as those for examination. The membrane filter technique (Jackson and Williams, 1962) was used for enumeration and identification of the groups. The qualitative and quantitative study of phytoplankton related to non-biological values indicating pollution shows that the ecological condition of this biological group appears to bear a direct relation to the sanitary state of water. No relation was found between the mere presence of the determined species and its abundance, with the conventional indices of pollution. The use of phytoplankton as biotical community indicator of pollution has value when comprehensive ecological study is made.

INDEX TERMS: Phytoplankton, Bioindicators, Water analysis, Water quality, Biological communities, Aquatic algae, Water properties, Chemical analysis, Chrysophyta, Aquatic bacteria, Water sampling, Chlorophyta, Cyanophyta, San Pedro River, Species diversity, Species diversity index, Venezuela.

AMIC-6582

"DENITRIFICATION. STUDIES WITH LABORATORY-SCALE CONTINUOUS-FLOW UNITS", Du Toit, P. J., Davies, T. R., Water Research, Vol. 7, No. 3, March 1973, pp 489-500.

Settled domestic sewage, lactate, and methanol were all investigated as carbon sources for denitrification in different types of denitrifying units. The denitrifying units consisted of a suspended growth (SG) unit and a FC unit. The SG units were operated at a hydraulic residence time of 40 h. The stone FC unit was operated at a hydraulic residence time of 10 h. The coke FC unit was operated at different residence times to determine the minimum time required for efficient denitrification of the nitrified effluent. Samples were withdrawn, at the different sampling ports (FC units) at each stage of the experiment after at least three hydraulic residence times had elapsed. Gas samples were periodically taken for analysis by gas chromatography. The units were operated in a controlled temperature room at 20 C. General chemical analysis (COD, total- and ortho-phosphate, total- and NH_3 -nitrogen, volatile fatty acids and ABS determinations) was performed by means of a Technicon autoanalyzer. Nitrates and nitrites were analyzed by previously described methods and lactate was determined enzymatically. Settled domestic sewage is unsuitable as a carbon source for inducing denitrification, although efficient COD removals can be obtained in the system. The fact that ammonia nitrogen flows freely through this system results in poor total nitrogen removal values. Lactate is an efficient additive for achieving denitrification. Efficient removal of nitrate by lactate addition can be achieved effectively by a C:N ratio of less than 1.5:1, where N represents -NO_3 or -NO_2 nitrogen. Methanol is also suitable for inducing an acceptable rate of denitrification. The packed column type unit appears to be a very effective system for use as a denitrifying unit, particularly when packed with coke to increase the surface area. A denitrifying unit packed with

2. BIOLOGICAL METHODS

AMIC-6582 (Continued)

Card 2/2

coke and receiving methanol as hydrogen donor used in series with a bacterial disc unit appears to provide an efficient unit for use in water reclamation schemes.

INDEX TERMS: Denitrification, Methodology, Sewage, Domestic wastes, Laboratory tests, Nitrates, Nitrites, Suspended solids, Chemical oxygen demand, Ammonia, Nitrogen compounds, Gas chromatography, Alkylbenzene sulfonates, Sampling, Chemical analysis, Hydrogen ion concentration, Lactate, Methanol, Continuous flow system, Substrate utilization, Denitrifying bacteria, Orthophosphates, Fatty acids, Enzymatic techniques, Culture media, Enrichment culture.

AMIC-6586

"CORRELATION TO EVALUATE THE EFFECTS OF WASTEWATER PHOSPHORUS ON RECEIVING WATERS", Fitzgerald, G. P., Faust, S. L., Nadler, C. R., Water and Sewage Works, Vol. 120, No. 1, January 1973, pp 48155.

Algal growth tests were conducted with water from several rivers and lakes in Wisconsin to determine the amounts of available phosphorus and the effect and sources of the phosphorus. The methods used were short- and long-term bioassays for measuring available phosphorus, in situ bioassays to determine limiting or surplus phosphorus, and chemical analyses to determine soluble ortho and total phosphorus. *Cladophora* sp., *Rhizoclonium* sp., and *Selenastrum capricornutum* were used in the bioassays. The water system investigated was Lake Mendota, Lake Monona, Lake Wingra, Lake Keweenaw, Lake Kegonsa, Lake Koshkonong and their connecting and feeding rivers. The results of the bioassays and the chemical analyses were compared to ascertain their validity. The results show that soluble ortho PO_4 -P analyses correlate with bioassays for available phosphorus, and total phosphorus analyses do not correlate. This indicates that either method (bioassay or chemical ortho PO_4 -P analysis) could be used to measure the phosphorus available for the growth of algae. There was close agreement of results between the two types of bioassay: the one-day sorption-extraction test versus the long-term growth assay, even though the two methods differ greatly. However, since the growth of algae on the phosphorus in water samples is the ultimate proof of the availability of phosphorus, the longer growth tests must still be used occasionally to check on the results obtained with the short-term bioassays or chemical analyses of soluble ortho PO_4 -P. The significance of the tests are discussed with regard to the sources and effects of phosphorus in the lakes and rivers analyzed.

INDEX TERMS: Bioassay, Growth rates, Phosphates, Chemical analysis, Water pollution sources, Limiting factors, *Cladophora*, Lakes, Rivers, Orthophosphate.

AMIC-6584

"THE ROLE OF SLUDGE WORMS IN EUTROPHICATION", Brinkhurst, R. O., University of Toronto, Department of Zoology, Ontario, Canada, Report No. EPA-R3-72-004, August 1972, 68 pp.

A study was undertaken to evaluate the recovery of potential nutrients from sediment via the production of sludge worm tissue and the rate of destruction of organic matter in sediment via assimilation by worms (production plus respiration). Samples of worms in Toronto Harbour were taken according to a grid plan whereby four samples were taken at each of 43 sites with a KB corer and screened through narrow mesh screens (0.2-mm opening). The worms were selected using stereo microscopes and their dry weight determined. Standing stock data were derived from monthly core samples. Sediment analyses for caloric content, nitrogen content, and percentage of organic matter were made on samples dried at 60 C prior to analysis. Samples of worms taken with the Ekman grab and retained by a 0.5-mm pore size sieve were used in respiration studies. Growth studies were conducted using pure cultures inoculated with a stock culture of five species of bacteria. Defecation rates, caloric values, and ash-free dry weights were determined. In grossly polluted Toronto Harbour, Lake Ontario the worm population averaging 96,000 animals/sq m (18.3 g ash-free dry wt/sq m) assimilates, 1,743 kcals/sq m/yr and produces 1550 kcals/sq m/yr worm tissue. Of the total nitrogen input of 830 tons/yr, 7 tons are present in worm tissue at any one time and 113 tons may be circulated in a year. Worms feed selectively upon the bacteria in sediment. They also pump water through sediment. Large worm populations play a significant role in preventing organic matter from being deposited in an energy or material sink.

INDEX TERMS: Sludge worms, Eutrophication, Secondary productivity, Respiration, Tubificids, Nitrogen, Organic matter, Sediments, Sewage bacteria, Assimilation.

AMIC-6587

"EFFECTS OF ALUM ADDITION ON ACTIVATED SLUDGE BIOTA", Anderson, D. T., Hammer, M. J., Water and Sewage Works, Vol. 120, No. 1, January 1973, pp 63-67.

Experiments were carried out with settled municipal wastewater and soluble synthetic waste to determine the effects of alum additions on BOD removal and on sludge biota. Alum was added at ratios of aluminum to phosphorus ranging from 0 to 2.6 to 1. Both sludges contained good varieties of higher life including *Naegleria*, *Euploes*, *Epistylis*, *Vorticella microstoma*, *Tokophrya*, *Philodina*, *Trichocera*, *Euclanis*, *Sphaerotilus natans*, *Spirostomum*, and *Oikomonas*. The additions of alum did not reduce BOD removal probably because alum removes free bacteria from suspension which stimulates further bacterial growth and extraction of wastes. Higher life forms were adversely affected by alum to the extent that additions in excess of 15 mg/l per liter eliminated viable protozoa. In this case chemical flocculation appeared to replace protozoan clarification. The effects of alum on protozoan metabolism is discussed.

INDEX TERMS: Activated sludge, Biochemical oxygen demand, Toxicity, Protozoa, Alum, *Naegleria*, *Euploes*, *Epistylis*, *Tokophrya*, *Vorticella microstoma*, *Philodina*, *Trichocera*, *Euclanis*, *Sphaerotilus natans*, *Spirostomum*, *Oikomonas*.

2. BIOLOGICAL METHODS

AMIC-6590

"TEMPERATURE TOLERANCE OF PATHOGENIC AND NONPATHOGENIC FREE-LIVING AMOEBAS", Griffin, J. L., *Science*, Vol. 178, No. 4063, November 24, 1972, pp 869-870.

Within tested strains of the genera *Naegleria* and *Acanthamoeba* the ability to grow at high temperatures seems directly related to virulence, with nonvirulent strains unable to grow at normal or elevated body temperatures. Outside these genera, nonvirulent *Hartmannella* and *Tetramitus* do grow at elevated temperatures, which suggests a barrier to pathogenicity other than temperature sensitivity. The high optimal temperature of pathogenic *Naegleria* apparently explains previous difficulty in obtaining isolates from the aquatic environment.

INDEX TERMS: Human diseases, Water pollution effects, Biological properties, Heat resistance, Protozoa, Invertebrates, Aquatic animals, Human pathology, Cultures, Freshwater, Temperature, Swimming pools, Amoebas, Pathogenicity, Pollutant effects, Tissue culture, *Naegleria fowleri*, *Naegleria gruberi*, *Acanthamoeba culbertsoni*, *Acanthamoeba rhyodes*, Virulence, *Acanthamoeba polyphaga*, *Acanthamoeba castellanii*, *Acanthamoeba astronyxis*, *Acanthamoeba palestinensis*, *Hartmannella agricola*, *Tetramitus rostratus*, Environmental samples, Pollution sources.

AMIC-6599

"TOXICITY OF COPPER TO *THALASSIOSIRA PSEUDONANA* IN UNENRICHED INSHORE SEAWATER", Erickson, S. J., *Journal of Phycology*, Vol. 8, No. 4, December 1972, pp 318-323.

Toxicity of copper to *T. pseudonana* (formerly *Cyclotella nana*, clone 13-1) was examined in inshore seawater using a 96-hr bioassay method. Raw unenriched seawater was filtered through a 0.22-micron membrane filter and then pasteurized for 30 min at 60 C. Following this treatment, samples contained 0.68-1.14 micrograms Cu/liter. Copper was added as the chloride in 5-microgram increments over the range of 5 to 30 micrograms/liter (about 0.1-0.5 microM). Population densities, mean cell volume, and C-14 bicarbonate uptake were measured. Population growth and C-14 uptake by *T. pseudonana* displayed inhibition over the entire range of added copper. Growth rate constant (K) to *T. pseudonana* decreased with increasing copper concentration and during the course of growth at each concentration. Correspondingly, mean cell volumes increased with copper concentration and time. Copper toxicity varied in different water samples. The presence of decomposed natural plankton and detritus decreased toxicity. In the absence of enrichment, bacteria had little effect on copper toxicity. Results were influenced by glassware treatment, collection and storage of seawater, and absence of enrichments.

INDEX TERMS: Toxicity, Copper, Water pollution effects, Diatoms, Bioassay, Heavy metals, Marine algae, Chrysophyta, Sea water, Growth rates, Absorption, Carbon radioisotopes, Water sampling, Water storage, Bacteria, Salinity, Hydrogen ion concentration, Tides, *Thalassiosira pseudonana*, *Cyclotella nana*, C-14, Population density, Enrichment.

AMIC-6598

"*THALASSIOSIRA ECCENTRICA* (EHRENB.) CLEVE, *T. SYMMETRICA* SP. NOV., AND SOME RELATED CENTRIC DIATOMS", Fryxell, G. A., Hasle, G. R., *Journal of Phycology*, Vol. 8, No. 4, December 1972, pp 297-317.

Examination of original material from the Ehrenberg collection plus clonal cultures from the Gulf of Mexico and net hauls from widely separated stations in the world's oceans confirms that *Coscinodiscus eccentricus* is correctly placed as *Thalassiosira eccentrica* (Ehremb.) Cleve. A closely related species, *T. symmetrica*, is described, with the main differences being found in the valve processes and distribution patterns. The former species is more abundant in the inshore waters; the latter has been found in oceanic waters. Comparisons are drawn between these 2 species, *T. mendiolana* and *Planktoniella sol*.

INDEX TERMS: Marine algae, Diatoms, Systematics, Ecological distribution, Phytoplankton, Chrysophyta, Gulf of Mexico, Distribution patterns, Cultures, Electron microscopy, Atlantic Ocean, Pacific Ocean, Indian Ocean, Water sampling, Speciation, *Thalassiosira eccentrica*, *Thalassiosira symmetrica*, Clones, Scanning electron microscopy, Light microscopy, Transmission electron microscopy, *Thalassiosira mendiolana*, *Planktoniella sol*, *Coscinodiscus eccentricus*.

AMIC-6600

"THE RELATIONSHIP OF LIGHT, TEMPERATURE, AND CURRENT TO THE SEASONAL DISTRIBUTION OF *BATRACHOSPERMUM* (RHODOPHYTA)", Rider, D. E., Wagner, R. H., *Journal of Phycology*, Vol. 8, No. 4, December 1972, pp 323-331.

Batrachospermum vagum and *B. moniliforme*, collected in a dark-water and a clear-water stream, respectively, were studied in order to elucidate species variation, growth phenomena, and the rates and causes of disintegration. To permit manipulation of environmental factors and simulate the natural habitat of *Batrachospermum*, a series of chambers was designed and constructed which allowed water in a trough to flow from one compartment to the other at a rate that could be adjusted by changing the slope of the trough. The water used in the system, transported from Black Moshannon Spring, was chosen because of its transparency. Carbon dioxide levels were maintained by filling an inverted 2-liter Erlenmeyer flask with pure CO₂ once or twice a day and allowing it to diffuse slowly through the water. Chemical characteristics of the water (CO₂, pH, iron, hardness, and sulfate) determined, using a Bach kit, after 3 weeks of running the water system with algal samples in it, remained unchanged. Light intensity was varied by raising or lowering lights above the chambers; readings were taken with a YSI-Kettering Model 65 Radiometer and a Weston Model 756 Sunlight Illumination Meter. Samples of *B. vagum* and *B. moniliforme* were maintained simultaneously in the trough under constant illumination for periods of 2 or 3 weeks. Chlorophyll was extracted from each sample after complete dehydration. All washes but one were made with methanol and the resulting lump of material was ground with mortar and pestle using MeOH until the wash was colorless and the cell remains were brown. Chlorophyll absorption and the concentration of Chl a were determined using data obtained with the Beckman DB recording spectrophotometer. Observations of the 2 growth sites and the laboratory experiments performed on

2. BIOLOGICAL METHODS

<p>AMIC-6600 (Continued) Card 2/2</p> <p><u>B. vagum</u> and <u>B. moniliforme</u> indicate that <u>B. moniliforme</u> is better suited to higher intensity illumination than is <u>B. vagum</u>. Without the protection of dark water, the <u>B. moniliforme</u> disintegrated under the high light intensities of summer. In the laboratory, <u>B. moniliforme</u> retained a healthy macroscopic condition over a full range of light-intensity treatments; above 250 ft-c <u>B. vagum</u> was increasingly disintegrated. It was found that within the limitations caused by water depth, current velocity can become limiting to the growth of <u>B. vagum</u>. Although the evidence for environmental factors affecting the growth of <u>B. moniliforme</u> in Smay's Run is less extensive, light intensity and current velocity in this site also appear to interact to control the growth pattern of the algae.</p> <p>INDEX TERMS: Limiting factors, Ecological distribution, Rhodophyta, Laboratory tests, On-site investigations, Environmental effects, Light intensity, Water temperature, Aquatic algae, Seasonal, Currents (water), Separation techniques, Water analysis, Growth rates, Degradation (decomposition), Batrachospermum vagum, Batrachospermum moniliforme, Chlorophyll a.</p>	<p>AMIC-6602</p> <p>"THE EFFECT OF GROWTH ILLUMINATION ON THE PIGMENTATION OF A MARINE DINOFLAGELLATE", Mandelli, E. F., <u>Journal of Phycology</u>, Vol. 8, No. 4, December 1972, pp 367-369.</p> <p>Variations in pigment concentration, especially within the carotenoid pigment system, were investigated in the marine dinoflagellate <u>Amphidinium klebsii</u> in relation to light intensity. Cultures of the dinoflagellate were grown in Guillard's medium 'f' under constant temperature and light intensities of 0.003, 0.032, 0.051, and 0.129 ly/min. Day-night conditions were simulated by alternating 12-hr periods of light and darkness. Cultures were harvested during the light photoperiod at mid-log growth phase; cell densities were determined using a hemacytometer. The pigments were extracted using 90 percent acetone, separated using diethyl ether, hydrated, and spotted on silica gel G. The developing solvent contained petroleum ether, ethyl acetate, and diethylamine (58:30:12v/v). Estimation of pigment concentration and identification of carotenoid pigments by determining absorption spectra in various solvents were carried out using a Beckman spectrophotometer. <u>Amphidinium klebsii</u> cultures grown under different light intensities exhibited similar chlorophyll a content per cell. Among the accessory pigments, chlorophyll c concentration decreased slightly in cells exposed to increasingly light intensities up to 0.129 ly/min. The concentration of the 2 major xanthophylls present in <u>A. klebsii</u> cells--peridinin and diadinoxanthin--however, varied according to the light background of the cells. Some biochemical pathways in the formation of peridinin in dinoflagellates are discussed.</p> <p>INDEX TERMS: Dinoflagellates, Light intensity, Plant pigments, Environmental effects, Pyrrophyta, Marine algae, Protozoa, Solvent extractions, Amphidinium klebsii, Chlorophyll a, Chlorophyll c, Carotenoids, Peridinin, Diadinoxanthin, Biosynthesis, Absorption spectra, Infrared spectra.</p>
<p>AMIC-6601</p> <p>"GROWTH AND EXCRETION IN PLANKTONIC ALGAE AND BACTERIA", Malewajko, C., Lean, D. R. S., <u>Journal of Phycology</u>, Vol. 8, No. 4, December 1972, pp 361-366.</p> <p>In short-term experiments using cultures of <u>Chlorella pyrenoidosa</u>, <u>Anabaena flos-aquae</u>, <u>Asterionella formosa</u>, and <u>Navicula pelliculosa</u>, both the proportion of photosynthetic products released from cells and the composition of these products altered with age. In the first 3 species, percentage extracellular release values increased with increasing growth rates, but the reverse trend was shown by <u>Navicula</u>. Fractionation of filtrates using Sephadex indicated that, in general, larger molecular weight compounds became predominant as cultures aged. Also a time-dependent shift in a similar direction occurred in cultures of all ages. In several lakes a predominance of large molecular weight compounds was apparent in filtrates even from short-term experiments. Filtrates of mixed cultures of planktonic bacteria growing on C-14 glycolate were found to contain large molecular weight organic compounds. It was demonstrated that in nonaxenic cultures of algae and in lake water, bacteria utilize low molecular weight extracellular metabolites of algae origin and larger molecular weight compounds are formed.</p> <p>INDEX TERMS: Aquatic bacteria, Aquatic algae, Photosynthesis, Growth rates, Primary productivity, Radioactivity techniques, Excretion, Metabolites, Chlorella pyrenoidosa, Navicula pelliculosa, Anabaena flos-aquae, Asterionella formosa, Substrate utilization, Glycolate, C-14, Release rates, Chemical composition.</p>	<p>AMIC-6603</p> <p>"THE UPTAKE OF GLUCOSE BY CHLAMYDOMONAS SP.", Bennett, M. E., Hobbie, J. E., <u>Journal of Phycology</u>, Vol. 8, No. 4, December 1972, pp 392-398.</p> <p>The glucose uptake of a species of <u>Chlamydomonas</u> was studied at various concentrations of D-glucose plus glucose-1-C-14 (0.003-10.0 mg/liter) and at various light levels (0-220 ft-c). The alga grows at 4 C either in the light or in the dark with added glucose, cellobiose, maltose, or fructose. Uptake of glucose could be described by the Michaelis-Menten equation, and both the maximum velocity of uptake and the half-saturation constant increased when the cells were exposed to glucose in the dark. However, the high value of the half-saturation constant (5 mg glucose/liter) compared with the low levels of glucose in nature (5-10 micrograms/liter) makes it unlikely that a transport system is effective under natural conditions. Even if a total of 10.0 mg/liter of glucose plus other organic compounds were available as substrate, the rate of photosynthesis would still be more than 10 times higher (at 220 ft-c) than the rate of organic substrate uptake. Light had no effect on the total uptake of glucose but did reduce the percentage of C-1402 evolved from 61 percent of the total C-14 taken up in the dark to 0 percent at 220 ft-c. This decrease could be due to either preferential use of the C-1402 in photosynthesis or of the photosynthate in respiration.</p> <p>INDEX TERMS: Absorption, Chlamydomonas, Aquatic algae, Velocity, Organic compounds, Carbohydrates, Phytoplankton, Protozoa, Invertebrates, Aquatic animals, Light intensity, Photosynthesis, Primary productivity, Path of pollutants, Radioactivity techniques, Carbon radioisotopes, Heterotrophy, Glucose, Substrate utilization, Cellobiose, Maltose, Fructose, Substrate concentration, C-14.</p>

2. BIOLOGICAL METHODS

AMIC-6604

"INHIBITION OF PHOTOSYNTHESIS IN ALGAE BY DIMETHYL SULFOXIDE", Cheng, K. H., Grodzinski, B., Colman, B., Journal of Phycology, Vol. 8, No. 4, December 1972, pp 399-400.

Bacteria-free cultures of the blue-green algae Oscillatoria sp., Anabaena flos-aquae, and Anacystis nidulans were grown and harvested according to a previously described method, and Chlorella pyrenoidosa was grown on the Watt and Fogg medium (1966) and harvested as were the blue-greens. The rate of photosynthesis was determined at 30 C by measuring O₂ evolution with a Gilson differential respirometer fitted with photoflood lamps which gave a light intensity of 10 klux at the flask level, and by measuring the incorporation of C-14 from C-14-bicarbonate under the same conditions. Cells were suspended in 2.7 ml of 0.01 M phosphate buffer, pH 8, containing 35 micromoles NaHCO₃ and O₂ evolution was measured for 30 min. Dimethyl sulfoxide (DMSO), a polar solvent which increases the permeability of cell membranes, of the appropriate concentration was added and O₂ evolution measured for an additional 30 min, at which time 0.1 ml of C-14-sodium bicarbonate (0.6 microCi) was added and O₂ evolution measured for an additional 30 min. A sample (100 microliters) of cell suspension was removed and C-14-incorporation determined. DMSO at concentrations above one percent inhibited photosynthetic oxygen evolution and C-14O₂ fixation by all 4 species of algae.

INDEX TERMS: Photosynthesis, Water pollution effects, Aquatic algae, Photosynthetic oxygen, Inhibition, Plant physiology, Laboratory tests, Bioassay, Plant physiology, Chlorophyta, Cyanophyta, Radioactivity techniques, Carbon radio-isotopes, Cultures, Dimethyl sulfoxide, Pollutant effects, Oscillatoria, Anabaena flos-aquae, Anacystis nidulans, Chlorella pyrenoidosa, Organic solvents, C-14.

AMIC-6614

"NITROGEN FIXATION IN CLEAR LAKE, CALIFORNIA. I. SEASONAL VARIATION AND THE ROLE OF HETEROCYSTS", Horne, A. J., Goldman, C. R., Limnology and Oceanology, Vol. 17, No. 5, September 1972, pp 678-692.

Details are given of more than 2200 acetylene reduction measurements of aquatic N₂ fixation for a 7-month period and their relationship to a correspondingly large number of measurements of other relevant physical and chemical variables. Samples were taken at 0.5- or 1.0-m intervals throughout the water column with a Van Dorn bottle. Samples from each depth were pooled to give a representative sample of the whole basin at that depth. Acetylene reduction was measured essentially by the original technique of Stewart et al. (1967). The main modifications were the exclusive use of unconcentrated phytoplankton samples, larger bottles (60 ml here) and in situ incubation (Horne 1969). Gas samples were analyzed for ethylene by GLC. Daily and hourly rates of reduction were calculated; algae, and heterocysts and cells were counted using a microscopic technique. Heterocysts were expressed either as a percentage of the total number of vegetative cells per species or as the total heterocyst numbers in the entire water column. Spectrophotometric determinations of nitrate, ammonia, and chlorophyll *a* were made; total-P and PO₄-P were estimated colorimetrically. Carbon fixation was measured using the C-14 technique, and total-N using a standard micro-Kjeldahl method. The nitrogen budget was calculated from regular measurements of the nitrogen content of the inflowing and outflowing streams and rainfall, including storm periods. The amount of nitrogen deposited in the sediments was found by direct measurement. Denitrification was estimated from changes in lake nitrogen when conditions were suitable for denitrification. The annual contribution of N₂ fixation to Clear Lake in 1970 was about 550 tonnes, 500 Mg (megagrams) or 18 kg/ha, 43 percent of the lake's yearly nitrogen inflow. Biological N₂ fixation is implicated as the main cause of large algal nuisance

AMIC-6614 (Continued)

Card 2/2

blooms on this lake. A sustained spring peak of fixation was associated with a simultaneous bloom of Aphanizomenon flos-aquae in all three basins, an autumn peak with an ephemeral bloom of Anabaena circinalis occurring at a different time in each basin. A stepwise multiple regression analysis showed that fluctuations in N₂ fixation were best described by variations in heterocysts, quantities of blue-green algae, PO₄-P, NO₃-N, and temperature. Annual rates of N₂ fixation were correlated with the proportion of heterocysts in Anabaena. Previous nitrogen budgets for Clear Lake have shown a large excess of nitrogen in outflow over inflow, which is accounted for by the levels of N₂ fixation measured.

INDEX TERMS: Eutrophication, Nitrogen fixation, Nitrogen cycle, Energy budget, Path of pollutants, Nitrates, Ammonia, Phosphates, Phosphorus, Cyanophyta, Aquatic algae, Phytoplankton, Primary productivity, Cycling nutrients, Methodology, Chemical analysis, Acetylene reduction, Heterocysts, Seasonal variation, Clear Lake, Ethylene.

AMIC-6615

"NITROGEN FIXATION IN CLEAR LAKE, CALIFORNIA. II. SYNOPTIC STUDIES ON THE AUTUMN ANABAENA BLOOM", Horne, A. J., Dillard, J. E., Fujita, D. K., Goldman, C. R., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 693-703.

Nitrogen fixation at three stages of an autumnal bloom of Anabaena circinalis was measured after almost simultaneous collection at up to 32 stations in Clear Lake and algal heterocysts, phytoplankton cell numbers, NO₃-N, NH₄-N, dissolved organic-N, PO₄-P, Fe, primary production, particulate carbon, and chlorophyll *a* were also measured. Nitrogen fixation was significantly and positively correlated to Anabaena heterocyst numbers (P greater 0.0001), negatively correlated to NO₃-N (P greater 0.01), and positively correlated to dissolved organic-N (P greater 0.01) and PO₄-P (P greater 0.05). A negative correlation with NH₄ is probable; no significant relationship was found with the other variables measured. An explanation of the apparent restriction of substantial cyanophycean N₂ fixation to nonoligotrophic waters is proposed. The results are consistent with the theory that heterocysts are responsible for N₂ fixation in situ under oxic conditions. (Reprinted from Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 693-703. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Nitrogen fixation, Eutrophication, Seasonal, Aquatic algae, Cyanophyta, Primary productivity, Nitrogen cycle, Cycling nutrients, Water pollution effects, Anabaena circinalis, Heterocysts, Clear Lake.

2. BIOLOGICAL METHODS

AMIC-6620

"THE UPTAKE OF UREA BY NATURAL POPULATIONS OF MARINE PHYTOPLANKTON", McCarthy, J. J., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 738-748.

Nitrogen-15 isotopes were used to study the uptake of nitrate, ammonium, and urea by natural phytoplankton populations in 36 samples collected at nine stations off the coast of southern California. Samples for measurement of nitrate, ammonium, and urea productivity and for chemical analyses were collected with a 50-liter PVC sampler or an 8-liter Van Dorn bottle from depths corresponding to the 87, 43, 20, 7, 4, and 1 percent surface light intensity as determined by either a submarine photometer or a Secchi disk. Subsamples were filtered through 183-micron nylon mesh to remove the larger zooplankton and were then used to fill 4-liter Pyrex bottles covered with neutral density filters calibrated to simulate the light level at the depth from which the samples were collected. Additions of the N-15-labeled compounds were made to different bottles from each sample; the bottles were plugged with silicone rubber stoppers and placed under natural light in Plexiglas incubators on the deck of the research vessel. The bottles were shaken every few hours and after 24 hr the contents were filtered, the particulate samples desiccated under partial vacuum over silica gel, combusted in a Coleman nitrogen analyzer, and the gaseous product swept into a glass vacuum system. A single beam Nier sector-type mass spectrometer was used to determine the N-15:N-14 ratio of each sample. Portions of sea water samples were analyzed for nitrate, ammonium, urea, particulate nitrogen, and carbon productivity. The percentage of the total phytoplankton nitrogen productivity accounted for by urea varied from less than 1 percent to greater than 60 percent and for the entire study averaged 28 percent. The percentage of total available nitrogenous nutrient (ambient nitrate, ammonium, and urea plus the N-15 additions) utilized per day varied among the stations from a minimum

AMIC-6620 (Continued)

Card 2/2

of 5 percent at station 4 (12 km off San Diego) to a maximum of 46 percent at station 19 (off White Point). The average C:N uptake ratio was 12.4.

INDEX TERMS: Absorption, Marine algae, Phytoplankton, Ureas, Radioactivity techniques, Primary productivity, Nitrates, Carbon, Chemical analysis, Sea water, Secondary productivity, On board analysis, Ammonium.

AMIC-6623

"COPEPODS OF MARINE AFFINITIES FROM MOUNTAIN LAKES OF WESTERN NORTH AMERICA", Wilson, M. S., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 762-763.

Occurrences of *Limnocalanus macrurus*, *Senecella calanoides*, a variation of *Mesochra rapiens* and *Huntemannia lacustris*, all copepods either euryhaline or related to marine forms, are recorded from lakes in the Cascade and Rocky Mountains, western North America. (Reprinted from Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 762-763. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Copepods, Salt tolerance, Lakes, Crustaceans, Invertebrates, Aquatic animals, Zooplankton, Deep water, Systematics, Euryhaline, *Limnocalanus macrurus*, *Senecella calanoides*, *Mesochra rapiens*, *Huntemannia lacustris*, Macroinvertebrates, Harpacticoids, Bear Lake, Arthropods, Waterton Lake, Cedar Lake.

AMIC-6627

"PREPARATION OF MEMBRANE FILTER SAMPLES FOR DIRECT EXAMINATION WITH AN ELECTRON MICROSCOPE", Harris, J. E., McKee, T. R., Wilson, R. C., Jr., Limnology and Oceanography, Vol. 17, No. 5, September 1972, pp 784-787.

A simple apparatus is described for transferring samples of suspended matter collected on Millipore filters to specimen grids for examination with an electron microscope. The apparatus is made from glassware available in most laboratories and is relatively inexpensive. Samples of suspended matter prepared with this method have been used to obtain the particle size distribution and shapes for particles between 5 and 0.05 microns. The distribution of coccoliths and other nanoorganism remains in the water column of the Gulf of Mexico are being studied. Clay minerals have been studied and successfully identified using selected area electron diffraction on samples prepared with this apparatus. This method should also be useful in preparing samples for light microscopy.

INDEX TERMS: Membrane filters, Sample preparation, Cellulose membranes, Particulate matter, Electron microscopy, Laboratory equipment, Distribution patterns, Aquatic microorganisms, Clay minerals.

2. BIOLOGICAL METHODS

AMIC-6628

"FRESHWATER HARPACTICOID COPEPODS OF NEW ZEALAND", Lewis, M. H., New Zealand Journal of Marine and Freshwater Research, Vol. 6, Nos. 1 and 2, June 1972, p 23-47.

Seven species of Attheyella and two of Elaphoidella are discussed. The original descriptions of A. brehmi (Chappuis, 1929) and A. maorica (Brehm, 1928) are revised and five new species described: two from each of the subgenera Delachauxiella and Chappusiella and a semi-terrestrial species of Elaphoidella.

INDEX TERMS: Copepods, Crustaceans, Aquatic animals, Systematics, Invertebrates, Ecological distribution, Habitats, Mosses, Peat, Harpacticoids, Speciation.

AMIC-6706

"TEMPERATURE FLUCTUATIONS WITHIN ENGLISH LOWLAND PONDS", Martin, N. A., Hydrobiologia, Vol. 40, No. 4, December 15, 1972, pp 455-470.

Continuous records were made, for almost two years, of the water temperatures in two ponds in Leicestershire, England. The number of degree-hours and the weekly and monthly mean temperatures were calculated. The water temperature in the ponds and the factors influencing the temperatures were very different in the winter and summer. In the winter the water temperature was fairly uniform, only fluctuating slightly, and was influenced mainly by the air temperature. In the summer the water temperature was very variable within a pond and was mainly influenced by the amount of sunshine received. The range of temperature fluctuation and rate of change within a pond varied inversely with the depth of water, water cloudiness and the amount of plant growth. These internal factors had greatest effects in the summer when the influence of the sun was greatest. The effect of temperature on pond water animals is briefly discussed.

INDEX TERMS: Water temperature, Fluctuations, Aquatic animals, Farm ponds, Thermal stress, Seasonal, Depth, Pondweeds, Aquatic plants, Aquatic algae, Aquatic insects, Amphibians, Newts, England, Thermographs, Potamogeton natans, Callitriche, Glyceria fluitans, Juncus articulatus, Juncus inflexus, Phalaris arundinacea, Sigara nigrolineata, Triturus vulgaris, Notonecta maculeata, Bugs.

AMIC-6631

"DEVICE FOR DETECTING AND MEASURING ACTIVITY OF LARGE MARINE CRUSTACEANS", Coombs, R. F., New Zealand Journal of Marine and Freshwater Research, Vol. 6, Nos. 1 and 2, June 1972, pp 194-205.

A device is described for detecting and measuring the locomotor activity of large marine crustaceans in captivity. The device consists of two electrodes: one of stainless steel, which acts as a sensing surface, and the other of aluminum immersed in a tank containing sea water. The sensor is essentially a simple galvanic cell, of which the electrolyte is the sea water in which the animal is maintained. When the cell circuit is initially closed a current flows which rapidly decreases as the cell polarizes mainly because of a build-up of hydrogen gas on the cathode. Any disturbance in the water displaces gas and the current produced by the cell increases. The activity sensor described was devised to record the activity of the spiny lobster Jasus edwardsii, and operates by detecting movements in the water and by contact of the animal with a sensing surface. It is effective in a large tank, and may be built at modest cost. It can, however, be used only for marine animals. A punched-tape recording system used with this device is also described.

INDEX TERMS: Crustaceans, Marine animals, Laboratory equipment, Measurement, Locomotor activity, Sensors, Macroinvertebrates, Detectors.

AMIC-6708

"ON THE CHANGES IN THE STRUCTURE OF TWO ALGAL POPULATIONS: SPECIES DIVERSITY AND STABILITY", Symons, F., Hydrobiologia, Vol. 40, No. 4, December 15, 1972, pp 499-502.

Two algal populations sampled in the same pond were compared and two assumptions were made: (1) When comparing two sample places in the same pond, the one taken nearer to the water edge will show a more diversified population structure. (2) The population taken nearer to the water edge having a more diversified population structure will be more self-regulatory than the one taken from the open water. For each of those two assumptions a quantitative measure was proposed. The calculated coefficients did seem to confirm the assumptions.

INDEX TERMS: Aquatic algae, Plant populations, Stability, Aquatic plants, Diatoms, Chrysophyta, Chlorophyta, Mathematical studies, Species diversity.

2. BIOLOGICAL METHODS

AMIC-6709

"LIMNOLOGICAL INVESTIGATIONS IN THE AREA OF ANVERS ISLAND, ANTARCTICA", Samsel, G. L., Jr., Parker, B. C., *Hydrobiologia*, Vol. 40, No. 4, December 15, 1972, pp 505-511.

Comparisons were made of primary productivity, physical features, and chemical and biological composition of two small lakes possessing different 'trophic states' during January, 1970 at Anvers Island, Antarctica. Measurements were made of radiation, water temperature, pH, primary productivity via a C-14 technique, extractable chlorophyll, and carbon fixation. Both lakes, less than 500 meters apart, had partial ice cover the entire season and were underlain with a similar silica-rich granite. Striking dissolved chemical differences were chloride (7.5 and 35.0), ammonium-N (0.1 and 2.5), and total phosphate-P (0.03 and 1.7 mg/l), respectively, for lake nos. 1 and 2. Extractable total chlorophyll in subsurface water ranged from 15-41 mg/sq m in lake no. 1 and 35-112 mg/cu m in lake no. 2 during the three week study period. Ranges in net photosynthesis were 0.78-3.5 (Lake no. 1) and 9.0-72.0 mgC/sq m/hr (Lake no. 2). Diel ranges for chlorophyll and carbon fixation also fell within these values. It is hypothesized that enrichment of lake no. 2 with phosphate-P and ammonium-N may account for its higher 'trophic state'.

INDEX TERMS: Limnology, Aquatic algae, Primary productivity, Water properties, Iced lakes, Photosynthesis, Chlorophyll, Phytoplankton, Aquatic plants, Antarctic, Physical properties, Chemical properties, Chlorophyta, Cyanophyta, Chrysophyta, Biomass, Aquatic bacteria, Protozoa, Crustaceans, Lake sediment, Lake morphology, Water analysis, Antarctica, Bryophytes, Anvers Island, Lichens, Snow algae.

AMIC-6710

"ON THE QUANTITATIVE CHARACTERISTICS OF THE PELAGIC ECOSYSTEM OF DALNEE LAKE (KAMCHATKA)", Sorokin, Yu. I., Paveljeva, E. B., *Hydrobiologia*, Vol. 40, No. 4, December 15, 1972, pp 519-552.

Data are presented on the biomass, production, metabolism, and trophic relations of the components of the ecosystem of Lake Dalnee (Kamchatka). Water samples were taken with a plastic water bottle of the Suslijaev type from depths selected according to the stratification of the water column. Primary productivity of phytoplankton, trophic characteristics of zooplankters, and bacterial production were measured by a C-14 technique. Counts of phytoplankton, colorless flagellates, and zooplankton were made. The carbon content of the predominant diatom, *Stephanodiscus astraea*, was measured by wet combustion of its suspension obtained in culture. The data on the spectrum of feeding, on rations and on optimal food concentrations were ascertained. All these data, together with the observations in the lake, were used for the construction of a scheme of energy flow. The scheme shows that the ecosystem of the lake receives the third part of its energy from the land as allochthonous organic matter via microbial biosynthesis. The main part of energy accessible to the animals of the second trophic level is used by protozoa, and of a third part by the predatory rotifer *Asplanchna*.

INDEX TERMS: Ecosystems, Trophic level, Biomass, Primary productivity, Zooplankton, Phytoplankton, Metabolism, Food habits, Ecological distribution, Vertical migration, Organic matter, Aquatic bacteria, Aquatic microorganisms, Eutrophication, Dominant organisms, Stratification, Predation, Pelagic animals, Energy flow, Lake Dalnee, *Stephanodiscus astraea*, Vertical distribution.

AMIC-6711

"POLYCHAETOUS ANNELIDS COLLECTED BY 'UMITAKA-MARU' FROM THE ARABIAN GULF", Mohammad, M-B. M., *Hydrobiologia*, Vol. 40, No. 4, December 15, 1972, pp 553-560.

Seventeen species of polychaetous annelids, belonging to 12 families, have been identified from a collection made by the Japanese research 'Umitaka-Maru' in December, 1968 from the Arabian Gulf. The material was collected from 12 sites along the coasts of Kuwait, Bahrain, Qatar, and the Trucial States. During the collection period, the mean sea-water temperature, salinity, and dissolved oxygen near the bottom (depth, 15 to 20 meters) at the stations at which the polychaetes were collected were in the neighborhood of 24.1 degrees C, 41.0 ppt, and 4.6 cc/l, respectively (Tokyo University of Fisheries and Kuwait Institute for Scientific Research, 1969). Two pelagic families (Alicopidae, Tomopteridae) and five species (*Platohelminis capitata*, *Tomopteris* sp., *Autolytus* cf. *A. longistaffi*, *Lysidice ninetta*, *Pista cristata*) have been recorded new to the fauna of the Arabian Gulf.

INDEX TERMS: Annelids, Invertebrates, Systematics, Marine animals, Polychaetes, Arabian Gulf, Pelagic animals, Speciation.

AMIC-6712

"PHOSPHORUS AVAILABILITY AND ALKALINE PHOSPHATASE ACTIVITIES IN TWO ISRAELI FISHPONDS", Berman, T., Moses, G., *Hydrobiologia*, Vol. 40, No. 4, December 15, 1972, pp 487-498.

Alkaline phosphatase activities and the release of orthophosphate from endogenous substrates by these enzymes were measured in waters from two commercial fishponds in the watershed area of Lake Kinneret (Northern Israel). These data were compared with results from the lake at seasons of adequate or limited phosphorus supply. In the fishponds, high relative phosphatase activity ratios (greater than 2) and relatively large amounts of orthophosphate extracted from plankton by autoclaving (average 27 percent of readily available phosphorus) indicated adequate, or even excess, levels of phosphorus availability despite elevated pond productivity (2 to 3 tons carp/ha/yr). Decreasing routine phosphorus fertilization of these ponds would not affect overall productivity, but would eventually lower the amounts of phosphorus reaching Lake Kinneret. In general, the R.P.A. ratio may be a useful index to evaluate phosphorus availability for a wide range of natural waters. Values for this ratio of less than 1 and greater than 2 appear indicative of limited or adequate phosphorus availability respectively. Three sources of orthophosphate, (Pi), readily available to phytoplankton, are indicated: (1) enzymatically released Pi, (2) Pi in intracellular pools and (3) Pi initially present in the water. Although the first source is always important, relatively greater amounts of Pi are contributed by the other fractions in situations of plentiful phosphorus availability. Activity of free dissolved phosphatases was found in filtered samples of fishpond water. However, neither these enzymes nor added phosphatases released significant amounts of Pi from the dissolved organic phosphorus compounds in the filtered water.

INDEX TERMS: Phosphorus, Primary productivity, Secondary productivity, Alkaline phosphatase, Nutrient availability, Enzyme activity, Substrate utilization.

2. BIOLOGICAL METHODS

AMIC-6737

"MERCURY CONCENTRATION IN RELATION TO SIZE IN SEVERAL SPECIES OF FRESHWATER FISHES FROM MANITOBA AND NORTHWESTERN ONTARIO", Scott, D. P., Armstrong, F. A. J., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 12, December 1972, pp 1685-1690.

Statistical analysis of 53 samples of 11 species of fishes from a number of areas of Manitoba and northwestern Ontario indicated that in general there was a positive correlation between mercury concentration and length. There also appeared to be a more variable positive relation between mercury concentration and fish condition (fatness). It was possible to predict, for 31 of the 53 samples, the range of lengths within which there was a 95 percent probability of all fish containing less than 0.5 ppm mercury. However, within species the relation between mercury concentration and length was not consistent. The results show that, for certain of the populations closed to commercial fishing because of mercury contamination, selection (by fishing technique or otherwise) of certain sizes should provide fish of acceptably low mercury concentration.

INDEX TERMS: Absorption, Mercury, Freshwater fish, Size, Mathematical studies, Regression analysis, Heavy metals, Canada, Yellow perch, Sauger, Walleye, Lake trout, White sucker, Burbot, Northern pike, Sheepshead, Lake whitefish, Tullibee, Goldeye.

AMIC-6739

"USE OF A COMMERCIAL DREDGE TO ESTIMATE A HARDSHELL CLAM POPULATION BY STRATIFIED RANDOM SAMPLING", Russell, H. R., Jr., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 12, December 1972, pp 1731-1735.

Results are presented of the application of a Fall River rocking-chair dredge in a stratified random sampling design in which a limited number of samples sufficed to provide a reasonably accurate population estimate of *M. mercenaria* in Narragansett Bay, Rhode Island. Stratified random sampling was designed such that the preliminary dredge survey served to identify centers of abundance and provide the information necessary to construct contours enclosing areas of equal abundance. Subsequent sampling was then directed towards approaching equal sampling fractions based on areas between contours, or strata. Because of the nonrandom distribution pattern of *M. mercenaria*, treatment of the data with normal statistics would indicate a mean of 1.64 bu per dredge tow with a variance of 1.80. Stratified sampling, due to its inherent weighting feature, provided a similar estimate of 1.36 bu per tow with a variance of 0.033.

INDEX TERMS: Animal populations, Estimating, Statistical methods, Clams, Mollusks, Invertebrates, Marine animals, Efficiencies, Dredging, Stratified random sampling, *Mercenaria mercenaria*, Rocking-chair dredge, Performance evaluation, Random sampling, Sampling design, Quahog, Macroinvertebrates, Data interpretation.

AMIC-6738

"EFFECTS OF VARIOUS METALS ON SURVIVAL, GROWTH, REPRODUCTION, AND METABOLISM OF DAPHNIA MAGNA", Biesinger, K. E., Christensen, G. M., Journal of the Fisheries Research Board of Canada Vol. 29, No. 12, December 1972, pp 1691-1700.

The toxicities of various metals to *Daphnia magna* was evaluated on the basis of a 48-hr 50 percent lethal concentration (LC50), a 3-week LC50, and a 16 percent decrease in the number of young born (reproductive impairment). The 3-week 16 percent reproductive impairment concentrations (in micrograms per liter) for the metal ions tested were: Na(I), 680,000; Ca(II), 116,000; Mg(II), 82,000; K(I), 53,000; Sr(II), 42,000; Ba(II), 5800; Fe(III), 4380; Mn(II), 4100; As(V), 520; Sn(II), 350; Cr(III), 330; Al(III), 320; Zn(II), 70; Au(III), 60; Ni(II), 30; Pb(II), 30; Cu(II), 22; Pt(IV), 14; Co(II), 10; Hg(II), 3.4; and Cd(II), 0.17. At metal concentrations permitting survival but impairing reproduction, daphnids weighed less than control animals. Amounts of total protein and glutamic oxalacetic transaminase activity varied with the different metals. The negative logarithm of the solubility product constant (pK sub sp) of the metal sulfides, electronegativity, and the logarithm of the equilibrium constant (log K sub eg) of the metal-ATP complex were positively correlated with toxicity to *D. magna*. Other physicochemical properties were considered, but no additional correlations were found.

INDEX TERMS: Toxicity, Heavy metals, Alkali metals, Alkaline earth metals, Bioassay, Water pollution effects, Animal physiology, Crustaceans, Zooplankton, Aquatic animals, Proteins, Enzymes, Statistical methods, Laboratory tests, Water analysis, Cations, Growth rates, Reproduction, Metabolism, *Daphnia magna*, Data interpretation, Biochemical tests, Macroinvertebrates.

AMIC-6743

"SOME PHYSIOLOGICAL CONSEQUENCES OF HANDLING STRESS IN THE JUVENILE COHO SALMON (*ONCORHYNCHUS KISUTCH*) AND STEELHEAD TROUT (*SALMO GAIKNERI*)", Wedemeyer, G., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 12, December 1972, pp 1780-1783.

The stress of handling juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*) in soft water and in water with added salts was evaluated using blood and tissue chemistry fluctuations as indices of metabolic and endocrine function. Changes in plasma glucose, chloride, calcium, and cholesterol levels indicated that significant osmoregulatory and metabolic dysfunctions can occur and persist for about 24 hr after handling in soft water. Pituitary activation, as judged by lack of interrenal ascorbate depletion, did not occur. Increasing the ambient NaCl and Ca(2 plus) levels to about 100 milliosmoles and 75-120 ppm, respectively, partially or completely alleviated the hyperglycemia and hypochloremia indicating that the stress of handling had been reduced.

INDEX TERMS: Fish physiology, Coho salmon, Rainbow trout, Juvenile fish, Environmental effects, Water balance, Chemical analysis, Bioassay, Hardness (water), Metabolism, Chlorides, Calcium, Handling stress, Biochemical tests, Blood, *Oncorhynchus kisutch*, Steelhead trout, *Salmo gairdneri*, Plasma glucose, Cholesterol, Ascorbate.

2. BIOLOGICAL METHODS

AMIC-6746

"FINE STRUCTURE OF SOME BRACKISH-POND DIATOMS", Hargraves, P. E., Levandovsky, M., Nova Hedvigia, Vol. 21, Nos. 2-4, 1971, pp 321-336.

Samples of diatoms were taken during summer from a brackish pond on the northern shore of Long Island, New York, 0.25 mile west of Mt. Sinai Harbor mouth. The diatoms were examined in the Philips EM-200 electron microscope at 80 kv as carbon replicas and as direct preparations of acid cleansed unreplicated frustules. Some of the taxa had previously been observed by electron microscopy, while others were new distributional records. Representative summer conditions of the pond are tabulated.

INDEX TERMS: Electron microscopy, Diatoms, Brackish-water, Chrysophyta, Systematics, Ecological distribution, Marine algae, Nanoplankton, Eutrophication, Water temperature, Salinity, Hydrogen ion concentration, Phytoplankton, Water properties, Summer, Pollutant identification, Ultrastructure, Sample preparation, Speciation, *Achnanthes hauckiana*, *Amphiprora hyalina*, *Amphora tenuissima*, *Bellerophon*, *Cyclotella cryptica*, *Cyclotella meneghiniana*, *Cylindrotheca closterium*, *Fragilaria pinnata*, *Fragilaria virescens* var. *subsalina*, *Navicula cryptocephala*, *Navicula cryptolyra*, *Nitzschia frustulum*, *Nitzschia ovalis*, *Skeletonema costatum*, *Thalassionema nitzschioides*, *Thalassiosira allenii*, *Thalassiosira pseudonana*.

AMIC-6750

"DIATOMS FROM THE DEVIL'S HOLE CAVE FIFE, SCOTLAND", Carter, J. R., Nova Hedvigia, Vol. 21, Nos. 2-4, 1971, pp 657-682.

Material collected by the late Mr. George West of the University College, Dundee, in the Devil's Hole Cave in Kincaig Hill, Fife, Scotland has been examined for the presence of diatoms. The preparations yielded an abundance of small and delicately structured forms, several of which could not be identified with certainty. A total of 94 species and other subcategories are reported, five of which are new to science. *Caloneis borealis*, *Cymbella diavola*, *Navicula variolinea*, *Navicula vula*, and *Nitzschia disputata* nov. spp. are described. The types of the new species are lodged in the British Museum (No. 77777 and 77778).

INDEX TERMS: Diatoms, Chrysophyta, Aquatic algae, Systematics, Ecological distribution, Marine algae, Pollutant identification, Speciation, Scotland, Devil's Hole Cave.

AMIC-6747

"*ALTHORNIA CROUCHII* GEN. ET SP. NOV., A MARINE BIFLAGELLATE FUNGUS", Jones, E. B. G., Alderman, D. J., Nova Hedvigia, Vol. 21, Nos. 2-4, 1971, pp 381-399.

A new species of marine fungus has been described and a new genus established. The morphological details observed by light microscopy are described. For electron microscopic investigations the following procedure was used. The fungus was grown in yeast extract peptone seawater broth for 7-14 days at a temperature of 25 C. One millilitre of the medium containing mature sporangia was transferred to 50 ml of 0.05 percent sodium glutamate in seawater in a 250 ml Erlenmeyer flask. Zoospores were discharged freely within 6-18 hours. The zoospores were fixed in 2 percent osmium tetroxide fumes, dried, and shadowed with gold-palladium. An alternate fixation method utilized 4 percent glutaraldehyde. The morphology of the zoospore and sporangium is described in detail.

INDEX TERMS: Marine fungi, Plant morphology, Pollutant identification, Systematics, Electron microscopy, Marine plants, *Althornia crouchii*, Ultrastructure, Sample preparation, Light microscopy, Speciation,

AMIC-6752

"ADDITIONS TO THE MARINE ALGAL FLORA OF GHANA I", John, D. M., Lawson, G. W., Nova Hedvigia, Vol. 21, Nos. 2-4, 1971, pp 817-842.

A list is given of 36 new records of marine algae from the Ghanaian coast. It includes information in the annotations on their morphology and other features of taxonomic interest together with notes on their localities and world distributions. A large proportion of these new records are of plants confined to the sublittoral (21) and this reflects the flora of new areas where collecting has now been made possible by aqua lung diving. Thirteen of these new records are of species not previously known from West Africa and 5 of these plants are new to the Atlantic Ocean.

INDEX TERMS: Marine algae, Plant morphology, Ecological distribution, Spatial distribution, Systematics, Chlorophyta, Phaeophyta, Rhodophyta, Atlantic Ocean, Africa, Pollutant identification, Ghana.

2. BIOLOGICAL METHODS

AMIC-6756

"THE LIFE-HISTORY OF SPHACELARIA FURCIGERA KUTZ. (PHAEOPHYCEAE) II. THE INFLUENCE ON DAYLENGTH AND TEMPERATURE ON SEXUAL AND VEGETATIVE REPRODUCTION", Colijn, F., van den Hoek, C., Nova Hedwigia, Vol. 21, Nos. 2-4, 1971, pp 899-922.

Cultures of gametophytes and sporophytes of *Sphacelaria furcigera* from Hoek van Holland formed abundant propagules under 12 C long day (equals 16 hours daylight) and 17 C long day conditions. This agrees with field data from temperature regions which indicate multiplication by propagules in the summer half year. No propagules were formed under 17 C short day, 12 C short day, 4 C long day, and 4 C short day conditions. Plurilocular macrogametangia were abundantly formed under 4 C long day and 12 C long day conditions. Under 17 C long day conditions plurilocular macrogametangia were initially formed, but were soon succeeded by propagules. Unilocular sporangia of the diploid generation were formed at 12 C and 4 C. There are some indications that short day conditions might have an influence on the formation of these structures, but the evidence is inconclusive. In nature (in temperate regions) unilocular zoidangia and plurilocular gametangia are known mainly from the winter half year, but the scarce data do not indicate whether the daylength might also play a role in their induction.

INDEX TERMS: Marine algae, Phaeophyta, Life history studies, Reproduction, Cultures, Temperature, *Sphacelaria furcigera*, Culture media.

AMIC-6757

"DIATOMS FOUND IN A BOTTOM SEDIMENT SAMPLE FROM A SMALL DEEP LAKE ON THE NORTHERN SLOPE, ALASKA", Foged, N., Nova Hedwigia, Vol. 21, Nos. 2-4, 1971, pp 923-1035.

In a sediment sample from 15.5 m depth in an unnamed freshwater lake of 1.25 sq. km on the Northern Slope, Alaska (70 degrees 01 min N. lat., 153 degrees 36 min W. Gr.) about 400 forms of diatoms belonging to 36 genera were identified (19 nov. spec., 5 nov. var., and 6 nov. fo. are described). The flora of diatoms is characterized, in addition to the richness of species, by the considerable number of forms, which previously often were found in interglacial or postglacial deposits in Europe or Asia. Especially remarkable are the finds of a number of species of *Surirella* which is surprisingly great for arctic regions. The lake must be very old, possibly from the Tertiary, since the area has neither been covered by inland ice since that time nor exposed to transgressions by the sea.

INDEX TERMS: Diatoms, Chrysophyta, Lake sediments, Aquatic algae, Alaska, Bottom sediments, Systematics, Speciation.

3. MICROBIOLOGICAL METHODS

<p>AMIC-6409 AUTOMATISATION DE L'ANALYSE BACTERIOLOGIQUE DE L'EAU -I. ETUDE D'UN NOUVEAU TEST SPECIFIQUE DE CONTAMINATION FECALE ET DES CONDITIONS OPTIMALES DE SA MISE EN EVIDENCE", Trinel, P. A., Leclerc, H., <u>Water Research</u>, Vol. 6, No. 12, December 1972, pp 1445-1458.</p> <p>With the aid of the Technicon auto-analyzer, the optimal conditions for synthesizing and measuring glutamic acid decarboxylase in suspensions of <i>Escherichia coli</i> have been defined. The proposed system allows for a simple, rapid and precise search for the glutamic acid decarboxylase in bacterial suspensions. It can also be used for the bacteriological analysis of water. (Original article and abstract in French)</p> <p>INDEX TERMS: Synthesis, Measurement, Automation, Methodology, Bacteria, <i>E. coli</i>, Enzymes, Water analysis, Amino acids, Separation techniques, Analytical techniques, Glutamic acid decarboxylase, Autoanalyzer.</p>	<p>AMIC-6413 (Continued) Card 2/2</p> <p>INDEX TERMS: Sewage effluents, Waste water (pollution), Hospitals, Municipal wastes, Water pollution sources, Worms, Animal parasites, Bacteria, Viruses, Pathogenic bacteria, Enteric bacteria, Sampling, Enterovirus, Eggs, Reovirus, Tapeworms.</p>
<p>AMIC-6413 "THE LOAD OF INFECTIOUS MICRO-ORGANISMS IN THE WASTE WATER OF TWO SOUTH AFRICAN HOSPITALS", Grabov, W. O. K., Nupen, E. M., <u>Water Research</u>, Vol. 6, No. 12, December 1972, pp 1557-1563.</p> <p>Counts of microorganisms including infectious bacteria, viruses and parasite ova in the waste water of two hospitals were compared with those in city sewage. One of these is an isolation hospital with stringent disinfection procedures. Grab samples were taken at hourly intervals over 24-hour periods and individual samples were immediately cooled to 4°C and pooled. The waste water of each hospital and the city's sewage effluent were sampled simultaneously. Prior to analysis, samples were homogenized in a mixer for 4 min at a speed selector setting of 4. Some of the bacterial counts included total coliforms, <i>Clostridium perfringens</i>, <i>Salmonella</i> fecal streptococci, <i>Pseudomonas aeruginosa</i>, confirmed <i>E. coli</i> I; the viral counts were of entero- and reoviruses, and those of parasite ova were for <i>Ascaris</i>, <i>Taenia</i>, <i>Trichuris</i>, and <i>Necator</i> or <i>Ancylostoma</i>. Counts of all the organisms tested, except <i>Pseudomonas aeruginosa</i>, were lower in the waste water of this hospital than in the sewage effluent of the town in which it is located. The other hospital is a general hospital with less stringent disinfection procedures. Counts of some organisms were slightly higher in the waste water of this hospital than in the sewage effluent of the city in which it is located. The results obtained indicated that under normal conditions the waste water of hospitals needs no treatment before disposal into city sewers. The disposal of primary treated hospital effluents into streams or their use for irrigation should, however, be considered with care.</p>	<p>AMIC-6414 "A SIMPLE METHOD FOR CONCENTRATING AND DETECTING VIRUSES IN WASTEWATER", Rao, V. C., Chandorkar, U., Rao, N. U., Kumaran, P., Lakhe, S. B., <u>Water Research</u>, Vol. 6, No. 12, December 1972, pp 1565-1576.</p> <p>A simple method has been developed for routine analysis of sewage effluents for detecting viruses using adsorption at pH 3 on a 0.45 µm-diameter 47-mm diameter membrane filter and elution at pH 8. It was tested on viruses added to autoclaved sewage. Homogenizing the sample for 4 min in a Waring blender and clarification by centrifugation at 1800 g and later at 9230 g facilitated easy filtration without any loss of virus. Retention of the eluant for 30 min on the millipore membrane and then elution in situ under suction provided a sterile eluate with 100 per cent recovery of viruses. Viruses added to fecal suspensions with 600 mg/l BOD were completely recovered when the sample pH was adjusted to 3 and its salt concentration increased by adding 1200 mg/l of Mg(2+) as the chloride. This procedure eliminated the need for passing the samples through ion exchange resins for removing membrane coating components. In a 1 yr program of monitoring of raw sewage from a middle income group community in Nagpur, a maximum of 3150 PFU/l during monsoon and 11575 PFU/l during winter was obtained. High efficiency and reproducibility of the method allowed the use of sample volumes of 40 ml of raw sewage and 320 ml of treated effluent for the detection of viruses.</p> <p>INDEX TERMS: Waste water (pollution), Isolation, Methodology, Viruses, Sewage, Sewage effluents, Hydrogen ion concentration, Laboratory equipment, Biochemical oxygen demand, Sample preparation, Recovery, Membrane filters.</p>

3. MICROBIOLOGICAL METHODS

<p>AMIC-6415 "RAPID BIODEGRADATION OF NTA BY A NOVEL BACTERIAL MUTANT", Wong, P. T. S., Liu, D., Dutka, B. J., <u>Water Research</u>, Vol. 6, No. 12, December 1972, pp 1577-1584.</p> <p>A bacterial mutant was isolated from sewage after ultraviolet mutagenization and penicillin selection during a study which was initiated to explore the possibility of isolating a potent bacterium which could degrade NTA rapidly. Bacterial flora from sewage after u.v. mutagenization and penicillin selection were plated onto NTA-agar plates. Colonies which developed after 5 days incubation at 20 degrees C, were picked off and purified by repeated transfers onto fresh agar medium. One culture of Gram-negative short rod bacteria was found to grow most rapidly in 0.5 per cent NTA broth. The following conclusions were reached concerning the mutant bacterium: 1. This mutant was able to grow without acclimatization in NTA concentrations as high as 2.5 per cent as sole carbon, nitrogen and energy source. 2. The mutant could degrade NTA at a wide range of temperatures from 4 degrees to 37 degrees C with the optimal temperature at 20 degrees C. 3. The optimal pH of NTA degradation was pH 7. 4. The mutant could grow on NTA as well as its intermediate products (glycine, iminodiacetic acid). 5. The bacteria were capable of utilizing NTA present in lake water and sewage. 6. The rate of NTA degradation was very rapid. Almost all the NTA was degraded after 4 days incubation at an initial concentration of 0.2 per cent NTA. 7. The NTA-metal complexes had no obvious effect on the bacterial degradation of NTA.</p> <p>INDEX TERMS: Nitrilotriacetic acid, Isolation, Microbial degradation, Sewage bacteria, Hydrogen ion concentration, Temperature, Environmental effects, Growth rates, Mutants, Substrate utilization, NTA-metal complexes, Iminodiacetic acid, Glycine, Degradation rates.</p>	<p>AMIC-6417 (Continued) Card 2/2</p> <p>immediately before and 0.5 h after treatment of water samples. Petri plates were incubated at 15 degrees C for 96 h before counting. Concentrations of metallic salts which resulted in bacterial death also caused erratic uptake and mineralization rates of C-14-glucose whereas sub-lethal concentrations, as determined by nutrient agar plate counts, caused a non-competitive inhibition of maximum heterotrophic activity and markedly increased the turnover time of the glucose substrate.</p> <p>INDEX TERMS: Metals, Salts, Water pollution effects, Aquatic microorganisms, Methodology, Sodium chloride, Radioactivity techniques, Bioassay, Heterotrophic bacteria, Viability, Substrate utilization, Silver sulfate, Barium chloride, Cadmium chloride, Chromium chloride, Mercury chloride, Copper chloride, Nickel chloride, Lead chloride, Zinc chloride, Glucose.</p>
<p>AMIC-6417 "TECHNIQUE FOR MEASURING METALLIC SALT EFFECTS UPON THE INDIGENOUS HETEROTROPHIC MICROFLORA OF A NATURAL WATER", Albright, L. J., Wentworth, J. W., Wilson, E. M., <u>Water Research</u>, Vol. 6, 1972, pp 1589-1596.</p> <p>A heterotrophic activity assay method is described which may be used to determine the effects of several metallic salts, Ag₂SO₄, NaAsO₃, BaCl₂.2H₂O, CdCl₂.2.5 H₂O, CrCl₂.6H₂O, CuCl₂, HgCl₂, NaCl, NiCl₂.h₂O, PbCl₂ and ZnCl₂, at very low concentrations, upon the net activity of the native heterotrophic microflora of an aquatic ecosystem, without unduly disturbing in situ conditions. The method is based upon the uptake and mineralization of a radioactivity labeled metabolite (C-14-glucose) by native heterotrophic microflora and the analysis of data by Michaelis-Menten enzyme kinetics equations. A 100-ml water sample was collected, temperature determined, and divided into 25-ml portions, each of which was treated with 0.0538, 0.2690, 0.5375 or 0.8075 microgram amounts of C-14-glucose. Five milliliters were removed from each portion and placed in separate 25-ml erlenmeyer flasks which were sealed immediately. The reaction and control were incubated with reciprocal shaking (60 strokes/min) in the dark at the same temperature of the water when sampled. After 0.5 h incubation the reaction flasks were acidified to about pH 1.0 to stop microbial activity and to drive off C-14 O₂ which was trapped on phenethylamine-impregnated whatman paper. After further incubation for an hour, the Whatman papers were removed, placed in scintillation vials containing a toluene-based cocktail of 2,5-diphenyloxazole (0.4 percent) and 1,4-bis-(5-phenyloxazoly 1-2)-benzene (0.01 percent). The aquatic contents of each flask were filtered, washed, dried at 60 C for 15 min and added to vials containing the same cocktail. Counting was done with a Beckman LS-250 scintillation spectrometer. Salt effects upon bacterial viability were determined using nutrient agar plate counts</p>	<p>AMIC-6419 "THE USE OF AGAR DIP-SLIDES FOR ESTIMATES OF BACTERIAL NUMBER IN POLLUTED WATERS", Mara, D. D., <u>Water Research</u>, Vol. 6, No. 12, December 1972, pp 1605-1607.</p> <p>Oxoid and 'Uricult' agar dip-slides were used to estimate to the nearest order of magnitude total and coliform counts in sewage and polluted rivers. Samples of sewage and polluted river water were collected in sterile 8-oz (228-ml) bottles. Standard plate counts were obtained in Oxoid yeast extract agar after 24 h incubation at 35 degrees C. Total coliform and faecal coliform pour-plate counts were obtained in lactose teepol agar (Jameson and Emburley, 1956) after 4 h incubation at 30 degrees C followed 18-20 h at either 35 degrees or 44 degrees C (Mara, in preparation). These counts were used to judge the accuracy of the dip-slide counts. Two Oxoid dip-slides were immersed in the sewage or river flow for ca. 5 s and incubated, one at 35 degrees C and the other 44 degrees C for 20-24 h. At some sampling stations 'Uricult' dip-slides (Orion Pharmaceutical, Helsinki) were also used. These estimates agreed closely with the corresponding pour-plate counts in yeast extract agar and lactose teepol agar. The dip-slide technique is simple and suitable for routine monitoring of effluent quality and river pollution.</p> <p>INDEX TERMS: Sewage bacteria, Aquatic bacteria, Monitoring, Water pollution, Sewage, Methodology, Pollutant identification, Agar dip-slides, Estimating, Culture media, Agars, Plate counts.</p>

3. MICROBIOLOGICAL METHODS

AMIC-6427

"INACTIVATION ASSAYS OF ENTEROVIRUSES AND SALMONELLA IN FRESH AND DIGESTED WASTEWATER SLUDGES BY PASTEURIZATION", Poliguet, J., Doncoeur, F., Water Research, Vol. 6, No. 11, November 1972, pp 1399-1407.

To determine the effectiveness of a pasteurization process for inactivating enteroviruses and Salmonella, three types of fresh sludge, three types of digested sludge, and pure cultures of poliovirus, Cocksackievirus, Salmonella paratyphi B were subjected to the treatment. The pasteurization procedures consisted of homogenization for 30 minutes, heating from 6-15 C to 80 C in less than 10 minutes, and maintenance at 80 C for 10 minutes. After treatment the samples were rapidly cooled to -70 C and stored at -25 C until use. Culturing procedures are described by which the samples were assayed. The results showed that the treatment provides relatively thorough inactivation of the pathogenic germs, thereby reducing the infection risk of the sludges. The samples cannot, however, be considered to be entirely sterile since they contain sporulated germs.

INDEX TERMS: Sludge treatment, Disinfection, Poliovirus, Cocksackievirus, Salmonella paratyphi, Pasteurization, Inactivation.

AMIC-6431

"BACTERIAL CHEMORECEPTION: AN IMPORTANT ECOLOGICAL PHENOMENON INHIBITED BY HYDROCARBONS", Mitchell, R., Fogel, S., Chet, I., Water Research, Vol. 6, No. 10, October 1972, pp 1137-1140.

Motile marine bacteria have been shown to display chemoreception, with each microorganism exhibiting a highly specific response, and are attracted to a wide range of organic compounds. Chemoreception is also involved in the biodegradation of phytoplankton and enteric bacteria by bacterial predators. Marine bacteria were isolated from seawater samples on seawater nutrient agar. The predators were isolated by enrichment culture on an artificial seawater medium containing the microbial prey as sole C source. Bacterial chemotaxis was detected using this method: A 5-micron capillary tube sealed at one end and containing the test chemical was placed in a suspension of test bacteria placed in seawater on a microscope slide. Bacterial attraction was observed microscopically. Quantitative data were obtained by plating the contents of the capillary tube on seawater nutrient agar. Nutrients, in very low concentrations, were detected very rapidly. Most carbohydrates and amino acids stimulated chemotaxis at concentrations as low as 0.01 micromM. The isolated bacterial predators were capable of degrading the diatom, Skeletonema costatum. The addition of specific aromatic hydrocarbons (phenol, toluene, crude oil) to seawater totally inhibited the chemotactic response of all bacteria without immobilization. The ecological implications of this type of sublethal effect on the self-purifying capacity of the sea and on the behavior of marine animals are discussed.

INDEX TERMS: Marine bacteria, Marine algae, Predation, Organic compounds, Oil pollution, Microbial degradation, Inhibition, Phenols, Chemoreception, Toluene, Crude oil, Skeletonema costatum.

AMIC-6441

"A PORTABLE VIRUS CONCENTRATOR FOR TESTING WATER IN THE FIELD", Wallis, C., Homma, A., Melnick, J. L., Water Research, Vol. 6, No. 10, October 1972, pp 1249-1256.

A system is described for concentrating viruses from large volumes of water. The system consists of a water pump, an electric generator, a series of clarifiers, a virus adsorbent, a virus reconcentrator, a 5- and a 1-gal pressure vessel with a small tank of nitrogen as a source of positive pressure, and ancillary equipment, all mounted on 2-wheel carts for easy portability. Standardization of the system was achieved by use of minute amounts of poliovirus. The virus was added to dechlorinated city tap water so that it could not be detected unless the virus was first concentrated. In the system, raw tap water containing virus is serially passed through clarifying filters of porosities of 5-1 microns to remove particulate matter, and then through a 1-micron cotton textile filter to electrostatically remove submicron ferric and other heavy metallic complexes. These filters do not detectably remove virus. Salts are then added to the running tap water to enhance the adsorption of virus to a fiberglass or cellulose acetate filter. Raw water could be processed at the rate of 300 gallons per hour, with total virus removal from the water and with 80 percent elution of the virus from the adsorbent.

INDEX TERMS: Viruses, On-site tests, Equipment, Pollutant identification, Methodology, On-site investigations, Adsorption, Potable water, Filtration, Monitoring, Portable virus concentrator, Adsorbents, Virus assays, Poliovirus, Metal complexes, Particulate matter, Plaque forming units, Detection limits.

AMIC-6514

"HIGH RESOLUTION FIELD IONIZATION MASS SPECTROMETRY OF BACTERIAL PYROLYSIS PRODUCTS", Schulten, H. R., Beckey, H. D., Meuzelaar, H. L. C., Boerboom, A. J. H., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 191-195.

The purpose of this study was to explore the potentials of high resolution field ionization-mass spectrometry (FI-MS) for the analysis of extremely complex multicomponent mixtures and to perform a general survey of the chemical nature of bacterial pyrolysis products. The spectra were obtained with a double-focusing mass spectrometer equipped with an FI-ion source and a specially designed emitter-adjusting manipulator. The sample was 5 mg of Pseudomonas putida bacteria, freeze-dried and pyrolyzed in a vacuum at 500 C. Over 200 lines were revealed on the developed photoplate. Density measurements were made on about 180 lines. Accurate mass measurements are listed for 119 of the strongest lines, and proposed names are included for some compounds. The results show that the range of compounds that can be analyzed by FI-MS is greater than that of GLC-MS. The usefulness of FI-MS is limited by its inability to separate and identify isomers without additional information. Consequently, the two methods may be used to supplement each other. Differentiation of bacterial strains may be possible in this way.

INDEX TERMS: Pseudomonas, Organic compounds, Pollutant identification, Mass spectrometry, Field ionization-mass spectrometry, Sample preparation, Pseudomonas putida, Mass spectra, Pyrolysis.

3. MICROBIOLOGICAL METHODS

AMIC-6539

"THE MICROBIOLOGY OF AN ACTIVATED SLUDGE WASTE-WATER TREATMENT PLANT CHEMICALLY TREATED FOR PHOSPHORUS REMOVAL", Davis, J. A., Unz, R. F., Water Research, Vol. 7, Nos. 1/2, January/February 1973, pp 325-327.

Microbiological research was conducted on a dual, secondary wastewater treatment system which was part of The Pennsylvania State University wastewater treatment plant. Each aeration basin received identical wastewater which was the effluent from a high rate trickling filter. One of the aeration basins was dosed with aluminum sulfate for the purpose of phosphorus removal. The other aeration basin (control) was operated in the conventional manner without alum addition. Plate counts performed on combined chemical-biological sludge and control activated sludge revealed that a higher number of viable microorganisms was contained in the chemical-biological sludge, but the magnitude of difference between the two sludges was significant depending on the culture medium employed. Results suggest the aluminum flocs formed in the chemical-biological treatment enmesh dispersed wastewater microorganisms, some of which are qualitatively unlike those indigenous to natural activated sludge. The combined chemical-biological sludge contained significantly higher numbers of lipolytic, gelatinolytic, and thiosulfate oxidizing microorganisms and, possibly, fewer nitrite oxidizing microorganisms than did control activated sludge. Alum did not appear to affect flagellated protozoa in mixed liquor; however, amoeboid and ciliated protozoa were found less frequently in alum dosed than in control mixed liquor. The settled effluent from the combined chemical-biological aeration basin generally contained fewer total coliforms, fecal coliforms, and fecal streptococci than did counterpart control effluents.

AMIC-6559

"POLLUTION OF A MARINA AREA BY WATERCRAFT USE", Mack, W. N., D'Itri, F. M., Journal Water Pollution Control Federation, Vol. 45, No. 1, January 1973, pp 97-104.

A bacteriological investigation was undertaken to ascertain how a northern Michigan marina affects an unpolluted area of Lake Michigan. The study established that the coliform organisms increased in the slips most frequently used by the yachts that remained overnight because the yachtsmen used the heads aboard their boats. An additional source of coliform contamination resulted from the outflow of the septic tank receiving human wastes from the rest rooms in the harbor master's building. The data indicated that only these two sources of coliform organisms significantly contributed to the total coliform pollution of the marina. It was also established that bacteriological coliform organism analysis is a much more sensitive indication of the presence of such pollution than the selected chemical parameters (chlorides, NH₃, NO₃, and P) frequently used as pollution indicators.

INDEX TERMS: Water pollution sources, Chemical analysis, E. coli, Marinas, Lake Michigan, Waste disposal, Water quality, Septic tanks, Yachts.

AMIC-6539 (Continued)

Card 2/2

INDEX TERMS: Phosphorus, Activated sludge, Microorganisms, Waste water treatment, Protozoa, Coliforms, Enteric bacteria, Analytical techniques, Alum, Removal.

AIC-6577

"CHANGES IN THE MICROBIAL POPULATIONS OF A RESERVOIR TREATED WITH THE HERBICIDE PARAQUAT", Fry, J. C., Brooker, M. P., Thomas, P. L., Water Research, Vol. 7, No. 3, March 1973, pp 395-407.

A freshwater fishing reservoir was treated with paraquat for the control of weeds and the response of microbial populations studied. Estimates of the standing crop of macrophytes (*P. pectinatus*, *M. spicatum*, and *C. globularis*) were made periodically by determining the organic carbon content. A paraquat formulation (Esgram) was sprayed evenly over the reservoir. Water, weed and mud were sampled frequently after each spraying and analyzed. Water samples taken in sterile bottles and mud samples taken from the surface of the mud were used in the microbial determinations. Counts of (1) viable heterotrophic microorganisms, (2) amylase producers, and (3) viable protease and cellulase producers were made on CPS medium using different methods of development. Viable paraquat resistant microorganisms were enumerated with the addition of 50 micrograms/ml paraquat, as Esgram, to the complete CPS medium. Submerged angiosperms were completely eradicated by the application of 1.0 mg/l paraquat, but the subsequent growth of the macrophytic alga, *Chara* sp., was resistant to a second application of the herbicide. Some changes in the microbial populations of the reservoir over the period of study were consistent with the movement of paraquat within the system and others with the death of the plants. Numbers of arbitrarily classified "paraquat resistant" micro-organisms increased in the water and mud immediately after both herbicide applications, and after the first application a reduction in total viable heterotroph counts was observed. Accompanying the death of the angiosperms were increases in the counts of viable heterotrophs and some exoenzyme producers in the mud and water but after the second application of paraquat, when there was no plant death, these micro-organisms showed little response.

3. MICROBIOLOGICAL METHODS

AMIC-6577 (Continued)

Card 2/2

INDEX TERMS: Microbial degradation, Paraquat, Aquatic microorganisms, Water pollution effects, Pesticide toxicity, Viability, Resistance, Chemical analysis, Mud, Aquatic algae, Enzymes, Angiosperms, Amylase, Protease, Cellulase.

AMIC-6648

"RECOVERY OF SHIGELLA UNDER ACIDIC CONDITIONS", Fishbein, M., Mehlman, I. J., Wentz, B., *Journal of the Association of Official Analytical Chemists*, Vol. 55, No. 6, November 1972, pp 1323-1327.

The rationale for an investigative approach in the recovery of small numbers of *Shigella* in the presence of large numbers of the competitive *Enterobacteriaceae* was discussed. On this basis, the acid production of the *Enterobacteriaceae* in common enrichment media was explored. The inhibition of *Shigella* growth initiation from small inocula (10-50 organisms/ml) by particular acid metabolites, such as formic and acetic acids, was shown. Finally, the ability of small *Shigella* inocula to grow in the fermented acidic media in which the *Enterobacteriaceae* have previously grown was studied in detail. It is recommended that the competitive factors affecting *Shigella* be studied further.

INDEX TERMS: *Shigella*, Acidity, Hydrogen ion concentration, Aerobic bacteria, Enteric bacteria, Competition, Organic acids, Pathogenic bacteria, Coliforms, Inhibition, Growth rates, Recovery, Culture media, Substrate utilization, Enrichment, Inorganic acids, *Enterobacteriaceae*.

AMIC-6632

"STANDARDS FOR FAECAL COLIFORM BACTERIAL POLLUTION", Loutit, M., *New Zealand Journal of Marine and Freshwater Research*, Vol. 6, Nos. 1 and 2, June 1972, pp 214-219.

Vidal and Collins (1970) discussed the applicability of a national standard for fecal coliform bacteria in the Wellington, New Zealand area. Comments have been made concerning the author's (1) use of the presumptive coliform test, (2) method(s) of counting fecal and non-fecal coliforms, and (3) contention that less strict standards be employed for the Wellington area. In response to the comments, the authors (Vidal and Collins) make clear the following points: (1) The production of gas and acid in MacConkey broth confirms rather than presumes the presence of coliform bacteria for water examination purposes. (2) The generally accepted term "fecal coliforms" better suits the modern concept of an indicator of fecal pollution. (3) The term "non-fecal" is unacceptable because all known coliforms can occur in faeces, although they do not invariably do so. (4) The lactose broth used in experimentation showed no selectivity between fecal coliforms and other coliform bacteria. (5) If a standard of 200 fecal coliforms/100 ml were set, then the Wellington area would not be on equal basis with districts where fecal coliforms make up a small proportion of the total index of coliform bacteria.

INDEX TERMS: Bioindicators, Water pollution, Water quality standards, Coliforms, Water pollution sources, *E. coli*, Fecal coliforms, Enumeration, Presumptive test, New Zealand, *Klebsiella rhinoscleromatis*, Lactose broth, MacConkey broth, Culture media, Selective media, *Citrobacter freundii*, *Klebsiella ozaenae*, *Klebsiella aerogenes*, *Klebsiella pneumoniae*.

AMIC-6707

"ECOLOGICAL OBSERVATIONS ON HETEROTROPHIC [METHANE OXIDIZING AND SULFATE REDUCING BACTERIA IN A POND", Capenberg, Th. E., *Hydrobiologia*, Vol. 40, No. 4, December 15, 1972, pp 471-485.

Numbers of heterotrophic, methane oxidizing and sulfate reducing bacteria were counted in Lake Vechten and a dynamic distribution pattern was found. A maximum of heterotrophs (numbers of greater than or equal to one billion bact./l) occurred in the deepest part of the lake in spring and in the metalimnion during summer-stratification. These bacteria use nearly all available oxygen in the hypolimnion. It was found that the concentration of available organic material and the oxygen tension caused the numbers of heterotrophs in the metalimnion to be high. The maximal numbers of methane oxidizers (number of greater than or equal to 500,000 bact./l) were found at a depth of maximal methane concentration: the de-oxygenated hypolimnion. Preliminary evidence indicated that these organisms were facultative methane oxidizers and must be regarded as micro-aerophillics. By oxidizing methane they removed the residual oxygen under the metalimnion. The sulfate reducing bacteria could be observed in the hypolimnion only. Decreased SO_4^{2-} concentration and increased numbers of bacteria were found in the bottom water. An association between the methane oxidizers and the sulfate reducers could be deduced. It was assumed that favourable redox requirements for obligate anaerobic sulfate reducers were the results of the activities of the methane oxidizing bacteria. The dynamic distribution equilibrium of the investigated groups of bacteria was disturbed by the autumn turn-over. The heterotrophic and methane oxidizing bacteria decreased in number and were equally distributed; no sulfate reducers could be detected in the free water.

3. MICROBIOLOGICAL METHODS

<p>AMIC-6707 (Continued) Card 2/2</p> <p>INDEX TERMS: Aquatic bacteria, Sulfur bacteria, Ecological distribution, Temporal distribution, Methane bacteria, Seasonal, Heterotrophic bacteria, Vertical distribution.</p>	<p>AMIC-6741 (Continued) Card 2/2</p> <p>INDEX TERMS: Industrial wastes, Fish handling facilities, Microbial degradation, Waste water (pollution), Bacteria, Canneries, Nutrient requirements, Culture media, Substrate utilization, Salmon cannery effluents, Fate of pollutants.</p>
<p>AMIC-6741</p> <p>"SALMON-CANNING WASTE WATER AS A MICROBIAL GROWTH MEDIUM", Stradine, G. A., Melville, J. M., <u>Journal of the Fisheries Research Board of Canada</u>, Vol. 29, No. 12, December 1972, pp 1769-1771.</p> <p>Salmon-canning waste water was shown to support the growth of six species of bacteria both as a complete growth medium and as a supplementary source of available nitrogen. Salmon-canning effluent (SCE) was collected from the outfall of a local cannery located on the Fraser River, B.C. The crude waste water was filtered through glass wool and 50-ml samples dispensed into 250-ml Erlenmeyer flasks. Six species of bacteria which may be of commercial value were cultured on the SCE-salts media, and on media using the following available nitrogen sources: trypticase, Bacto-peptone, polypeptone, phytone, aciditase, and beef extract. Total carbohydrate, free glucose, reducing sugar, and total nitrogen were determined by previously described methods. All six species of bacteria showed relatively good growth in the SCE-salts media; with the exception of polypeptone and possibly phytone, this was not true for the remaining nitrogen sources. Based on the results obtained, two general approaches may be considered for the microbial utilization of salmon-canning waste water. The first and probably the simplest of these would include those possibilities in which the SCE serves as an inexpensive source of available nitrogen for the microbial degradation and/or utilization of nitrogen-deficient wastes. One such waste is the spend liquor from the sulfite pulping process. The second approach for SCE would include those methods designed for the microbial utilization of the waste per se as a pollution abatement system and for the production of a marketable product.</p>	<p>AMIC-6762</p> <p>"HYPHOMYCETES UTILIZING NATURAL GAS", Davies, J. S., Wellman, A. M., Zajic, J. E., <u>Canadian Journal of Microbiology</u>, Vol. 19, No. 1, January 1973, pp 81-83.</p> <p>Twelve cultures of Hyphomycetes capable of growth upon the ethane component of natural gas were isolated from raw sewage by a continuous enrichment technique. Five continuous enrichment systems were operated simultaneously. Each consisted of a closed 4-liter Erlenmeyer flask containing Coty's mineral salts medium; the pH was adjusted with 2 N HCl. A mixture of 50 percent natural gas and 50 percent air was bubbled through each system. Agitation of the medium was effected by means of magnetic stirrers which also aided in dispersion of the gas bubbles. During the enrichment procedure fresh medium was pumped in daily by means of a multi-channel peristaltic pump and the effluent was harvested by positive gas pressure at the same rate, thus effecting dilution. Each system received an inoculum of 5 percent by volume of raw sewage, taken from several points in an activated sludge-sewage treatment plant. All five systems were run continuously for 6 weeks; after the first 2 weeks, attempts were made at weekly intervals to isolate individual fungi from the effluent of each system by the following method. Samples of the enrichment effluent were treated for 30 s in a Waring Blender to break up hyphal clumps into smaller fragments. Each sample was washed by suspending the hyphae in sterile Coty's medium (pH 5.5) followed by centrifugation at 100 g for 2 min. Tenfold dilutions in sterile Coty's medium were made from the resulting suspension and 0.1-ml aliquots were spread over the surface of Petri plates of Coty's agar. Replicate plates of each dilution of the sample were incubated at room temperature (22-25 C) in desiccators, gassed manometrically as follows: (1) Methane 40 percent:air 60 percent, (2) Ethane 40 percent:air 60 percent, (3) Air 100 percent (control). The plates were examined regularly for growth; when</p>

3. MICROBIOLOGICAL METHODS

<p>AMIC-6762 (Continued) Card 2/2</p> <p>significant growth of fungal colonies occurred, serial transfers were made to fresh medium until pure cultures were obtained. All isolates also grew on propane and n-butane but not methane. These cultures are described and their taxonomic position discussed. Four were tentatively placed in <u>Graphium</u>; three were identified as <u>Phialophora jeanselmei</u> (Langeron) Emmons; the remaining five are similar to <u>Acremonium sensu Gams</u>.</p> <p>INDEX TERMS: Aquatic fungi, Sewage sludge, Isolation, Natural gas, Pollutant identification, Systematics, Activated sludge, Hyphomycetes, Substrate utilization, Sewage fungi, Ethane, Propane, n-butane, Graphium, Phialophora jeanselmei, Acremonium, Continuous cultures, Culturing techniques, Culture media.</p>	<p>AMIC-6764 (Continued) Card 2/2</p> <p>p-chlorobenzoic acids were produced from the degradation of BP and PCB, respectively, by <u>Achromobacter</u> <u>PCB</u>. Chloride was not produced by either isolate during the degradation of all chlorobiphenyls tested including the growth of <u>Achromobacter</u> <u>PCB</u> on p-chlorobiphenyl.</p> <p>INDEX TERMS: Polychlorinated biphenyls, Microbial degradation, Sewage bacteria, Degradation (decomposition), Isolation, Aerobic bacteria, Pollutant identification, Sewage effluents, Chemical analysis, Oxidation, Oxygen, Absorption, Metabolites, Achromobacter BP, Achromobacter PCB, Culturing techniques, Heterotrophic bacteria, Fate of pollutants, Chlorinated hydrocarbons, Ultraviolet spectra, Mass spectra, Infrared spectra, NMR spectra, Substrate utilization.</p>
<p>AMIC-6764</p> <p>"DEGRADATION OF POLYCHLORINATED BIPHENYLS BY TWO SPECIES OF ACHROMOBACTER", Ahmed, M., Focht, D. D., <u>Canadian Journal of Microbiology</u>, Vol. 19, No. 1, January 1973, pp 47-52.</p> <p>Two species of <u>Achromobacter</u> were isolated from sewage effluent using biphenyl (BP) and p-chlorobiphenyl (PCB) respectively as sole carbon sources. Cultures of these bacteria were incubated at 28 C on a reciprocating shaker for 36 and 66 hours, respectively, to achieve stationary phases of growth. Oxygen uptake was determined at 30 C using a Gilson respirometer. To isolate the final products of degradation, the culture medium was centrifuged to obtain clear supernatant solutions. The supernatants were acidified with 1 N acetic acid. A compound was precipitated from the culture supernatant of PCB on acidification, whereas no precipitate was formed from the BP supernatant. The precipitate was washed twice with distilled water and dissolved in ethanol. Light brown crystals that were formed on evaporation of the alcohol were purified by crystallization with chloroform. The product was identified by uv., i.r., n.m.r., and mass spectral analyses. Acidified BP supernatant was extracted with diethyl ether. The crystalline material obtained on evaporation of the ether was recrystallized twice from ethanol. The compound was identified by uv. and i.r. spectral analyses. <u>Achromobacter</u> BP grown on biphenyl accumulated a product with an ultraviolet absorption maximum at 257 nm which could not be identified. Washed cell suspensions of both isolates oxidized biphenyl, o-phenylphenol, phenylpyruvate, catechol, p-chlorobiphenyl, m-chlorobiphenyl, o-chlorobiphenyl, o,o'-dichlorobiphenyl, and p,p'-dichlorobiphenyl. Both isolates produced meta cleavage products by fission of the benzene ring. However, spectral characteristics of degradation products from respective substrates were different between the two isolates, indicating divergent degradation pathways. Benzoic and</p>	<p>AMIC-6765</p> <p>"ULTRASTRUCTURE OF TWO SPECIES OF OIL-DEGRADING MARINE BACTERIA", Atlas, R. M., Heintz, C. E., <u>Canadian Journal of Microbiology</u>, Vol. 19, No. 1, January 1973, pp 43-45.</p> <p>Two species of marine bacteria with the ability to degrade crude oil were compared ultrastructurally after growing in the presence and absence of oil. The procedure of negative staining was used to evaluate the specimens by electron microscopy. For observations by light microscopy, the organism cells were stained with Sudan black B according to Burdon's method of fat staining. Large electron-dense inclusions, which were located predominantly at the cell terminus, characterized species of <u>Flavobacterium</u> and <u>Brevibacterium</u> when growing on oil. Cells of <u>Flavobacterium</u> sp. had smaller inclusions when grown on marine agar, while inclusion bodies were not found in <u>Brevibacterium</u> sp. grown on marine agar. Sudan black B staining indicated the inclusions are stored lipids.</p> <p>INDEX TERMS: Marine bacteria, Microbial degradation, Electron microscopy, Cytological studies, Aerobic bacteria, Ultrastructure, Crude oil, Flavobacterium, Brevibacterium, Heterotrophic bacteria, Light microscopy, Sample preservation, Sample preparation.</p>

3. MICROBIOLOGICAL METHODS

AMIC-6807

"MICROBIAL DEGRADATION OF CRUDE OIL: FACTORS AFFECTING THE DISPERSION IN SEA WATER BY MIXED AND PURE CULTURES", Reisfeld, A., Rosenberg, E., Gutnick, D., Applied Microbiology, Vol. 24, No. 3, September 1972, pp 363-368.

By means of the enrichment culture technique, a mixed population of microorganisms was obtained which catalyzed the dispersion of crude oil in supplemented seawater. From this enrichment culture, eight pure cultures were isolated and studied. Only one of the isolates (RAG-1) brought about a significant dispersion of crude oil. RAG-1 has been tentatively characterized as a member of the genus Arthrobacter. The other seven isolates gave rise to colonies on supplemented oil agar, but were neither able to disperse oil nor to stimulate the dispersion catalyzed by RAG-1. The dispersion of crude oil by either RAG-1 or the enrichment culture was absolutely dependent on exogenous sources of nitrogen and phosphorus and completely inhibited by 0.01 M azide. The increase in cell number of RAG-1 was directly proportional to the concentration of crude oil added to the medium over the range 0.05 to 1.0 mg/ml. Within this linear region, 1.0 mg of crude oil yielded 90 billion cells and approximately 65 percent of the oil was converted into a nonbenzene extractable form. Accompanying the emulsification was a decrease in the pH from 7.6 to 5.0. Acidic conditions, however, were neither necessary nor sufficient for oil dispersion. When seawater was supplemented with 0.029 mM K_2HPO_4 and 3.8 mM $(NH_4)_2SO_4$ and inoculated with RAG-1, oil dispersion occurred within 1 day. This dispersion could also be brought about by the supernatant following separation of the cells from the medium. Similarly, the supernatant obtained following growth of RAG-1 on hexadecane was capable of emulsifying crude oil in 60 min. (Reprinted from Applied Microbiology, Vol. 24, No. 3, September 1972, pp 363-368. Copyright 1972 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

AMIC-6807 (Continued)

Card 2/2

INDEX TERMS: Microbial degradation, Sea water, Dispersion, Kinetics, Environmental effects, Oil spills, Oil wastes, Marine bacteria, Crude oil, Fate of pollutants, Enrichment, Arthrobacter, Mixed cultures, Pure cultures.

AMIC-6808

"MICROBIAL POPULATION OF FEEDLOT WASTE AND ASSOCIATED SITES", Rhodes, R. A., Hrubent, G. R., Applied Microbiology, Vol. 24, No. 3, September 1972, pp 369-377.

A quantitative determination was made every 2 months for a year of the microflora of beef cattle waste and runoff at a medium-sized midwestern feedlot. Counts were obtained for selected groups of organisms in waste taken from paved areas of pens cleaned daily and, therefore, reflect the flora of raw waste. Overall, in terms of viable count per gram dry weight, the feedlot waste contained 10 billion total organisms, one billion anaerobes, 100,000,000 gram-negative bacteria, 10,000,000 coliforms, 1,000,000 sporeformers, and 100,000 yeasts, fungi, and streptomycetes. The specific numbers and pattern of these groups of organisms varied only slightly during the study in spite of a wide variation in weather. Data indicate that little microbial growth occurs in the waste as it exists in the feedlot. Runoff from the pens contained the same general population pattern but with greater variation attributable to volume of liquid. Comparable determinations of an associated field disposal area (before and after cropping), stockpiled waste, and elevated dirt areas in the pens indicate that fungi, and especially streptomycetes, are the aerobic organisms most associated with final stabilization of the waste. Yeasts, which are the dominant type of organism in the ensiled corn fed the cattle, do not occur in large numbers in the animal waste. Large ditches receiving runoff and subsurface water from the fields have a population similar to the runoff but with fewer coliforms. (Reprinted from Applied Microbiology, Vol. 24, No. 3, September 1972, pp 369-377. Copyright 1972 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

AMIC-6808 (Continued)

Card 2/2

INDEX TERMS: Farm wastes, Feed lots, Cattle, Runoff, Pollutant identification, Microorganisms, Confinement pens, Coliforms, Anaerobic bacteria, Yeasts, Fungi, Water pollution sources, Sampling, Methodology, Bacteria, Isolation, Soil disposal fields, Domestic animals, Ruminants, Analytical techniques, Sample preparation, Culture media, Streptomycetes, Enumeration.

3. MICROBIOLOGICAL METHODS

AMIC-6809

"ENTEROBACTERIA IN FEEDLOT WASTE AND RUNOFF", Hrubant, G. R., Daugherty, R. V., Rhodes, R. A., Applied Microbiology, Vol. 24, No. 3, September 1972, pp 378-383.

Samples of beef cattle feedlot waste (FLW), runoff from the pens, and water from a large drainage ditch at the feedlot were examined for Enterobacteriaceae. The drainage ditch receives the runoff but contains primarily subsurface drainage from fields on which FLW is spread for disposal. Plating and enrichment techniques with seven different media were used to isolate 553 cultures of enterobacteria. FLW contains about 50 million enterobacteria/g dry weight. More than 90 percent of these were Escherichia coli, none of which were enteropathogenic types as determined with multivalent sera. Citrobacter and Enterobacter cloacae were other organisms present in moderate numbers. Application of enrichment techniques broadened the spectrum of enterobacteria isolates to include the four Proteus spp., both Providencia spp., Klebsiella, Enterobacter aerogenes, Arizona, and a single isolate of Salmonella (serological group C2). Shigella was not isolated. The wide spectrum of enterobacteria in FLW may be a hazard if unsterilized waste is refed. Fewer enterobacteria occurred in the runoff and in the drainage ditch; the most numerous species in FLW also were most numerous at these sites. However, neither Salmonella nor Arizona was isolated from runoff or drainage-ditch waters. (Reprinted from Applied Microbiology, Vol. 24, No. 3, September 1972, pp 378-383. Copyright 1972 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Cattle, *Feed lots, Runoff, Enteric bacteria, Farm wastes, Pollutant identification, Isolation, Aerobic bacteria, Drainage ditches, Enterobacteriaceae, Enrichment, Culture media, Plate counts, Selective media.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-6662

"COLLABORATIVE STUDY OF A SIMPLIFIED HALPHEN PROCEDURE FOR THE QUANTITATIVE DETERMINATION OF LOW LEVELS OF CYCLOPROPENE FATTY ACIDS", Coleman, E. C., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 82-85.

A collaborative study was conducted on a simplified Halphen procedure for the quantitative determination of low levels of cyclopropene fatty acids. Twelve laboratories (some of these participated in a precollaborative study of this procedure) analyzed 9 samples consisting of mixtures of transesterified corn oil and cottonseed oils, whose cyclopropene content ranged from 0.00 to 0.19 percent. The amount of cyclopropene fatty acids in the samples was estimated in the Associate Referee's laboratory from HBr titration data. A statistical evaluation of the collaborative data indicated good precision and accuracy. Evidence for a significant between-laboratory systematic error could not be found. It is recommended that work be continued on development of a suitable calibration procedure and/or acquisition of a reference standard.

INDEX TERMS: Pollutant identification, Organic acids, Methodology, Chemical analysis, Collaborative studies, Interlaboratory studies, Corn oil, Cottonseed oil, Method evaluation, Fatty acids, Cyclopropene fatty acids, Precision, Halphen procedure, Quantitative analysis.

AMIC-6672

"DETERMINATION OF STRONTIUM-90 IN WATER: COLLABORATIVE STUDY", Baratta, E. J., Knowles, F. E., Jr., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 208-212.

A procedure involving carbonate precipitation and purification with nitric acid was evaluated by 11 collaborators for the determination of strontium-90 in water. Four 1050-ml samples were analyzed by each collaborator. Unknown to the collaborators, these samples consisted of 2 sets of similar, but not identical, samples. The request was to perform single analyses, using the procedure without modification. The ingrowth level of yttrium-90 was counted and used to calculate the strontium-90 activity present. The accuracy of the method ranged from 9 to 16 percent and within-laboratory precision ranged from 13 to 19 percent for strontium-90 levels of 26.2 to 99.6 pCi/L. A slight bias on the low side, caused by individual laboratory techniques, was not considered serious. The method has been adopted as official first action.

INDEX TERMS: Water analysis, Pollutant identification, Methodology, Strontium radioisotopes, Chemical analysis, Aqueous solutions, Chemical precipitation, Collaborative studies, Interlaboratory studies, Sr-90, Method evaluation, Precision, Y-90, Yttrium radioisotopes, Accuracy.

AMIC-6671

"GAMMA SPECTROSCOPIC DETERMINATION OF CESIUM-137 IN MILK, USING SIMULTANEOUS EQUATIONS: COLLABORATIVE STUDY", Baratta, E. J., Knowles, F. E., Jr., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 204-207.

A gamma spectroscopic method, using a sodium iodide (thallium-activated) crystal, was evaluated by 25 collaborators for the determination of cesium-137 in milk. Triplicate analyses were performed on 2 milk samples with high and low activities. The values obtained were statistically analyzed by the use of laboratory mean values. The statistical analysis showed that the collaborators were able to determine levels of activity in the two samples satisfactorily. There was a greater dispersion of results for the low level sample which was not surprising and was to be expected. The percent error found for the low level of Cs-137 activity was 10.2 and that for the high level was 5.9. Overall average recoveries of 295 plus or minus 18.1 and 53 plus or minus 5.3 pCi/L were obtained for samples containing 305 and 52 pCi/L, respectively. The presence of iodine-131 and barium-140 did not interfere with the analyses. This method has been recommended to be adopted as official first action since: (1) the slight bias on the low side and the greater dispersion of results for the low level sample were not considered serious; and (2) the method is acceptable for the analysis of various levels of Cs-137 activity in fluid milk.

INDEX TERMS: Milk, Pollutant identification, Iodine radioisotopes, Radioactivity, Methodology, Statistical methods, Aqueous solutions, Collaborative studies, Cs-137, Interlaboratory studies, Precision, Method evaluation, Cesium radioisotopes, Chemical interference, I-131, Ba-140, Barium radioisotopes, Recovery, Errors.

AMIC-6673

"ION EXCHANGE DETERMINATION OF STRONTIUM-89 AND STRONTIUM-90 IN MILK: COLLABORATIVE STUDY", Baratta, E. J., Knowles, F. E., Jr., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 213-218.

A method for the determination of strontium-89 and strontium-90 in milk, involving ion exchange and purification with nitric acid, was evaluated by 11 collaborators. The accuracy of the method for strontium-89 ranged from 2 to 56 percent and the within-laboratory precision ranged from 11 to 76 percent for a concentration range of 68-480 pCi/L; values for strontium-90 in a concentration range of 50.2-116.2 pCi/L were 6.4 to 10 and 4 to 11 percent, respectively. The slight bias on the high side for strontium-90 was not considered serious. The collaborators had difficulty with strontium-89 analyses, as shown by the high precision and accuracy estimation values.

INDEX TERMS: Ion exchange, Milk, Pollutant identification, Methodology, Strontium radioisotopes, Laboratory tests, Chemical analysis, Aqueous solutions, Separation techniques, Radioactivity, Sr-89, Sr-90, Collaborative studies, Precision, Method evaluation, Interlaboratory studies, Accuracy, Yttrium radioisotopes, Y-90, Recovery, Errors.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-6766

"A BAYESIAN APPROACH TO BIOASSAY", Ramsey, F. L., Biometrics, Vol. 28, No. 3, September 1972, pp 841-858.

A prior distribution for the class of continuous, non-decreasing potency curves is introduced. The Bayes posterior distribution resulting from an assay experiment with quantal responses is discussed. Several examples are presented where a posterior modal function is used to summarize the posterior distribution. The examples illustrate the value of obtaining smooth estimates of potency and the value of experimental designs using many doses with few observations per dose. The methods suggested may be used to analyze quantal response from experiments with one observation per dose, situations in which the standard probit and logit methods cannot be used. It is even suggested that one observation per dose may be in fact the best design for estimating ED50.

INDEX TERMS: Bioassay, Toxicity, Statistical methods, Estimating, Lethal limits, Water pollution effects, Mathematical studies, Bayesian method, Median tolerance limit, Data interpretation, Potency curves, Experimental design.

AMIC-6770

"ESTIMATION OF MICROBIAL VIABILITY", Thomas, V. J., Doughty, N. A., Fletcher, R. H., Robertson, J. G., Biometrics, Vol. 28, No. 4, December 1972, pp 947-958.

Determinations of microbial viability, using the slide culture technique on suspensions in which organisms are aggregated to form clusters, give higher values than would be obtained if all organisms were suspended singly. Formulae have been derived for estimating the viability of individual organisms from the viability of clusters and the distribution of organisms among clusters of different sizes. With the limited stochastic model used it was assumed that clusters of a given size are randomly distributed over a slide and that the distributions of numbers of different sized clusters are statistically independent. An additional assumption was made to the effect that the probability of any organism being alive is constant with value p_i , and that life or death for any one organism is an independent binomial variate with parameter p_i . Depending on the method of sampling used there are two reasonable approaches for estimating the viability of individual organisms from the cluster viability and the cluster size distribution. (1) The first approach depends on a sampling scheme in which a count is made of the number of live and dead clusters for each cluster size over a number of separate samples. In practice this could be carried out by counting the same field of view on a microscope slide before and after growth of the clusters. (2) If preparation of a sample for counts of live clusters differs from, and is incompatible with, preparation for counts of cluster sizes, two separate sets of samples are used. The latter method was used for estimating viability on suspensions of *Nocardia corallina*. A difference of 8.8 percent was obtained between the viability of clusters and that of individual organisms. This value was considerably greater than the degree of uncertainty in both estimates. It was concluded that clustering does have a considerable effect on

AMIC-6767

"SOME DISTRIBUTION-FREE PROPERTIES OF THE ASYMPTOTIC VARIANCE OF THE SPEARMAN ESTIMATOR IN BIOASSAYS", Chang, P. C., Johnson, E. A., Biometrics, Vol. 28, No. 3, September 1972, pp 882-889.

Some distribution-free properties of the asymptotic variance of the Spearman estimator in bioassay have been investigated. The integral of the function, $F(1-F) dx$ was investigated for distribution functions with varying skewness and kurtosis. It was shown that for various shapes of the tolerance distribution, the asymptotic variance of the Spearman estimator can be expressed approximately in terms of either the standard deviation or the distance between the 5th and the 95th percentile of the tolerance distribution. It was observed that $K_{\text{prime sub } 60}$, $K_{\text{prime sub } 80}$, and $K_{\text{sub } \sigma}$ all depend upon skewness and kurtosis of distribution functions more than does $K_{\text{prime sub } 90}$. $K_{\text{prime sub } 90}$ equals approximately 0.17 for all those distribution functions except for the t distribution with 1 degree of freedom. These distribution-free properties can be used in planning quantal assays of required precision.

INDEX TERMS: Bioassay, Lethal limits, Statistical methods, Laboratory tests, Toxicity, Resistance, Mathematical studies, Experimental design, Spearman estimator, Asymptotic variance, Precision, Data interpretation, Quantal assays, Median tolerance limit.

AMIC-6770 (Continued)

Card 2/2

viability determinations and it should be considered especially where interpretations of intracellular materials on maintenance of viability are to be made.

INDEX TERMS: Estimating, Viability, Microorganisms, Mathematical studies, Model studies, Probability, Soil fungi, Water pollution effects, Environmental effects, Stochastic models, Data interpretation, Slide culture techniques, *Nocardia corallina*, Cluster analysis, Random distribution, Pollutant effects.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-6771

"INVERSE SAMPLING OF A POISSON DISTRIBUTION", Weiler, H., Biometrics, Vol. 28, No. 4, December 1972, pp 959-970.

Given a situation where an observation or 'trial' may result in a number X equals 0, 1, 2, ... of events or 'successes', with X a poisson variate of mean μ , a series of independent trials is conducted, resulting in X_1, X_2, \dots successes respectively. The series is terminated as soon as the total number X_1 plus X_2 plus ... plus X_n of successes has reached or exceeded a preassigned number k . Let N_k be the number of trials required to reach k successes. The moments, of N over k to m are derived for both positive and negative integer values of m . Exact confidence limits for μ , based on N_k , are derived, and the width of the confidence interval in relation to the size of the trial unit is discussed. In applications to counts of particles in suspension, the most suitable dilution and size of the trial unit are investigated to ensure an approximate Poisson distribution.

INDEX TERMS: Sampling, Statistical methods, Confidence limits, Poisson distribution, Sample size.

AMIC-6773

"QUANTAL RESPONSE ANALYSIS FOR A MIXTURE OF POPULATIONS", Ashford, J. R., Walker, P. J., Biometrics, Vol. 28, No. 4, December 1972, pp 981-988.

This paper is concerned with the biological assay of a mixture of populations which cannot be differentiated on the basis of their external characteristics. It is shown that the overall dosage-response relation may be expressed in terms of the corresponding relations for the separate populations and of the proportion of each present in the mixture. The derivation of the maximum likelihood (ML) estimates of the unknown parameters is then described and the proposed methods are illustrated by an example of the analysis of a quantal assay of trypanosomes involving a mixture of two distinct populations. The calculation of the parameter estimates involved an iterative procedure which is only practicable using a digital computer, and it is pointed out that the quantity and quality of the experimental data must conform to very stringent criteria if an analysis is to be worthwhile.

INDEX TERMS: Bioassay, Statistical methods, Estimating, Toxicity, Population, Mathematical models, Data interpretation.

AMIC-6772

"INVERSE BINOMIAL SAMPLING AS A BASIS FOR ESTIMATING NEGATIVE BINOMIAL POPULATION DENSITIES", Gerrard, D. J., Cook, R. D., Biometrics, Vol. 28, No. 4, December 1972, pp 971-980.

A sequential sampling procedure has been developed which yields minimum-variance, unbiased estimates of a mean density population and relies solely upon the presence or absence of individuals in sampling units. Using inverse binomial samples of presence or absence, the population densities of negative binomially distributed organisms are characterized by a known parameter k . The estimator is shown to be the only unbiased, uniformly minimum variance estimator obtainable from inverse binomial samples. A comparison of its cost efficiency with that of conventional sampling indicates that the proposed technique offers a promising, economical alternative whenever direct enumeration of populations is either difficult or impractical.

INDEX TERMS: Sampling, Estimating, Statistical methods, Population, Distribution pattern, Data interpretation.

AMIC-6775

"BAYESIAN ESTIMATION AND DESIGN OF EXPERIMENTS FOR GROWTH RATES WHEN SAMPLING FROM THE POISSON DISTRIBUTION", Behnken, D. W., Watts, D. G., Biometrics, Vol. 28, No. 4, December 1972, pp 999-1009.

Data on algal growth rates were used to investigate the problem of estimating the growth rate parameter, β , for a process with an expected value λ_{t_i} equal to $\alpha e^{\beta t_i}$. This equation produces data from a Poisson distribution p of λ_{t_i} at time t_i (i equals 1, 2, ..., n). The posterior distribution for β is derived, and an approach to designing experiments in this situation is suggested.

INDEX TERMS: Estimating, Growth rates, Algae, Statistical methods, Bioassay, Sampling, Data interpretation, Experimental design, Poisson distribution, *Selenastrum capricornutum*.

5. INSTRUMENT DEVELOPMENT

AMIC-6211

"CALIBRATION AND MAINTENANCE EXPERIENCE WITH AN OCEANOGRAPHIC AND METEOROLOGICAL DATA ACQUISITION SYSTEM FOR LARGE NAVIGATION BUOYS", McIntosh, J. A., U. S. Coast Guard, Office of Research and Development, Washington, D.C., Final Report, May 1972, 49 pp. NTIS Report No. AD 742 659.

Instruments to measure air temperature and pressure, wind speed and direction, water temperature and conductivity, and current speed and direction were installed on a large, unmanned buoy, together with equipment to telemeter the data ashore. On shore, a terminal was installed to receive, store, and display the data. The purpose of the installation was to gain experience with instrumentation of this type. To date the installation is about four years old. The installation and operation of the instruments on an unmanned buoy presented no problems and did not interfere with the buoy's primary purpose, that is, as a platform for various marine aids to navigation. Except for the problems of marine fouling and corrosion, which may well have been solved by the use of copper-plated plastic exterior housings, the equipment mounted on the buoy required little maintenance. The trend of the calibration data obtained indicated that annual re-calibration of the meteorological instruments would be more than adequate. The maintenance of the shore terminal required far more effort than had been anticipated. The equipment involved was so complex that even under optimum conditions, it was estimated that it would require attention for an average of about two hours per week by a skilled and knowledgeable technician. The shore terminal for an operational system with the same instruments as presently used could (and should) differ from the prototype in one of two ways. Either it could be much simpler and cheaper, or a terminal similar to the existing one could be used to interrogate and process the data from a much larger number of sensors on each of several buoys.

AMIC-6211 (Continued)

Card 2/2

INDEX TERMS: Maintenance, Electronic equipment, Water temperature, Conductivity, Current meters, Calibrations, Fouling, Corrosion, Buoys.

AMIC-6215

"SURFACE CURRENT MEASUREMENTS BY EXPENDABLE PROBES", Broida, S., Richardson, W. S., U. S. Coast Guard, Office of Research and Development, Washington, D.C., Technical Report, Contract No. DOT-CG-20,859A, June 1972, 7 pp. NTIS Report No. AD 743 706.

An expendable probe for making measurements of surface currents and directions consists of six basic parts: a weighted nose cone, a clock (a kitchen timer), two floats that rise from the bottom when released by the clock, the surface marker, and a protective outer tube. When the probe is dropped from an airplane the surface marker is separated and floats to the surface. The remainder of the probe settles to the bottom and releases two floats after predetermined time delays between them. These floats emit fluorescein dyes at the surface. Surface current and direction can be calculated from the known time delay and the distance between floats. One possible use of the equipment is in determining bulk movement of spilled materials.

INDEX TERMS: Currents (water), Mechanical equipment, Drifting (aquatic).

AMIC-6253

"SOME CHARACTERISTICS OF SEVERAL COMMERCIALY AVAILABLE CATION-RESPONSIVE GLASS ELECTRODES", Phang, S., Steel, B. J., Analytical Chemistry, Vol. 44, No. 13, November 1972, pp 2230-2232.

Ten cation-responsive glass electrodes are characterized and the conditions necessary for such electrodes to be useful in the determination of activity coefficients are given. Solutions of reagent grade sodium chloride, nitric acid, and sodium hydroxide were used to test the electrodes. The electrodes were tested at 25 C; each cell was magnetically stirred and only aged thermal electrolytic type Ag, AgCl electrodes were used. The response of the electrodes tested in reference to pH variations was consistent with the K sub HN sub a values found by earlier experimentation. Responses to light variations show that the effects of light on glass electrodes are serious when accurate activity coefficients are to be measured.

INDEX TERMS: Cations, Physical properties, Electrical properties, Variability, Hydrogen ion concentration, Light intensity, Ion selective electrodes, Glass electrodes, Characterization, Activity coefficients, Silver electrodes.

5. INSTRUMENT DEVELOPMENT

AMIC-6467

"WATER QUALITY MONITORING IN DISTRIBUTION SYSTEMS: A PROGRESS REPORT", McClelland, N. I., Mancy, K. H., Journal American Water Works Association, Vol. 64, No. 12, December 1972, pp 795-803.

The progress of the Water Quality Monitoring Project which is being conducted by the National Sanitation Foundation is reviewed. A prototype potable-water quality monitor is on-stream and can measure: temperatures using thermistors; DO with a voltammetric membrane electrode; pH with a glass electrode; conductivity with an a-c conductivity cell; hardness, nitrates, chlorides, and fluorides with ion-selective electrodes; turbidity with a nephelometer; free residual chlorine with a galvanic cell; alkalinity with a glass electrode; Cu by anodic stripping voltammetry; Cd and Pb by differential anodic stripping voltammetry; and corrosion by a polarization admittance technique. Sample analyses for hardness, nitrates, chlorides, fluorides, and heavy metals are included. A laboratory test for measuring scaling potential using a rotating ring disc electrode has also been developed.

INDEX TERMS: Potable water, Monitoring, Instrumentation, Water temperature, Dissolved oxygen, Hydrogen ion concentration, Conductivity, Hardness, Chlorides, Fluorides, Turbidity, Alkalinity, Nutrients, Nitrates, Chlorine, Copper, Cadmium, Lead, Corrosion, Scaling, Heavy metals, Ion selective electrodes, Nephelometers, Galvanic cells, Anodic stripping voltammetry.

AMIC-6463

"ACTIVITY MEASUREMENTS AT HIGH IONIC STRENGTHS USING HALIDE-SELECTIVE MEMBRANE ELECTRODES", Bagg, J., Rechnitz, G. A., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 271-276.

The newer halide-selective electrodes have been examined in a cell with a homoionic liquid-junction which does not require a reversible cation-electrode or the use of extra-thermodynamic assumptions in the calculation of theoretical emf. These electrodes have been shown to have nearly theoretical potentiometric response in chloride, bromide, and fluoride solutions up to 4-5 molal. The iodide-selective electrode is restricted by deterioration of the electrode surface to solutions less than 0.5 molal. The single-ion activity convention, based upon hydration considerations, proposed by Bates, Staples, and Robinson, combined with the Henderson equation for residual liquid-junction potentials, fitted the data for a cell with heteroionic junction up to 6M NaCl, 4M KCl, 4M KBr, 3M KF, and 1M LiCl. The results are consistent with previously proposed mechanistic models for the operation of crystal membrane electrodes. (Reprinted from Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 271-276. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Halides, Measurement, Bromides, Chlorides, Fluorides, Electrochemistry, Iodides, Ion selective electrodes, Membrane electrodes, Halide selective electrodes, Ionic strength, Ionic activity.

AMIC-6460

"ELECTROCHEMICAL CHARACTERISTICS OF THE GOLD MICROMESH ELECTRODE", Blaedel, W. J., Boyer, S. L., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 258-263.

The design and construction of a flow-through gold micromesh electrode are described. Current-voltage curves are reported for various flow rates. Measured limiting currents are shown to be directly proportional to the number of screens (N) in the electrode, to the concentration of electroactive material (C), and to the cube root of the volume flow rate (Vf) of solution through the electrode. Various mesh sizes are examined. Application is made to the measurement of submicromolar concentrations.

INDEX TERMS: Design, Construction, Electrochemistry, Flow rates, Zeta potential, Physical properties, Electric currents, Electrochemical properties, Gold micromesh electrodes, Ion selective electrodes.

AMIC-6478

"IMPROVED UREA ELECTRODE", Guilbault, G. G., Nagy, G., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 417-419.

An improved urea electrode was made by covering the active surface of a solid type ammonium electrode with a physically immobilized urease (enzyme) reaction layer. This layer was made according to the procedure of Guilbault and Montalvo (1970). A nylon net was placed over the sensor surface and fixed with rubber rings. A solution of 175 mg urease in 0.9 ml monomer solution was dropped onto the netting and polymerized by light for 60 min. The ammonium selective electrode was made using the antibiotic Nonactin as the active ingredient embedded in a silicone rubber matrix. Studies of the electrode show it to have good stability and response characteristics. It allows a convenient determination of urea in water solution, an estimation of urea content of biological fluids of unknown potassium ion concentration, and an accurate measurement of the urea concentration in biological fluids of approximately known potassium concentration. Some theoretical aspects of the enzyme electrode are discussed.

INDEX TERMS: Aqueous solutions, Pollutant identification, Ureas, Selectivity, Potassium, Ions, Enzymes, Electrical stability, Zeta potential, Construction, Methodology, Electrochemistry, Urea electrode, Ion selective electrodes, Biological fluids, Response time, Ureas, Ammonium electrode.

5. INSTRUMENT DEVELOPMENT

AMIC-6479

"DEMOUNTABLE RING-DISK ELECTRODE", Harrington, G. W., Laitinen, H. A., Trendafilov, V., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 433-434.

Although the ring disk electrode has become a valuable tool in studying many electrochemical processes, there are difficulties in fabricating and centering the electrode. The use of different materials requires fabrication of an entirely new electrode for each material. With the present designs, heat treatment of coated electrodes is impossible. An electrode has been specifically designed to permit the use of different materials for the disk and to eliminate problems associated with centering the electrode. Two platinum disk-platinum ring electrodes were constructed and tested with solutions of Cu(II) in 0.5 M KCl; the results agreed exactly with those published previously. Experimental collection efficiency agreed with the theoretical value of 0.345 within less than 2 percent. The electrodes were disassembled and reassembled several times with no changes in the experimental collection efficiency. The procedure, accompanied by a diagram, is given for constructing such an electrode. A descriptive discussion is also presented for a tin oxide-coated glass disk-platinum ring electrode and an electrode in which both disk and ring are of tin oxide-coated glass.

INDEX TERMS: Construction, Design, Methodology, Efficiencies, Electrochemistry, Laboratory equipment, Ring disk electrode, Platinum, Sensors, Tin oxide-coated glass, Precision.

AMIC-6506 (Continued)

Card 2/2

INDEX TERMS: Electrochemistry, Instrumentation, Ion selective electrodes, Transfer functions, Mercury electrodes, Platinum electrodes.

AMIC-6506

"LINEAR AND NONLINEAR SYSTEM CHARACTERISTICS OF CONTROLLED-POTENTIAL ELECTROLYSIS CELLS", Harrar, J. E., Pomernacki, C. L., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 57-78.

A detailed study was made of the characteristics of three-electrode controlled-potential electrolysis cells as components of control systems. In the absence of significant faradaic current, these cells can be represented as linear, bridged-T type networks. Important parameters that determine cell response are the reference electrode resistance and a parasitic capacitance that couples the cell input to the output. Cells whose electrodes are arranged for optimum dc potential distribution were also found to have the minimum phase shift for a given attenuation, and on the basis of the circuit model the phase shift will not exceed 90 degrees. Cells with poor geometry exhibit excessive phase shift in their transfer functions. In the presence of significant faradaic current, the fundamental frequency transfer function is altered considerably and at applied potentials near the current-potential waves the cells are nonlinear. Negative-admittance reactions can cause the cell phase shift to be more negative than -90 degrees, but most faradaic reactions cause the cell to exhibit less phase shift than the background solution value. Sufficient conditions for system stability, taking into account the time-varying, nonlinear, and other complicating characteristics of the cells, can be rigorously obtained using the circle criterion. Several aspects of electrochemical system design and measurement are discussed. (Reprinted from Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 57-78. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

AMIC-6519

"AUTOMATED DATA HANDLING USING A DIGITAL LOGGER", Larsen, D. G., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 217-220.

Data from analytical instruments requiring little or no control may be input to a small computer by a system developed by the author. Analog data are fed into a Keithley Model 160 Digital Multimeter whose BCD signal is converted to ASCII code by a coupler driver. This code is then fed to an ASR 33 teletype which produces hard copy and paper tape output. The tape is then used as input to the computer. The data logger has proven to be useful for automating digital data collection from a wide variety of spectrometers and other equipment. The logging speed or data rate is limited to a maximum of one data word per second. The logging system has the advantage of low cost and can be built from commercially available equipment. Schematics of the system are included.

INDEX TERMS: Digital computers, Electronic equipment, Data processing, Data transmission, Analog to digital converters, Data logger.

5. INSTRUMENT DEVELOPMENT

<p>AMIC-6630</p> <p>"UNDERWATER CAMERA SYSTEM FOR DEEP-SEA BOTTOM PHOTOGRAPHY", Singleton, R. J., Cole, A. G., <u>New Zealand Journal of Marine and Freshwater Research</u>, Vol. 6, Nos. 1 and 2, June 1972, pp 185-193.</p> <p>A 35 mm camera system has been developed to operate to depth of 4,000 m. The camera and trigger unit are in an underwater housing and are worked by a magnetic switch which is closed on contact with the ocean bottoms. The camera in turn fires a flash unit in a separate housing. A DC/DC converter charges the flash unit from batteries and a Schmitt trigger turns off the DC/DC converter when the flash unit is charged, thus extending battery life. The system described uses standard carbon-zinc torch cells, and has been designed to give maximum battery life by using a flash unit of relatively low output (40 J), restricting the recycle time of the system to 60 s, and an electronic system to turn off the power to the flash unit when fully charged. The batteries in the flash unit will last 300 flashes or more, and those of the camera unit more than 1,000. The system takes up to 24 pictures at one lowering. Details of the system are given.</p> <p>INDEX TERMS: Deep water, Photography, Sea water, Mechanical equipment, On-site data collections, On-site investigations, Construction, Design data, Marine environment, Underwater camera system, Sea bottom, Underwater cameras.</p>	<p>AMIC-6740 (Continued) Card 2/2</p> <p>INDEX TERMS: Conductivity, Estuaries, Monitoring, Instrumentation, Profiles, Measurement, Density stratification, Inlets (waterways), Automation, On-site data collections.</p>
<p>AMIC-6740</p> <p>"AN INSTRUMENT FOR MEASURING CONDUCTIVITY PROFILES IN INLETS", Farmer, D. M., Osborn, T. R., <u>Journal of the Fisheries Research Board of Canada</u>, Vol. 29, No. 12, December 1972, pp 1767-1769.</p> <p>A description is given of an instrument for monitoring conductivity profiles in the upper few meters of stratified estuarine waters. Watertight containers of P.V.C. tubing separately house the batteries and the electronics. Four low specific gravity 6-volt, lead-acid batteries provide the power. Each probe was calibrated by immersing it in a large container of salt water of known temperature, for which the conductivity could be determined accurately by other means. After noting the output, the cell was removed from the salt solution and a conducting loop in series with a potentiometer was passed through the probe. In this way, it was possible to find a cell constant, Kc, in terms of the solution conductivity, Sc, and the 'equivalent resistance', Req, of the potentiometer that yielded the same output as that obtained with the cell in solution. The instrument measures the electrical conductivity of seawater at 14 depths by successively interrogating, for 1 min at a time, each of the 14 conductivity probes on the chain. There is a 15th probe inside the instrument housing which serves as a check on any drift in the response of the electronics. Output from the conductivity measuring circuit is fed to a Rustrak chart recorder. A converted fiberglass marker buoy with a lid at one end and an inner sheath of plastic foam affords shock protection and flotation for the battery and instrument cases. The instrument runs for one week between chart replacements. Contours of constant conductivity derived from the chart records have provided a graphic description of wind effects in Alberni Inlet.</p>	<p>AMIC-6825</p> <p>"CYCLIC ANALOG-TO-DIGITAL CONVERSION", Barnes, J., <u>Instruments and Control Systems</u>, Vol. 46, No 3, March 1973, pp 35-36.</p> <p>Cyclic converters are continuous devices in which lists are calculated serially and an output word is always available. The conversion may be implemented in a series of successive approximation stages. To determine whether the bit at each stage is ONE or ZERO, the reference voltage, which equals half the full-scale of the converter, is subtracted from the unknown input. The difference is multiplied by -2, and is applied to a sign comparator. For the most significant bit (MSB) a negative value causes the sign comparator to generate a ONE and a positive value results in a ZERO. For all subsequent bits, the polarities are reversed. The output of the reference comparator is also applied to an absolute value circuit, to create a residue for use as the input to the next stage. The analog portion of each converter stage can be implemented with operational amplifiers. The reference comparator, sign comparator, and absolute value circuit are described.</p> <p>INDEX TERMS: Data processing, Data transmission, Electronic equipment, Analog to digital converters.</p>

5. INSTRUMENT DEVELOPMENT

AMIC-6826

"WATER POLLUTION MONITORING", Conti, U., Industrial Photography, Vol. 21, No. 7, July 1972, pp 30-31, 49.

Members of the Geoscience Engineering Department at the University of California, Berkeley, are testing an automatic, continuous, in situ water pollution monitoring system which promises to be both more economical and easier to operate than a comparable system already in use. This system consists of a towed vehicle about four feet long, capable of following a given vertical path (constant depth of constant distance from the bottom) and housing a number of sensors. The parameters measured are depth, dissolved oxygen, temperature, salinity, pH, chloride ion activity, sulfide ion activity and ambient light. The system is powered by its own battery pack and does not require an electrical cable incorporated in the tow line. The problem of recording the eight parameters (plus two internal checks and time for a total of 11 parameters) has been solved very economically with a movie camera by translating the various parameters to voltages, which are displayed sequentially in alphanumeric form on a Weston Model 1292 digital voltmeter. A Bell and Howell 16mm magazine camera takes single-frame pictures of the digital voltmeter, of an electric watch and of the scanner readout which shows which parameter is being measured. The camera has been modified to be motor driven at a speed of 20 frames per minute. As no changes have been made on the shutter mechanism, each frame is exposed for about 1.5 seconds. A standard 50-foot 16mm magazine contains 2000 frames or data points, and supplies more than 1.5 hours continuous record. The film is read on a small standard editor, and the data from one 50-foot reel can be transcribed onto tables or computer cards in about two hours. The main advantages of this system are great reliability, ease of operation and low cost. The entire system has been tested extensively at sea in Mexico and in the San Francisco

AMIC-6827

"CALIBRATING PLATINUM RESISTANCE THERMOMETERS", Benedict, R. P., Russo, R. J., Instruments and Control Systems, Vol. 45, No. 10, October 1972, pp 55-56.

Replacement of the International Practical Temperature Scale of 1948 (IPTS-48) with IPTS-68 requires that the calibration of platinum resistance thermometers be changed. Consequently, the Callender interpolation equation has been revised for determining calibration constants from experimental data in the temperature range between the ice and antimony points. A correction factor is applied to the equation to satisfy the new scale.

INDEX TERMS: Calibrations, Temperature, Platinum thermometers.

AMIC-6826 (Continued)

Card 2/2

Bay. The recording system worked flawlessly, recording very small changes in the measured parameters. Additional uses of the system are discussed.

INDEX TERMS: Water pollution, Monitoring, Automation, Photography, Water properties, Mechanical equipment, Water quality, Physical properties, Chemical properties, Cameras, Reliability, Sensors.

AMIC-6828

"TEMPERATURE COEFFICIENTS AND THEIR COMPENSATION IN ION-SELECTIVE SYSTEMS", Negus, L. E., Light, T. S., Instrumentation Technology, Vol. 19, No. 12, December 1972, pp 23-29.

Temperature effects in ion-selective electrode systems are discussed as well as compensation techniques for these effects. The electrodes discussed fit in either of the following categories: 1. The cell potential and thermal characteristics are independent of any internal filling solution (solid-state membrane electrodes for Ag, chloride, bromide, iodide, sulfide, cyanide, and Cu). 2. The cell potential and thermal characteristics are dependent upon the internal filling solution (electrodes for pH, Na, fluoride, Ca, Mg, and water hardness). Application of such electrodes is aided if there is exact information available on their thermal characteristics. It has been shown that those characteristics can be derived from the Nernst equation and from experimental data, and how various thermal effects can be minimized.

INDEX TERMS: Thermal properties, Instrumentation, Mathematical studies, Temperature, Laboratory equipment, Research equipment, Temperature control, Electrochemistry, Ion selective electrodes, Temperature coefficients, Temperature compensation, Sensors.