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# Reviews of Current Literature on Analytical Methodology and Quality Control

No. 15



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## NOTICE

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

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

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REVIEWS OF CURRENT LITERATURE ON  
ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 15

By

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WASHINGTON, D.C. 20460



NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM  
ANALYTICAL QUALITY CONTROL LABORATORY

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ANALYTICAL METHODOLOGY AND QUALITY CONTROL

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

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# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6233

"THE SNOW REMOVAL CONTROVERSY", Van Loon, J. C., Water and Pollution Control, Vol. 110, No. 11, November 1972, pp 16, 19-20.

Controversy has arisen in Canada over the effects of street salting and snow dumping in lakes and rivers. For the past three years, the author's laboratory has monitored runoff from urban streets, contamination of urban and rural water courses, runoff and solids residues in contaminated snow being dumped, airborne winter dusts and snow, and winter rains for toxic metals, chlorides, phosphorus, sodium, and calcium. The data show that: (1) Phosphorus contents of snow were insignificant. (2) Soluble metal contents of snow compared with that of runoff. (3) Airborne dust is a major component of street snow residue. (4) The chloride value of snow was 3.1 ppm compared with 2.4 ppm for summer rain indicating that road salt is recycled into the air in winds. It is concluded that salting programs are essential for safety reasons, but salt must be used sparingly since the vast majority of salt eventually discharges into lakes and rivers regardless of disposal methods. However, as much snow as possible should be left at roadside. Heavy metal content of snow do not appear to be above those of the receiving waters. The fate of oils, greases, and toxic organics is only partially understood at the present time.

INDEX TERMS: Water pollution sources, Runoff, Snow removal, Heavy metals, Chlorides, Oil, Phenols, Organic matter, Street salting.

AMIC-6455

"APPLICATION OF A WAVELENGTH SCANNING TECHNIQUE TO MULTI-ELEMENT DETERMINATIONS BY ATOMIC FLUORESCENCE SPECTROMETRY", Norris, J. D., West, T. S., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 226-230.

Two dual-element electrodeless discharge lamps, operated from a single microwave generator via a two-port power divider, enable a separated air-acetylene flame to be illuminated with the intense resonance radiation of four elements. The resultant atomic fluorescence may be rapidly measured by scanning over the appropriate wavelength range. Results obtained for the sequential multi-element determination of zinc, cadmium, nickel, and cobalt show that the sensitivity and selectivity are the same by the scanning technique as by conventional atomic fluorescence spectrometry. Wavelength scans are also given for nickel, cobalt, iron, and manganese, and for selenium, tellurium, nickel, and cobalt combinations. (Reprinted from Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 226-230. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Aqueous solutions, Chemical analysis, Pollutant identification, Heavy metals, Nickel, Cobalt, Iron, Manganese, Zinc, Cadmium, Selectivity, Alkaline earth metals, Multielemental analysis, Atomic fluorescence spectroscopy, Electrodeless discharge lamps, Wavelength scanning technique, Selenium, Tellurium, Detection limits, Reproducibility, Chemical interference.

AMIC-6449

"BENTHAL OXYGEN DEMANDS AND LEACHING RATES OF TREATED SLUDGES-", Mueller, J. A., Su, W. J.-I., Journal Water Pollution Control Federation, Vol. 44, No. 12, December 1972, pp 2303-2315.

The effects of sludge dumping in coastal waters, such as the New York Bight, were studied in the laboratory in continuous flow reactors supplied with raw, digested, heat treated, and wet oxidized sludges. The sludges were concentrated, analyzed, and seeded using sea water overlying sludge deposits. The reactors consisted of Plexiglas cylinders 2 3/4 inch i.d. by 5 inches high mounted on a square base. A plastic screen covered the sludge to maintain stability during continuous air diffusion. The reactors were placed in a water bath maintained at 15 C. For each sludge, one reactor as used for determination of oxygen uptake and effluent analyses during a 45-day incubation period. A second reactor was used for sludge analysis after 21 days. After 45 days, sludge in a third reactor was mixed with its supernatant and oxygen uptake monitored for several days. Test results indicated that treatment of sludges before disposal reduced benthic demands and nutrient leaching rates. Benthic demands could be reduced 50 percent by heat treatment, low-pressure wet oxidation, or digestion, and over 90 percent by intermediate and high-pressure wet oxidation. Wet oxidation also provided the best reduction of volatile solids in the sludges.

INDEX TERMS: Biochemical oxygen demand, Cultures, Leaching, Sewage sludge, Sludge disposal, Water pollution effects, Chemical oxygen demand, Laboratory equipment, Heavy metals, Laboratory tests, Nutrients.

AMIC-6469

"FLOW PROGRAMMING IN COMBINED GAS CHROMATOGRAPHY--MASS SPECTROMETRY", Grayson, M. A.; Levy, R. L.; Wolf, C. J., Analytical Chemistry, Vol. 45, No. 2, February 1973, pp 373-376.

The use of flow programming gas chromatography (FPGC) in combination with GC-mass spectrometry has been studied using a Bendix time-of-flight mass spectrometer coupled to a Beckman gas chromatograph with a molecular effusion type separator. An Analabs flow programmer was used to program the flow rate. The ion source pressure was monitored with a Bayard Alpert ionization gauge. In order to have a molecular separator that operates efficiently over a broad range of carrier gas flow rates the latter of these 3 approaches were used: The outlet of the GC column is directly connected to the molecular separator and the entire column effluent is introduced to the separator; the outlet of the GC column is connected to a 'flow splitter', thus allowing only a fixed flow to enter the separator while the excess flow is vented; the separator is optimized for the highest flow rate encountered in the program. Using the latter, flow programming with GC/MS produced no change in yield during analysis. During an analysis of n-octane, the relatively low background current observed with FPGC (in contrast to TPGC) illustrated the utility of the extension of the useful range of the chromatographic column while minimizing the effect of 'column bleed'. The intensity of the peaks obtained during the elution of n-octane with TPGC indicates the advantage of FPGC-MS in obtaining the net mass spectrum.

INDEX TERMS: Methodology, Separation techniques, Pollutant identification, Flow rates, GC-mass spectrometry, FPGC-mass spectrometry, Flow programming.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6476

"AUTOMATED KJELDAHL NITROGEN DETERMINATION--A COMPREHENSIVE METHOD FOR AQUEOUS DISPERSIBLE SAMPLES", Kramme, D. G., Griffen, R. H., Hartford, C. G. [Corrado, J. A., *Analytical Chemistry*, Vol. 45, No. 2, February 1973, pp 405-408.

A standardized, automated procedure has been developed for the determination of Kjeldahl N without modification regardless of the composition of the sample. A basic Technicon AutoAnalyzer System was used with a special custom made gas aspiration pipet in the continuous digester. The Technicon procedure was modified to give a tenfold increase in sensitivity and the digester input manifold was changed to increase sample size by 50 percent. The heating stages were reversed to eliminate excess fumes. Reducing the  $\text{SeO}_2$  (catalyst) concentration from 0.3 to 0.15 percent eliminated the precipitation problem and maintained good digestion with the reversed heating stages. Various N-containing compounds were analyzed using identical conditions and recoveries were nearly 100 percent. Liquid samples containing up to 10 percent carbohydrate can be digested without interference or further dilution. Significant interference was observed in tests on color development with 50 ppm Cr (3 plus), Mn (2 plus), Fe (3 plus), and Co (2 plus), and with 400 ppm Li, K, Mg, Ni, Zn, Cu, Cd, Hg, and Pb cations. The use of EDTA or sodium potassium tartrate results in a significant reduction in interference with some metal ions; no change in the interference of others; and with certain other ions, enhances the interference. In this comprehensive method, chelating agents were not included because sample composition is often unknown or widely varied. The automated method was compared with the manual Kjeldahl method by analyzing four unknown samples by both procedures. Good agreement of the two methods was achieved.

AMIC-6476 (Continued)

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INDEX TERMS: Chemical analysis, Aqueous solutions, Carbohydrates, Automation, Nitrogen, Pollutant identification, Cations, Heavy metals, Alkaline earth metals, Alkali metals, Methodology, Color reactions, Kjeldahl nitrogen, Kjeldahl procedure, Ionic interference, Chelating agents, Recovery, Sensitivity.

AMIC-6477

"STABILITY OF METAL DITHIOCARBAMATE COMPLEXES", Scharfe, R. R., Sastri, V. S., Chakrabarti, C. L., *Analytical Chemistry*, Vol. 45, No. 2, February 1973, pp 413-415.

The objectives of this study were to: (1) to determine the stability constants of complexes of some divalent metal ions with a variety of N-substituted dithiocarbamic acids; and (2) determine the effect of various substituents at the nitrogen atom in disubstituted dithiocarbamic acids on the magnitude of stability constants. Aqueous solutions of the dithiocarbamic acids prepared as the Na salt, of the metal ion (Pb, Ni, Zn), and of the competing ligand (NTA or EDTA) were studied using solvent extraction and polarographic methods. There was fair agreement between the values of the stability constants obtained by those methods; the differences were possibly due to the different ionic strengths, 0.01 and 1.00, respectively, employed in the 2 methods. In the case of Pb, there was a linear relationship between the stability constant values and the pK (basicity) of three dithiocarbamic acids. In the case of Zn and Ni, there was no regular trend in the stability constants with the increasing basicity of dithiocarbamic acids. The order of the stability constants for Zn, Ni, and Pb was hexamethylene DTC greater than pipDTC greater than PyrDTC. Pyrrolidine DTC forms complexes of the same degree of stability as the widely used diethyl DTC. However, at low pH of 1.0, pyrrolidine DTC is more stable than diethyl DTC. Thus, the substitution of pyrrolidine DTC in many existing procedures which call for diethyl DTC will add an additional element of flexibility to many analytical procedures. (Holoman-Battelle)

INDEX TERMS: Lead, Zinc, Nickel, Polarographic analysis, Solvent extractions, Stability, Aqueous solutions, Nitrilotriacetic acid, Chemical reactions, Dithiocarbamic acids, Metal complexes, Stability constants, Ligands, EDTA.

AMIC-6516

"SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH CHROMAZUROL S AND CETYLPIRIDINIUM BROMIDE", Leong, C. L., *Analytical Chemistry*, Vol. 45, No. 1, January 1973, pp 201-203.

Since the uranyl ion has been found to form a soluble blue complex with chromazurol S and cetylpyridinium bromide (CPB), a study has been made of the color reaction with reference to the development of a suitable spectrophotometric method for determining U(VI). A study of the optimum conditions for color development yielded the following: (1) pH 4.8 was chosen for all absorption measurements. (2) At an average temperature of 20 C, maximum absorbance was obtained in 15 minutes and absorbance remained constant for at least 24 hours. (3) The complex was not extractable by chloroform, carbon tetrachloride, ether, nitrobenzene, nitromethane, isobutyl ketone, isoamyl alcohol, and benzyl alcohol. (4) The calibration graph obeyed Beer's law for 0-100 micrograms of U(VI)/ 50 ml of solution. (5) The color reaction has a molar absorptivity of 99,000 at 625 nm and a relative standard deviation of 3 percent. (6) A 100-fold weight excess of Al(III), Cr(VI), Be(II), Fe(III), Bi(III), Mo(VI), Yb(III), Dy(III), and Ce(III) gave serious interferences, while a 2-fold weight excess of Th(IV) gave interference. Preliminary separation of U(VI) by such methods as ion exchange will be necessary before determination.

INDEX TERMS: Color reactions, Aqueous solutions, Spectrophotometry, Heavy metals, Pollutant identification, Chemical reactions, Separation techniques, Cations, Hydrogen ion concentration, Solvent extractions, Alkaline earth metals, Chromazurol S, Cetylpyridinium bromide, Uranium, Absorbance, Ionic interference, Reproducibility, Molar absorptivity, Sensitivity, Chromogenic reagents, Rare earth elements.



# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6561

"DISSOLVED OXYGEN AND TEMPERATURE IN A STRATIFIED LAKE", Smith, S. A., Bella, D. A., Journal Water Pollution Control Federation, Vol. 45, No. 1, January 1973, pp 119-133.

Temporal and spatial variations of temperature and dissolved oxygen were measured in Triangle Lake in Oregon. The lake was relatively uniform in the horizontal direction and significantly stratified vertically. Diel dissolved oxygen variations were less than 0.5 mg/l in surface regions. Diel temperature variations resulted in a nocturnal density overturning extending to about 9 ft (3 m) in depth. Depth of summer diel overturning defined the lower boundary of the epilimnion and upper boundary of metalimnic dissolved oxygen maximum. Complete overturn did not occur during the mild winter of 1969-70, and low hypolimnetic dissolved oxygen values occurred the following summer. During summer months, desirable game fish habitats in the lake are restricted by temperature and oxygen conditions.

INDEX TERMS: Dissolved oxygen, Water temperature, Thermal stratification, Hypolimnion, Mixolimnion, Water properties, Water quality, Data collections, Water sampling, Epilimnion, Chemical analysis, Water analysis, Diel variations, Triangle Lake, Metalimnion.

AMIC-6589

"WHAT'S KNOWN ABOUT PENTACHLOROPHENOLS", Cote, R. P., Water and Pollution Control, Vol. 110, No. 12, December 1972, pp 35-37.

A review of the literature was conducted to summarize the available knowledge of pentachlorophenols, potentially harmful pollutants. The review covers production, use, chemical and physical properties, methods of analysis, toxicity to mammals and aquatic organisms, and effects on sludge bacteria. The evidence on pentachlorophenol and sodium pentachlorophenate as environmental contaminants suggests that the problem is not of the same magnitude as DDT or oil. Nevertheless, PCP and its salts cause significant impact in localized areas where it is continuously added to the environment. Heavy usage on an intermittent basis could also have severe consequences. Fortunately the persistence of PCP and its sodium salt are limited, however, their degradation products may present toxicity problems of a chronic or sublethal nature.

INDEX TERMS: Water pollution effects, Toxicity, Degradation (decomposition), Solubility, Gas chromatography, Invertebrates, Fish, Snails, Shrimp, Pentachlorophenol, Sodium pentachlorophenol, Fate of pollutants, Tadpoles.

AMIC-6572

"PROCEEDINGS THIRD NATIONAL SYMPOSIUM ON FOOD PROCESSING WASTES. March 28-30, 1972, New Orleans, Louisiana", Pacific Northwest Water Laboratory, National Waste Treatment Research Program, Corvallis, Oregon, Report No. EPA-R2-72-018, November 1972, 498 pp.

Technical papers presented at the Third National Symposium on Food Processing Wastes, March 28-30, 1972, New Orleans, Louisiana include the following topics of interest: 1. 'Report on First Commercial Evaluation of Dry Caustic Peeling of Clingstone Peaches' by Herbert Stone; 2. 'Ice Cream Wastewater Characterization and Treatability' by E. F. Dul; 3. 'Ocean Assimilation of Food Residuals' by Walter W. Rose, et al.; 4. 'Winery Wastewater Treatment' by Edwin Hayes, et al.; 5. 'Characterization and Treatment of Brewery Wastes' by Henry G. Schwartz, Jr. and Richard H. Jones; 6. 'Characterization of Fruit and Vegetable Processing Wastewaters' by M. R. Soderquist et al.; 7. 'Progress Report: Seafoods Processing Wastewater Characterization' by M. R. Soderquist et al.; and 8. 'A Field Study on the Application of Individual Quick Blanching' by Daryl B. Lund.

INDEX TERMS: Waste water (pollution), Pollutant identification, Conferences, Food processing industry, Effluents, Waste water disposal, Monitoring, Waste water treatment, Fruit crops, Vegetable crops, Waste identification, Physical properties, Chemical properties, Water pollution sources, Solid wastes, Water analysis, Chemical analysis, Liquid wastes, Path of pollutants, Canneries, Fish handling facilities, Industrial wastes, Characterization, Ice cream, Breweries, Seafoods.

AMIC-6593

"DETERMINATION OF CADMIUM IN BLOOD BY A DELVES CUP TECHNIQUE", Ediger, R. D., Coleman, R. L., Atomic Absorption Newsletter, Vol. 12, No. 1, January-February 1973, pp 3-6.

A simple, rapid method is described for the determination of cadmium in blood utilizing the Delves cup apparatus. Heparinized blood is pipetted into the Delves cups after passage through the air-acetylene flame in order to decontaminate the surface. The cups were placed in their tray, dried at 150 C for 1 min, individually mounted on the Delves cup apparatus, and pushed almost to the center of the flame. Upon cessation of combustion, the cup was immediately pushed to the center of the flame and the Cd absorption peak was recorded. The Deuterium Background Corrector was used to compensate for nonspecific absorption. Standardization was by the method of additions on a normal blood sample spiked with cadmium to yield added concentrations of 0.50, 1.00 and 1.50 micrograms Cd/100 ml. With this procedure, less than 0.02 microgram Cd/100 ml of blood can be detected using a 10-microliter sample. The technique yields values comparable to data obtained with an extraction procedure utilizing the graphite furnace. The effects of cup positioning on absorbance and the use of background correction are discussed.

INDEX TERMS: Cadmium, Heavy metals, Methodology, Chemical analysis, Pollutant identification, Delves cup method, Atomic absorption spectrophotometry, Blood, Biological samples, Absorbance, Detection limits, Body fluids.



# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6594

"THE GENERATION AND DETERMINATION OF COVALENT HYDRIDES BY ATOMIC ABSORPTION", Pollock, E. N., West, S. J., Atomic Absorption Newsletter, Vol. 12, No. 1, January/February 1973, pp 6-8.

The use of  $TiCl_3$  with magnesium metal or the use of  $NaBH_4$  as reductants and sources of nascent hydrogen for the generation of volatile hydrides from the covalent metals has extended this atomic absorption spectroscopy technique to include Bi, Sb, Te and Ge as well as As and Se. The development of an apparatus compatible with the change in chemical reactions has led to simple precise methods for the determination of these six elements. Further changes in reagents, technique or apparatus may extend the usefulness of this method to the determination of Sn, Si and Pb. The data showed excellent precision to be obtainable in the  $TiCl_3$ -Mg method for determination of As, Se, Sb, Bi, Te at the submicrogram level. Ge determination using  $NaBH_4$  was less sensitive and showed poorer precision. Detection limits are shown to be much better with the hydride method than with conventional AA. The method was unsuccessful with Sn, Pb, and Si.

INDEX TERMS: Aqueous solutions, Atomic absorption spectrophotometry, Arsenic, Selenium, Bismuth, Germanium, Antimony, Tellurium, Hydrides, Sample preparation, Detection limits.

AMIC-6597

"THE USE OF ATOMIC ABSORPTION SPECTROSCOPY FOR THE DETERMINATION OF PARAMETERS IN THE SOLVENT EXTRACTION OF METAL CHELATES, Berger, S. A., Atomic Absorption Newsletter Vol. 12, No. 1, January-February 1973, pp 30-32.

Problems of determining equilibria in the solvent extraction of metal chelates can be minimized by using atomic absorption spectroscopy. A suggested procedure involves preparation of calibration curves for both the aqueous and organic phases. Sample calibration curves were prepared for the solvent extraction system, Fe (III)-chlorogenic acid, using  $Fe(ClO_4)_3 \cdot 6H_2O$  in distilled water saturated with benzene or MIBK plus chlorogenic acid. The results show that AA is useful for study of the equilibria in solvent extraction of metal chelates since it is rapid and requires minimal sample preparation. Recoveries with Fe (III) were about plus or minus 3 percent.

INDEX TERMS: Iron, Solvent extractions, Heavy metals, Calibrations, Chelated metals, Sample preparation, Atomic absorption spectrophotometry.

AMIC-6596

"COMPARISON BETWEEN DRY ASHING AND WET DIGESTION IN THE PREPARATION OF PLANT MATERIAL FOR ATOMIC ABSORPTION ANALYSIS", Giron, H. C., Atomic Absorption Newsletter, Vol. 12, No. 1, January-February 1973, pp 28-29.

Samples of alfalfa, clovers, and grasses were collected, pooled, chopped, dry ashed or wet digested, analyzed by atomic absorption, and the results subjected to statistical analysis to determine whether the ashing procedures affected results. Twenty-five 2-gram samples were placed in porcelain crucibles and dry ashed at 550 C for 2-3 hours in a muffle furnace. The ashed samples were then boiled in 1 N HCl and diluted with distilled water. The same number of samples were wet ashed by letting them stand overnight in concentrated  $HNO_3$ . The solution was then boiled, cooled, and  $HClO_4$  added. After heating, the samples were diluted with distilled water. The prepared samples were analyzed for iron, sodium, potassium, calcium, magnesium, copper, manganese, and zinc by AA. The statistical analysis showed nonsignificant differences in results except for iron concentration in alfalfa and grass. Iron appeared to be higher with dry ashing. A second series of tests using a quartz shield to protect the sample from contamination inside the furnace gave results which were not significantly different. Dry ashing appeared to give better precision, and since it is more rapid than wet digestion, it is suggested that dry ashing may be a more desirable process for sample preparation.

INDEX TERMS: Grasses, Statistical methods, Heavy metals, Sodium, Potassium, Calcium, Magnesium, Iron, Copper, Manganese, Zinc, Alfalfa, Clover, Sample preparation, Wet ashing, Dry ashing, Atomic absorption spectrophotometry.

AMIC-6637

"IMPROVED METHOD FOR DETERMINATION OF XANTHOPHYLL IN FRESH ALFALFA AND WET FRACTIONS", Knuckles, B. E., Bickoff, E. M., Kohler, G. O., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 6, November 1972, pp 1202-1205.

An improved method has been described for the analysis of xanthophyll, as well as carotene, in fresh alfalfa. Samples of the plant are cut and chopped for uniform mixing if necessary. A quantity of the sample is mixed with absolute ethanol and filtered through fluted filter paper. An aliquot of the filtrate is then mixed with 40 percent methanolic KOH and evaporated to dryness under vacuum (60-65 C). The evaporated extract is transferred onto a chromatographic column, vacuum is applied and the pigment eluate is collected in a flask. The eluate is mixed with its eluant, and the volume is diluted with acetone and stored in the dark. In order to determine the pigmenting xanthophylls, ethanolic HCl is added to an aliquot of eluate, diluted with acetone, and mixed. The absorbance can be determined between 5 and 15 min after mixing with any suitably calibrated colorimeter or spectrophotometer. The outlined method is relatively rapid, is suitable for routine use, and measures both carotene and xanthophyll in the same extract.

INDEX TERMS: Methodology, Plant pigments, Solvent extractions, Separation techniques, Primary productivity, Colorimetry, Color, Xanthophylls, Carotene, Organic solvents, Absorbance, Sample preparation.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6638

"CONFIRMATION OF PESTICIDE RESIDUE IDENTITY. IV. DERIVATIVE FORMATION IN SOLID MATRIX FOR THE CONFIRMATION OF ALPHA- AND BETA-ENDOSULFAN BY GAS CHROMATOGRAPHY", Chau, A. S. Y., Terry, K., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 6, November 1972, pp 1228-1231.

The new solid matrix derivation procedure has now been applied to the confirmation of endosulfan residue identity. This procedure involves the conversion of endosulfans to the same diacetate in alumina impregnated with H<sub>2</sub>SO<sub>4</sub> and acetic anhydride. The concentrated sample extract or standard solution is applied to the surface of the solid matrix in the microcolumn. The column is heated for two hours and the eluted with benzene. The eluate is then examined, with and without concentration, by electron capture gas-liquid chromatography. Comparable yield of the diacetate was obtained from the present approach and from a previously reported acetylation method. Of the various experimental conditions investigated, the best conditions included derivatization for 2 hr at 100 C in solid matrix of alumina-acetic anhydride-H<sub>2</sub>SO<sub>4</sub> (50 plus 10 plus 5) (w/v/v). The advantage of the present method over the previously reported procedure is discussed, and the applicability of this method to the confirmation of endosulfan in fish and water is illustrated.

INDEX TERMS: Pesticide residues, Chlorinated hydrocarbon pesticides, Pollutant identification, Methodology, Insecticides, Chemical analysis, Alpha-endosulfan, Beta-endosulfan, Derivatization, Electron capture gas chromatography, Acetylation.

AMIC-6639

"CONFIRMATION OF PESTICIDE RESIDUE IDENTITY. V. ALTERNATIVE PROCEDURE FOR DERIVATIVE FORMATION IN SOLID MATRIX FOR THE CONFIRMATION OF ALPHA- AND BETA-ENDOSULFAN BY GAS CHROMATOGRAPHY", Chau, A. S. Y., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 6, November 1972, pp 1232-1238.

A quick and sensitive new method has been developed for the confirmation of alpha- and beta- endosulfan by conversion to the same ether in a solid matrix. It seems by far to be the most sensitive method reported to date for positive identification of alpha- and beta-endosulfan. As little as 0.005 ppm of the parent compounds in a 10 g fish or sediment extract and 0.003 ppb in a 2 l water extract can be routinely confirmed.

INDEX TERMS: Pesticide residues, Chlorinated hydrocarbon pesticides, Pollutant identification, Insecticides, Methodology, Chemical analysis, Fish, Sediments, Water analysis, Alpha-endosulfan, Beta-endosulfan, Electron capture gas chromatography, Detection limits.

AMIC-6640

"DETERMINATION OF MATACIL AND ZECTRAN BY FLUORIGENIC LABELING, THIN LAYER CHROMATOGRAPHY, AND IN SITU FLUORIMETRY", Frei, R. W., Lawrence, J. F., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 6, November 1972, pp 1259-1264.

The fluorogenic labeling of Matacil (4-dimethylamino-m-tolyl N-methylcarbamate) and Zectran (4-dimethylamino-3,5-xylyl N-methylcarbamate) with dansyl chloride (1-dimethylamino-naphthalene-5-sulfonyl chloride) results in 3 fluorescent derivatives, and labeling with NBD-Cl (4-chloro-7-nitrobenzo-2,1,3-oxadiazole) produces 2 fluorescent derivatives for each carbamate, all of which can be separated by thin layer chromatography (TLC). These derivatives are identified by nuclear magnetic resonance, infrared, and fluorescence spectroscopy, aided by TLC data. The carbamates are hydrolyzed in dilute base and the resulting amine or phenol hydrolysis products react with the labeling reagents. The derivatives are analyzed by TLC and in situ fluorimetry with a spectrophotometer in the fluorescence mode and a spectrofluorometer with the thin layer scanning accessory. Reactions, fluorescence phenomena, and chromatographic properties of the derivatives are investigated for evaluation of the method as a quantitative technique. A reproducibility of 3-5 percent relative standard deviation can be expected in the concentration range from 15 to 300 ng/spot for derivatives of the 2 labeling procedures. The dansyl derivatives are instrumentally detectable as low as 1 ng/spot while the NBD derivatives may be detected at concentrations of less than 0.5 ng/spot.

INDEX TERMS: Carbamate pesticides, Fluorometry, Pollutant identification, Methodology, Chemical analysis, Fluorescence, Nuclear magnetic resonance, Insecticides, Thin layer chromatography, Matacil, Zectran, Fluorogenic labeling technique, Infrared spectrophotometry, Spectrofluorimetry, Reproducibility, Detection limits.

AMIC-6643

"COLORIMETRIC DETERMINATION OF PHENYLAMIDE PESTICIDES IN NATURAL WATERS", El-DIB, M. A., Aly, O. A., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 6, November 1972, pp 1276-1279.

Phenylamide pesticides include a great variety of compounds such as N-phenylcarbamates, phenylureas, and anilides. A simple, rapid, and sensitive colorimetric method for their determination in natural waters has been proposed. Phenylamides are rapidly hydrolyzed in acid medium at elevated temperature (150-155 degrees C), yielding the corresponding anilines. The latter compounds are diazotized and coupled with 1-naphthol to yield intensely colored azo dyes. Standard and recovery solutions of specific phenylamides were used in testing the procedure. Aliquots of the solutions were acidified with H<sub>2</sub>SO<sub>4</sub>, extracted with CHCl<sub>3</sub> and evaporated just to dryness. The solution was then refluxed, mixed respectively with NaNO<sub>2</sub> solution, sulfanic acid, 1-naphthol, and finally NaOH for maximum color development. Absorbance was read against a reagent blank. Efficiency of the hydrolytic procedure was checked by comparing 100 micrograms of each pesticide with the corresponding theoretical amounts of anilines liberated by complete hydrolysis. Recoveries of the phenylamides from tap and raw river waters ranged from 96 to 100 percent. Using the proposed method, extraction and subsequent determination of the pesticides require about 40 minutes. Both phenylamides and aniline derivatives can be determined in a sample in the presence of each other. The method is sensitive to 0.02 mg/l; coefficients of variation range between 6.0 and 0.2, according to the amount of phenylamide pesticide being measured.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-6643 (Continued)

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INDEX TERMS: Water analysis, Pollutant identification, Colorimetry, Methodology, Carbamate pesticides, Urea pesticides, Chemical analysis, Color reactions, Chlorinated hydrocarbon pesticides, Efficiencies, Natural waters, Phenylamide pesticides, Aniline derivatives, Sample preparation, Recovery, Precision, Sensitivity.

AMIC-6656

"FLUOROMETRIC DETERMINATION OF OXYTETRACYCLINE IN PREMIXES", Katz, S. E., Fassbender, C. A., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 17-19.

A simple fluorometric procedure is presented for the determination of oxytetracycline in which a highly sensitive fluorometer and ultrapure deionized water are used to eliminate background fluorescence. Standard solutions are mixed with 1 N  $\text{NH}_4\text{OH}$ , allowed to stand for 15 min and the fluorescence intensity is measured. Premixes are mixed with an extracting solution for 30 min by shaking; the extract is settled, filtered and diluted with 1 N  $\text{NH}_4\text{OH}$  for fluorescence intensity measurements. Recoveries from fortified extracts of commercial premixes ranged from 95.0 to 102.5 percent; the ratio of results of microbiological to fluorometric methods ranged from 0.97 to 1.05 percent. The procedure is reasonably specific for oxytetracycline in relationship to interference from chlortetracycline because there is a significant difference between excitation and emission wavelengths for these compounds: 390 and 520 nm for oxytetracycline vs. 350 and 420 nm for chlortetracycline. The main advantage of the fluorometric method over the microbiological method is that the fluorometric method requires less time and can be used effectively for quality assurance and in regulatory laboratories.

INDEX TERMS: Antibiotics (pesticides), Chemical analysis, Aqueous solutions, Pollutant identification, Methodology, Fluorometry, Fluorescence, Assay, Oxytetracycline, Chemical interference, Recovery, Premixes, Chlortetracycline, Sample preparation, Sensitivity.

AMIC-6655

"GAS CHROMATOGRAPHIC DETERMINATION OF TRIARIMOL IN FORMULATIONS AND TECHNICAL MATERIAL", Frank, R., Decker, O. D., Day, E. W., Jr., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 11-13.

The triarimol content in formulations and technical materials is determined by flame ionization gas-liquid chromatography after the sample is dissolved in or extracted with chloroform. Pesticides commonly occurring with triarimol do not interfere in this method. Replicate injections of emulsifiable concentrate and wettable powder samples showed good precision. The described procedure has been successfully used for the determination of triarimol in experimental combination formulations containing one of the following pesticides: captan, diazinon, disulfoton, chlorpyrifos, ethion, dicofol, malathion, methoxychlor, carbaryl, and maneb.

INDEX TERMS: Fungicides, Assay, Chlorinated hydrocarbon pesticides, Chemical analysis, Triarimol, Formulations, chemical interference, Flame ionization gas chromatography, Sample preparation.

AMIC-6657

"EVALUATION OF CHEMICAL CONFIRMATORY TESTS FOR ANALYSIS OF DIELDRIN RESIDUES", Maybury, R. B., Cochrane, W. P., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 36-40.

Eight of the more commonly used reagents for the confirmation of dieldrin at the residue level were compared for several substrates. After an aliquot of the standard or sample extract was placed in a glass-stoppered centrifuge tube, the solvent was evaporated. The reagent was added, and the tube placed in boiling water bath for 30 min. After cooling, the contents were diluted with distilled  $\text{H}_2\text{O}$ , mixed, and shaken upon the addition of hexane. The hexane layer was dried and injected into a gas chromatograph. Dry (animal feeds) samples were extracted with hexane, and cleaned up on two reagents, aqueous  $\text{HBr}$  solution and  $\text{BCl}_3/2$ -chloroethanol, were especially useful because of their application and sensitivity, i.e., 0.0003 ppm for a 10 g dry sample and 0.001 ppm for a 25 g wet sample. The  $\text{ZnCl}_2/\text{HCl}$  reagent was a practical alternative to the  $\text{BCl}_3/2$ -chloroethanol reagent. The  $\text{HBr}/\text{Ac}_2\text{O}$  reagent gave a more positive confirmation at a lower sensitivity.

INDEX TERMS: Pesticide residues, Dieldrin, Chemical reactions, Pollutant identification, Laboratory tests, Evaluation, Chemical analysis, Reagents, Sample preparation, Electron capture gas chromatography.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6658

"GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF METHYL ISOTHIOCYANATE IN SOILS", Sirons, G. J., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 41-44.

Residues of methyl isothiocyanate, the active ingredient (20 percent) in the soil fumigant Vorlex, in soils were extracted with diethyl ether containing 5 percent ethanol, concentrated in a Kuderna-Danish concentrator, and subjected to gas-liquid chromatography without further cleanup. A 6 percent Carbowax 20M column was used in conjunction with either conductivity (nitrogen mode) or flame photometric (sulfur mode) detection systems. Two types of soils, mineral and organic (muck), were used for recovery tests. The soils were air-dried at room temperature, fortified with microgram quantities of CH<sub>3</sub>NCS, and mixed thoroughly for 60 minutes. Extractions were made immediately and at 3, 7, 14, and 28 days post-fortification. The observed limits of detection of methyl isothiocyanate were approximately 4.5 ng with the flame photometric detector and 5 ng with the conductivity detector. Recoveries from fortified soils ranged from 80-86 percent using the Kuderna-Danish concentrator. The method is rapid and capable of determining methyl isothiocyanate residues in soils at a level as low as 0.01 ppm.

INDEX TERMS: Soil analysis, Pesticide residues, Pollutant identification, Chemical analysis, Methodology, Fumigants, Soil contamination, Sulfur compounds, Soil sterilants, Methyl isothiocyanate, Vorlex, Flame photometric gas chromatography, Conductive gas chromatography, Detection limits, Recovery, Sample preparation.

AMIC-6659

"CONDITIONING OF POLYALKYL GLYCOL LIQUID PHASES FOR FLAME PHOTOMETRIC GAS CHROMATOGRAPHIC ANALYSIS OF DURSBN AND ITS OXYGEN ANALOG", Struble, D. L., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 49-52.

Dursban and its oxygen analog were resolved by 3 liquid phases, Ucon 75-H-90,000 and Carbowaxes 20M and 20M TPA, on unsilanized, acid-washed Chromosorb W. The GLC responses and resolutions of the 2 compounds were dependent upon the conditioning of the packing before it was placed in the GLC columns. The most satisfactory results were obtained when the column packing was heated in the presence of atmospheric oxygen. The best liquid phase for the GLC analysis of Dursban and its oxygen analog was Ucon 75-H-90,000.

INDEX TERMS: Phosphothioate pesticides, Chemical analysis, Organophosphorus pesticides, Methodology, Insecticides, Dursban, O O-diethyl O-3 5 6-trichloro-2-pyridyl phosphate, Sample preparation, Flame photometric gas chromatography, O O-diethyl O-3 5 6-trichloro-2-pyridyl phosphorothioate.

AMIC-6660

"REVIEW OF THE SCHOENEMANN REACTION IN ANALYSIS AND DETECTION OF ORGANOPHOSPHORUS COMPOUNDS", Poziomek, E. J., Crabtree, E. V., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 56-62.

This report reviews the chemistry of the Schoenemann reaction and describes the principles and applications in the detection of organophosphorus compounds. Emphasis is placed on the analysis of the very toxic compounds ethyl N,N-dimethylphosphoramido cyanide and isopropyl methylphosphonofluoridate. There are many literature publications and government reports which illustrate applicability of the Schoenemann reaction. Key literature references are mentioned throughout this report; also, there are many citations of unpublished data.

INDEX TERMS: Chemical reactions, Organophosphorus compounds, Pollutant identification, Color reactions, Chemical analysis, Methodology, Inhibitors, Organic compounds, Inorganic compounds, Cations, Anions, Chemistry, Schoenemann reaction, Ethyl N N-dimethylphosphoramido cyanide, Isopropyl methylphosphonofluoridate, Chemical indicators, Aromatic amines, Sensitivity, Chemical interference.

AMIC-6663

"APPLICATION OF A LABORATORY ANALOG-DIGITAL COMPUTER SYSTEM TO DATA ACQUISITION AND REDUCTION FOR QUANTITATIVE ANALYSES", John, M. K., Laerhoven, C. J., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 135-139.

A flexible, general purpose program was developed for a laboratory data acquisition and reduction system employing a minicomputer for off-line processing of digitized data readings from electroanalytical instrumentation. Instrument data from the on-line operation of a hard-wired analog-to-digital data acquisition subsystem in conjunction with an atomic absorption instrument, a colorimeter, or a pH/millivolt meter for specific-ion electrode determinations, are transformed into concentration units by using a linear interpolation method. The relationship between instrument measurements and quantitative data is approximated by several straight-line segments between the graphical coordinates associated with each of the reference standards analyzed. The coordinates are determined by calibrating readings and known concentrations. Routines are included to edit incorrect raw readings and to make corrections to compensate for unavoidable deviations from standard analytical procedure. The FOCAL-8 language program, therefore, permits unattended processing of sequentially read paper tape input. The results punched on paper tape are easily transferred to a large computer for more sophisticated data analysis and storage.

INDEX TERMS: Laboratory equipment, Programming languages, Data processing, Computer programs, Automatic control, Electronic equipment, Data acquisition, Analog-digital computer, FOCAL-8.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6664

"ON-LINE COMPUTER SYSTEM FOR AUTOMATIC ANALYZERS", Overton, M. W., Alber, L. L., Smith, D. E., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 140-146.

A computer system has been developed for acquisition and reduction of data obtained from an Autoanalyzer. An 8K core memory computer was interfaced with the Autoanalyzer through an operational amplifier manifold and plug-in components. The interfacing circuitry is based on the use of a retransmitting slidewire mounted on the pen cable pulley of the spectrophotometer. The program, which is included in the text, was written in FOCAL-12 and can be easily modified. The system is easily adapted to a wide variety of instruments where analog data are collected as a function of time.

INDEX TERMS: Digital computers, Data processing, Autoanalyzer.

AMIC-6666

"GAS-LIQUID CHROMATOGRAPHIC SEPARATION OF N-ACETYL-N-BUTYL ESTERS OF AMINO ACIDS", Vincent, P. G., Kirksey, J., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 158-161.

Gas-liquid partition chromatography of a number of N-acetyl-n-butyl esters of amino acids has been investigated. Results obtained with a column packed with methyl silicone grease (DC-200, 12,500 cst viscosity) were better than those reported for Carbowax 1540 or hydrogenated vegetable oil. Amino acid derivatives were distinctly resolved on methyl silicone grease columns. Preliminary determinations were obtained for synthetic mixtures of the acids. The method should prove a useful adjunct to current techniques for the separation and quantitative measurement of amino acids.

INDEX TERMS: Separation techniques, Amino acids, Gas liquid chromatography, Proline, Threonine, Homoserine, 4-aminobutyrate, Methionine, Citrulline, Arginine, Aspartate, Phenylalanine, Ornithine, Glutamine, Lysine, Histidine, Tyrosine, Tryptophan.

AMIC-6665

"COLLABORATIVE STUDY OF THE CATION EXCHANGE CAPACITY OF PEAT MATERIALS", Thorpe, V. A., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 154-157.

To provide a measure of the total amount of exchangeable cations that can be held by peat expressed as mequiv./100 g air-dried peat, the modified method of Puustjarvi for cation exchange capacity has been proposed and studied collaboratively. The statistical treatment of the collaborators' results indicates a satisfactory degree of precision and accuracy for the 3 products considered, moss, humus, and reed-sedge. The method for cation exchange capacity of peat materials, with the description of the transfer technique included, has been adopted as official first action. The 7 ASTM methods have been adopted as procedures.

INDEX TERMS: Peat, Humus, Collaborative studies, Cation exchange capacity, Reed-sedge, Sample preparation.

AMIC-6669

"USE OF ISOTOPIC ABUNDANCE RATIOS IN IDENTIFICATION OF POLYCHLORINATED BIPHENYLS BY MASS SPECTROMETRY", Rote, J. W., Morris, W. J., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 1, January 1973, pp 188-199.

Polychlorinated biphenyls are industrial compounds which are being detected throughout the global ecosystem. Because of the presence of other residues, combined gas chromatography-mass spectrometry must be used for their confirmation. Using isotope abundance ratios, the theoretical probability of the occurrence of ions of different masses in the molecular cluster has been calculated for the polychlorinated biphenyls, polychlorinated terphenyls, and chlorinated naphthalenes. Mass spectra of mono- through decachlorobiphenyl have been taken with a unit resolution, computer-controlled GC-MS system and parent ion clusters were matched with the theoretical isotopic patterns. This method provides the unambiguous identification of polychlorinated biphenyls in the presence of other substances.

INDEX TERMS: Polychlorinated biphenyls, Pollutant identification, Mass spectrometry, Chemical analysis, Industrial wastes, Gas chromatography, GC-Mass spectrometry, Isotopic abundance ratios, Aroclor 1232, Aroclor 1254, Aroclor 1268, Isomers, Polychlorinated terphenyls, Chlorinated naphthalenes.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6682

"MERCURY IN A MARINE PELAGIC FOOD CHAIN", Knauer, G. A., Martin, J. H., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 868-876.

Phytoplankton, zooplankton, and anchovies collected in Monterey Bay, California, over a 10-month period were analyzed for total mercury. Known wet weight or dry weight quantities of homogenized samples were weighed into disposable ampoules, a 2:1 solution of concentrated H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub> added (wet samples were chilled over ice), and the samples heated overnight at 80 C. After acid digestion, the ampoules were chilled in ice and a 6 percent KMnO<sub>4</sub> solution added for the development of color. Excess permanganate was reduced with 30 percent H<sub>2</sub>O<sub>2</sub> and the solution was back titrated with the permanganate solution to yield a pink color (this avoided suppression of peaks). The sample digest was drawn, a reductant added, and the Hg partitioned on a vortex mixer. The resulting vapor was injected into an AA spectrophotometer. A few samples of anchovies and phytoplankton were analyzed for organic Hg by flameless AAS after extracting the homogenate with benzene and cysteine acetate. The cysteine/Hg complex was treated as for total Hg except no HNO<sub>3</sub> or back titration was necessary. In general, mercury levels were low and no evidence of food chain amplification was observed. Temporal variations of Hg concentrations in phytoplankton were greater than those for zooplankton; however, no seasonal trends were observed for either group. Mercury levels were approximately equal in inshore and offshore zooplankton. The highest average mercury concentration was found in phytoplankton-net samples from the open ocean that contained radiolarians and other small zooplankton forms as well as diatoms.

AMIC-6682 (Continued)

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INDEX TERMS: Mercury, Zooplankton, Phytoplankton, Marine fish, Food chains, Chemical analysis, Path of pollutants, Pollutant identification, Heavy metals, Methodology, Sampling, Organic mercury, Atomic absorption spectrophotometry, Flameless atomic absorption spectrophotometry, Sample preparation, Anchovy, Monterey Bay, Myctophidae.

AMIC-6683

"TRACE ELEMENTS IN CLAMS, MUSSELS, AND SHRIMP", Bertine, K. K., Goldberg, E. D., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 877-884.

Compositional changes in the trace element content of shells of mussels and clams that might be related to man's influence on the composition of inshore marine waters over the past hundred years were sought but not found. The elements Rb, Fe, Co, Sb, Sc, Ag, Cr, Zn, Se, and Hg were analyzed in freshly caught and museum specimens by instrumental neutron activation analysis. Contamination from the preservatives was evident in the shells and tissues of museum specimens. Elemental concentrations in the calcareous shells, both aragonitic and mixed aragonitic-calcitic, are similar and may reflect the composition of the waters in which they lived, rejection by the organisms, or surface associated features. The proteinaceous molts of shrimp contained high levels of these elements, in agreement with previous investigations. With 20-25 molts per shrimp per year, the molting of shrimp can cause a redistribution of these elements within the marine environment. (Reprinted from Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 877-884. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Trace elements, Clams, Mussels, Shrimp, Neutron activation analysis, Path of pollutants, Shellfish, Chemical analysis, Shells, Tissue.

AMIC-6691

"DECOMPOSITION OF DISSOLVED ORGANIC CARBON AND NITROGEN COMPOUNDS FROM LEAVES IN AN EXPERIMENTAL HARD-WATER STREAM", Wetzel, R. G.; Manny, B. A., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 927-931.

To study decomposition of natural organic substances in water, dry hickory and maple leaves, enclosed in nylon mesh, were immersed in one of two 12-m recirculating streams simulating natural hard-water woodland streams. Particulate organic carbon was determined by sulfuric-dichromate oxidation and spectrophotometry; total dissolved organic carbon was determined by persulfate oxidation of filtrates and infrared CO<sub>2</sub> analysis; and total dissolved organic nitrogen was fractionated into labile and refractory components on the basis of UV combustion and spectrophotometry. Bacteria were also counted. Addition of leaves for 30 hr increased dissolved organic carbon (DOC) levels nearly 10-fold. Bacterial populations which developed rapidly decomposed labile organic carbon and nitrogen compounds in the leaf leachate within 72 hr. Bacteriologically labile and refractory dissolved organic carbon fractions, with T<sub>1/2</sub> decomposition rates of 2 and 80 days, respectively, were present in the leachate. Most refractory dissolved organic nitrogen compounds persisted unmodified for at least 24 days. The processing capacity of woodland streams for natural dissolved organic compounds is much greater than previously believed.

INDEX TERMS: Water pollution sources, Decomposing organic matter, Microbial degradation, Leaves, Water analysis, Model studies, Dissolved organic nitrogen, Dissolved organic carbon, Natural organics.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6693

"IMPROVED TECHNIQUE FOR ANALYSIS OF CARBOHYDRATES IN SEDIMENTS", Gerchakov, S. M., Hatcher, P. G., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 938-943.

The phenol-sulfuric acid method for analysis of carbohydrates in sediments has been modified to improve reproductibility and eliminate extraneous color development. Sediment samples were collected from Mangrove Lake, Bermuda for analysis. After filtration, the samples were crushed and dried. Samples to be analyzed were divided into three series. Phenol solution and conc.  $\text{H}_2\text{SO}_4$  were added to the first; water and conc.  $\text{H}_2\text{SO}_4$  were added to the second; and phenol and water were added to the third. The absorbance of each solution was determined and the results used to correct for absorbances due to sample/sulfuric acid, sample/phenol, and phenol/sulfuric acid interactions. Carbohydrate content, as glucose, was then determined using a calibration curve constructed using glucose standards. Total organic carbon was also determined by dry combustion of the samples and absorption of the evolved  $\text{CO}_2$ . Statistical treatment of the absorbances from the three samples indicated that absorbance from sample/phenol or glucose/phenol interactions was insignificant with this sample but may have to be considered with others. Absorbance due to phenol/sulfuric acid interaction can generally be neglected. Correction for absorbance due to sediment/sulfuric acid is necessary with this method. Carbohydrate values obtained with the modified method were generally lower than those obtained with the unmodified method.

INDEX TERMS: Calibrations, Carbohydrates, Sediments, Spectrophotometry, Errors, Total organic carbon, Absorbance, Phenol-sulfuric acid method, Sample preparation.

AMIC-6694

"CARBON DIOXIDE CONTENT OF THE INTERSTITIAL WATER IN THE SEDIMENT OF GRANE LANGSO, A DANISH LOBELIA LAKE", Wiium-Andersen, S., Andersen, J. M., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 943-947.

Sediment samples were collected with Perspex tubes from various depths of Lake Grane Langse for analysis of  $\text{CO}_2$  in the interstitial water. Since interstitial water could not be recovered from the sediment,  $\text{CO}_2$  was determined directly by a modification of the method of Krogh and Rehberg. In this method, boiling water was added to the sample to drive off free  $\text{CO}_2$  and that from  $\text{HCO}_3^-$ . The gas was collected in a receiver flask of a still containing a known amount of  $\text{Ba}(\text{OH})_2$ . The amount of  $\text{BaCO}_3$  formed was calculated by titrating the remaining  $\text{Ba}(\text{OH})_2$  with  $\text{HCl}$ . The results showed  $\text{CO}_2$  content of the interstitial water to be between 1 and 5 mmole per liter. It is concluded that the sediment must liberate  $\text{CO}_2$  to the lake water in amounts sufficient for optimal photosynthesis of *Lobelia*. Zonation of *Isoetes*, *Littorella*, and *Lobelia* in the lake cannot be correlated with the  $\text{CO}_2$  content of the sediment.

INDEX TERMS: Sediments, Carbon dioxide, Connate water, Chemical analysis, Photosynthesis, Sample preparation, *Lobelia dortmanna*, Lake Grane Langso.

AMIC-6695

"A PRELIMINARY INVESTIGATION OF ORGANIC-INORGANIC ASSOCIATIONS IN A STAGNATING SYSTEM", Schindler, J. E., Alberts, J. J., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 952-957.

Undisturbed water samples were collected from Lago Pond in Georgia using a free-fall corer fitted with a plastic insert which could be easily removed and serve as a microcosm of the sediment for use in molecular weight fractionation studies. The purpose of the study was to examine the possibility of organic-inorganic complex formation as a mechanism for mobilization of metals during stagnation of a lake sediment system. Portions of the samples were withdrawn at various locations and at certain intervals based on redox potentials and pH values. The portions were passed through membrane filters which retained material with molecular weights of 100,000, 50,000, 10,000, 2,000, and 50. Replicate aliquots of water fractions were analyzed for organic carbon. The remainder of each water fraction was analyzed for Fe, Mg, Mn, and Zn by AA. Unfiltered samples were analyzed for organic carbon and the aforementioned metals. The concentration of each element retained in the molecular weight fractions was calculated by subtracting from the concentration in the next larger size sample. Total inorganic carbon of the aqueous phase was determined by infrared gas analysis. The results showed that (1) inorganic carbon increased during reduction; (2) organic carbon fractions were more evenly distributed by molecular weight during reduction; (3) Fe, Mg, and Mn were associated with the 10,000-50,000 molecular weight fraction during reduction; and (4) only Zn was associated with the 0-500 molecular weight fraction. It is suggested that the association of the elements studied with colloid-forming materials could impart a stability which would permit their transport to oxygen-rich, productive areas of lakes.

AMIC-6695 (Continued)

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INDEX TERMS: Sediments, Sediment-water interfaces, Oxidation-reduction potential, Heavy metals, Sorption, Hydrogen ion concentration, Filtration, Iron, Zinc, Manganese, Magnesium, Molecular weight fractionation, Transport.



# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6698

"THE PHYSICOCHEMICAL LIMNOLOGY OF A STRETCH OF THE GUADALUPE RIVER, TEXAS, WITH FIVE MAIN-STREAM IMPOUNDMENTS", Young, W. C., Hannan, H. H., Tatum, J. W., Hydrobiologia, Vol. 40, No. 3, October 30, 1972, pp 297-319.

The limnological profile and the associated cause effect relationships have been determined for a portion of the Guadalupe River, Texas, which has main-stream reservoirs that do not stratify. Sixteen sites were sampled monthly for a year with samples being taken on a diel basis at and below the surface and about 1 m above the bottom using a Kemmerer water sampler. The following physicochemical measurements or determinations were made: wind velocity, thermal stratification, pH, water and air temperature, specific conductance, water velocity, depth, transparency, dissolved oxygen, oxygen saturation, alkalinity, turbidity, and chlorophyll a. Seasonal and diel changes in limnological conditions were of greater magnitude in impoundments than in lotic areas. Periods of low flow and low velocity resulting in long water retention periods in impoundments coupled with greater solar input associated with long days contributed to the greatest fluctuations. Longitudinal variations in physicochemical conditions were influenced by the impoundment of water, effluent of sewage disposal plants, reseration through turbulence, and was greatly affected by seasonal periods of drought and flooding. High dissolved oxygen in impoundments was accompanied by high chlorophyll a, high pH, and low bicarbonate alkalinity. These conditions indicate the importance of bicarbonate ions as a carbon source for phytoplankton in this system.

INDEX TERMS: Limnology, Physicochemical properties, Impounded waters, Water sampling, Surface waters, Reservoirs, Optical properties, Water properties, Guadalupe River.

AMIC-6704

"ICE ANALYSES. DATA FROM THREE NORWEGIAN LAKES", Groterud, O., Hydrobiologia, Vol. 40, No. 3, October 30, 1972, pp 371-391.

Ice from three Norwegian lakes was analyzed and corresponding investigations of the lake waters and the precipitation from the lake areas were carried out. Field investigations included echo sounding, and temperature, pH, transparency, color, oxygen, and alkalinity determinations. In the laboratory determinations were made for water color, optical density, specific conductivity, potassium permanganate consumption, Ca, Mg, Na, K, chloride, sulfate, reactive silicate, orthophosphate, nitrate plus nitrite, ammonia, ferrous and ferric iron, and total inorganic manganese. Different places and different layers of the ice were investigated to get an impression of the vertical and horizontal distribution of the components analyzed. The contents of NO<sub>3</sub> plus NO<sub>2</sub> and NH<sub>4</sub> were relatively high in the ice of the three lakes. On the other hand, the PO<sub>4</sub> content seemed to be relatively high only in the ice of Ovre Heimdalsvatn (the high mountain lake). Some freezing experiments of the lake water indicated that PO<sub>4</sub> may be released from living and dying cells on freezing. The influence of nutrients in the ice on the water of the lake and the relationship between the ionic balance of the ice and that of the lake water are discussed.

INDEX TERMS: Lake ice, Chemical analysis, Water analysis, Iced lakes, Snowfall, Sampling, Nutrients, On-site investigations, Lake Ovre Heimdalsvatn, Norway, Lake Sandtjern, Lake Abbottjern.

AMIC-6718

"FATTY ACIDS IN SURFACE PARTICULATE MATTER FROM THE NORTH ATLANTIC", Schultz, D. M., Quinn, J. G., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 10, October 1972, pp 1482-1486.

On R/V Trident Cruise 102 from Reykjavik, Iceland, to Halifax, Nova Scotia (August 1971), samples were taken at seven stations to determine the fatty acid composition of open-ocean surface particulate matter and to compare it with particulate matter in estuarine samples from Narragansett Bay, R. I. Surface samples (20 cm depth) were collected in polyethylene carboys and filtered through Gelman type A glass-fiber filters. The filters were placed in culture tubes and stored at a minus 20 C in the ship's freezer for periods up to one month. After transferring the samples to the laboratory for analysis, the following were added (in the order given): an internal standard (17:0), KOH/MeOH, MeOH, and benzene. The samples were saponified and the methyl esters were extracted, and separated and purified using preparative TLC. The esters were then extracted from the silicic acid and analyzed by GLC. The estuarine samples were collected in glass containers at flood tide and prepared and analyzed as above. Values of total fatty acids (free and esterified) ranged from 4 to 26 micrograms. A high proportion of the fatty acids was long-chain polyunsaturated acids. The low relative abundance of iso and anteiso 15-carbon acids indicated little bacterial contribution to the particulate matter. This fatty acid distribution was in contrast to that found in estuarine particulate matter, which contained only trace amounts of the long-chain polyunsaturated acids and substantial quantities of branched chain acids.

INDEX TERMS: Atlantic Ocean, Chemical analysis, Water analysis, Surface waters, Pollutant identification, Saline water, Water sampling, Fatty acids, Particulate matter, Narragansett Bay, Sample preparation, Thin layer chromatography.

AMIC-6719

"MERCURY CONTENT OF SPINY DOGFISH (SQUALUS ACANTHIAS) IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA", Forrester, C. R., Ketchen, K. S., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 10, October 1972, pp 1487-1490.

Dogfish were collected with a small-meshed otter trawl, longline gear, and handlines in four areas of the Strait of Georgia during a study conducted to determine whether or not there was any systematic pattern of mercury content in fish from these areas. A total of 685 dogfish were captured and 206 flesh samples taken from the dorsal musculature between the first and second dorsal fins were analyzed. Sets of zero plus and one plus intrauterine embryos were obtained and analyzed for Hg content. Total mercury content (ppm wet weight) of the samples was determined through wet digestion and flameless atomic absorption spectrophotometry, according to the method described by Armstrong and Uthe (1971). The total mercury content of Squalus acanthias reached levels of 0.5 ppm at fish lengths of 72 and 77 cm for male and female fish, respectively. For any given length above 65 cm the mercury content was higher among males than females and higher in samples taken off the Fraser River Estuary than in other areas of the Strait. Levels of mercury reached 1.7 ppm in males (to 95 cm in total length) and almost 2.0 ppm in females (to 120 cm in total length). Mercury content in the embryos ranged from 0.01 to 0.05 ppm with no age differences.

INDEX TERMS: Mercury, Heavy metals, Embryonic growth stage, Sharks, Marine fish, Elasmobranchs, Canada, Sampling, Chemical analysis, Pollutant identification, Spiny dogfish, Squalus acanthias, Strait of Georgia, Flameless atomic absorption spectrophotometry, Biological samples, Sample preparation.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6723

"THE PERCENT UN-IONIZED AMMONIA IN AQUEOUS AMMONIA SOLUTIONS AT DIFFERENT pH LEVELS AND TEMPERATURES", Trussell, R. P., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 10, October 1972, pp 1505-1507.

Previous studies have shown that the toxicity of aqueous ammonia or ammonium salt solutions is dependent largely on the pH of the solution since only the un-ionized molecule is toxic to fish. So that the amount of toxic ammonia can be determined, a table was constructed which shows percentage of un-ionized ammonia in aqueous solutions at different pH values and temperatures. The values were calculated using accurate ionization constants.

INDEX TERMS: Toxicity, Water temperature, Hydrogen ion concentration, Ionization, Ammonia, Water analysis.

AMIC-6758 (Continued)

Card 2/2

INDEX TERMS: Reaeration, Streams, Water pollution effects, Linear alkylate sulfonates, Nitritotriacetic acid, Domestic wastes, Research equipment, Mineral oil.

AMIC-6758

"CHARACTERIZATION OF STREAM REAERATION CAPACITY", Tsivoglou, E. C., Wallace, J. R., Georgia Institute of Technology, Atlanta, Georgia, Report No. EPA-R3-72-012, October 1972, 317 pp.

The purposes of this research were to characterize stream reaeration capacity in terms of the stream hydraulic properties and to develop procedures for evaluating the effects of pollutants on reaeration. Field studies of the reaeration capacity and the associated hydraulic properties of five rivers have been completed, using a gaseous tracer procedure for field measurement of reaeration. These studies have incorporated a wide range of hydraulic features, such as waterfalls, rapids, shoals and pools, with stream flows ranging from 5 to 3,000 cfs. The range of BOD's and temperatures encountered was also large. Studies of the effects of both pure substances and community wastes on the reaeration capacity have been conducted in a newly designed test system. Tests of observed vs. predicted values of the coefficient of reaeration have shown that none of the available models is capable of providing dependable predictions of stream reaeration capacity, especially under highly turbulent flow conditions. A new energy dissipation model has been derived, by which the reaeration capacity of a stream is explained in terms of the rate of energy dissipation, measured as the loss of water surface elevation divided by the time of flow. Two distinct forms of the energy dissipation model have been tested against the observed results, and it has been shown that both forms provide dependable predictions of stream reaeration capacity. The tests of pollutant effects have shown that LAS and community wastes decrease the reaeration rate coefficient, pure NTA has no effect, and pure mineral oil increases the reaeration rate coefficient.

AMIC-6759

"INSTRUMENTATION FOR ENVIRONMENTAL MONITORING. WATER.", University of California, Lawrence Berkeley Laboratory, Environmental Instrumentation Group, Berkeley, California, Lawrence Berkeley Laboratory Report LBL-1, Vol. 2, February 1, 1973, 224 pp.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation. Instruments being investigated are those useful for measurements related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. Methods for water (fresh and estuarine) are divided into the following categories: Metals; Halides and cyanide; Nitrogen, phosphorus, and sulfur; Biological parameters; Dissolved gases; Pesticides; Phenolics; Petrochemicals; Oil and grease; and Physical parameters.

INDEX TERMS: Automation, Water analysis, Water quality standards, Heavy metals, Hardness (water), Dissolved oxygen, Pesticides, Industrial wastes, Mass spectrometry, Colorimetry, Bacteria, Oil, Instrumentation, Turbidity, X-ray fluorescence, Neutron activation analysis, Polarographic analysis, Atomic absorption spectrophotometry, Atomic fluorescence spectroscopy, Fluorescent antibody techniques, Anodic stripping, Detection limits, Chemical interference, Chemiluminescence, Ion selective electrodes.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6778

"CHARACTERIZATION AND IDENTIFICATION OF SPILLED RESIDUAL FUEL OILS BY GAS CHROMATOGRAPHY AND INFRARED SPECTROPHOTOMETRY", Kawahara, F. K., Journal of Chromatographic Science, Vol. 10, No. 10, October 1972, pp 629-636.

Analytical methods developed recently at the Analytical Quality Control Laboratory are described for the characterization and identification of heavy residual fuel oil pollutants found in surface waters. Procedures are described for sample collection, extraction, concentration, and analysis. Identity can be made through use of each of the four GC techniques and infrared analytical procedure even when two different oils are spilled near the same area at about the same time. Infrared spectral differences reveal the approximate ages of the spills. A new electron capture detector gas chromatographic procedure designed for the diagnostic identification of heavier petroleum products shows excellent promise.

INDEX TERMS: Sampling, Oil spills, Gas chromatography, Sample preparation, Oil characterization, Infrared spectrophotometry, Aging (physical), Naphtha, Gasoline, Jet fuel, Kerosene, No. 1 fuel oil, No. 2 fuel oil, No. 5 fuel oil, No. 6 fuel oil, Crude oil, Petroleum jelly, Gas oil, White oil, Motor oil, Asphalt, Grease, Lubricating oil.

AMIC-6779

"GAS CHROMATOGRAPH INJECTION SYSTEM", Pollock, G. E., et al., National Aeronautics and Space Administration, Moffett Field, California, Report No. NASA-CASE-ARC-10344-1, September 16, 1971, 13 pp. NTIS Report No. N72-21433.

This patent covers a gas chromatograph injection system which consists of a sample chamber instead of a septum. The sample is placed in the chamber at room temperature and pressure and the solvent removed by evaporation. After the chamber is closed, the position of the carrier gas control valve is changed, the chamber is heated, and the sample is volatilized and swept into the analysis apparatus. Disadvantages of syringe injection methods are obviated.

INDEX TERMS: Gas chromatography, Laboratory equipment, Injection systems.

AMIC-6786

"A FEASIBILITY DEMONSTRATION OF AN AERIAL SURVEILLANCE SPILL PREVENTION SYSTEM", Welch, R. I., Marmelstein, A. D., Maughan, P. M., Earth Satellite Corporation, Washington, D. C., Water Pollution Control Research Series 15080HOL 01/72, Contract No. 68-01-0145, January 1972, 120 pp.

Acquisition and interpretation of multispectral aerial photography and thermal infrared imagery were performed to evaluate their utility in an aerial surveillance spill prevention system. The San Francisco Bay area was used as a test site; major sub-areas were delineated which contained facilities and activities that might lead to spills of oil and other hazardous substances into waterways. Results demonstrated that high quality, small scale (1/40,000 to 1/60,000), color infrared photography can be used for regional surveillance, leading to classification of land use areas where potential spill sources exist. High quality, large scale (1/5,000 to 1/10,000), color aerial photography can be used for localized delineation of potential spill sources. Localized surveillance should be supported by low angle, oblique telephotography and limited ground surveillance. Recommendations are given for an operational spill surveillance system using multiscale aerial photography obtained on a 9-inch film format. Use of thermal infrared imagery is not indicated at this time, as additional information acquired is minimal compared to resources required for its acquisition.

INDEX TERMS: Oil spills, Aerial photography, Infrared radiation, Industrial wastes, Powerplants, Chemical industry, Remote sensing, Steel mills.

AMIC-6788

"REVEGETATION AUGMENTATION BY REUSE OF TREATED ACTIVE SURFACE MINE DRAINAGE", Zaval, F. J., Robins, J. D., Department of Natural Resources, Division of Reclamation, Kentucky, Report No. EPA-R2-72-119, November 1972, 147 pp.

The objective of this study was to determine the feasibility of conducting a full-scale demonstration project on the use of neutralized acid mine drainage to irrigate new vegetative cover on regraded spoil banks. Two active surface mine sites in the Commonwealth of Kentucky were thoroughly evaluated for this purpose. Based upon this investigation, it was determined that a site located in the Western Coal Field of Kentucky, near Madisonville, was the most suitable for implementation of the revegetation concept. Determination of project feasibility was based upon the performance and results of the following investigative measures: waters of receiving streams and pit discharges were analyzed and evaluated for treatment; regraded spoil banks were sampled and analyzed with respect to treatment and nutrient requirements necessary for vegetative survival; and weir structures, monitor enclosures and instruments were evaluated and selected for application in unattended installations. Based upon the analyses performed, a flow diagram of a suitable limestone neutralization facility was developed. Four irrigation techniques were evaluated before a high pressure spray system was selected as the most practical means of delivering the treated drainage. Pertinent cost estimates were developed for the construction, installation and operation of the entire system at the selected demonstration site.

INDEX TERMS: Mine water, Coal mine wastes, Monitoring, Water quality, Water reuse, Water treatment.

AMIC-6836

"A REAPPRAISAL: CORRELATION TECHNIQUES APPLIED TO GAS CHROMATOGRAPHY", Moss, G. C., Godfrey, K. R., Instrumentation Technology, Vol. 20, No. 2, February 1973, pp 33-35.

The case for applying correlation techniques to gas chromatography has been reexamined by the authors following the introduction of on-line cross-correlators. Although they conclude that there is still little need for these techniques in many chromatographic analyses, they have designed a series of experiments that demonstrate the feasibility of applying cross-correlation to trace gas analysis. The experiments show that correlation offers considerable advantages over the single-sample injection method when minute quantities of a component in a sample gas are being measured. There appears to be much scope for the application of correlation techniques to pollution measurement.

INDEX TERMS: Gas chromatography, Pollutants, Pollutant identification, Methodology, Correlation techniques, Trace levels, Detection limits.

AMIC-6838

"DEPLETED URANIUM AS CATALYST FOR HYDROCRACKING SHALE OIL", Cottingham, P. L., Barker, L. K., Industrial and Engineering Chemistry. Product Research and Development, Vol. 12, No. 1, March 1973, pp 41-47.

Depleted uranium oxide, deposited by the impregnation method on activated alumina and on commercial cobalt molybdate catalyst, was evaluated for catalytic use in hydrocracking crude shale oil at 3000 psig with temperatures from 807 degrees to 1010 degrees F. Adding 10 percent uranium oxide to the catalysts significantly increased the conversion of heavy shale oil to lighter products during hydrocracking. Gasolines produced at the higher conversion levels with the uranium-promoted catalysts were richer in aromatics and had higher octane numbers than those produced with the unpromoted catalysts. Adding uranium to alumina substantially improved the desulfurization activity, but adding uranium to cobalt molybdate did not significantly affect the already high desulfurization activity of this catalyst.

INDEX TERMS: Uranium oxide, Catalysts, Gasoline, Hydrocracking, Shale oil.

AMIC-6842

"NONDESTRUCTIVE INSTRUMENTAL MONITORING OF FUEL OIL FOR VANADIUM, SODIUM, AND SULFUR", Persiani, C., Shelby, W. D., Environmental Science and Technology, Vol. 7, No. 2, February 1973, pp 125-127.

Samples of No. 6 (bunker) fuel oil were analyzed for sodium and vanadium by neutron activation analysis and for sulfur and vanadium by x-ray fluorescence. Results from the two techniques were compared with those from atomic absorption spectrophotometry. Fuel oil samples for NAA were placed in pressed fit, polyethylene capsules, irradiated, and monitored for gamma rays using a scintillation counter composed of two NaI (TI) crystals mounted on photomultiplier tubes. Samples for determination of sulfur by x-ray fluorescence were analyzed using the method of successive additions which involves spiking samples with known amounts of amyl ziram and back-calculating original sulfur content. These results were verified using classical methods and served as standards for succeeding samples. For vanadium analysis by x-ray spectrography, samples were ashed, the ash dissolved in HNO<sub>3</sub>, dried, triturated, and analyzed. The results show that relative errors for V and Na were 20 and 10 percent, respectively, with NAA. For x-ray spectrographic analysis, the detection limits were 10 and 500 ppm and relative precisions were plus or minus 5.0 and 1.0 percent for V and S, respectively. Interferences with both methods were minor. Since the methods require little sample preparation they should be useful for rapid analysis of fuel oils.

INDEX TERMS: Neutron activation analysis, X-ray fluorescence, Sulfur, Sodium, No. 6 fuel oil, Detection limits, Vanadium, Sample preparation, Atomic absorption spectrophotometry.

AMIC-6843

"A UNIQUE COMPUTER CENTERED INSTRUMENT FOR SIMULTANEOUS ABSORBANCE AND FLUORESCENCE MEASUREMENTS", Holland, J. F., Teets, R. E., Timnick, A., Analytical Chemistry, Vol. 45, No. 1, January 1973, pp 145-153.

A computer centered spectrophotometer-spectrofluorimeter combination instrument has been fabricated that will allow simultaneous absorption and fluorescence measurements. The dedicated computer applies corrections to the data collected for many of the instrumental and photophysical variables of fluorescence measurements. From data collected during an excitation scan, the computer can output absorbance, fluorescence, quanta corrected fluorescence, and a unique quantity, partial quantum efficiency. From an emission scan, absorbance, fluorescence, quantum corrected fluorescence, and total quantum efficiency can be obtained. Absorption corrected fluorescence is the name proposed for measurements which correct for the attenuation of excitation beam by absorption processes in the sample cell. The computer program is detailed and results are presented to evaluate the system for the various absorption and fluorescence measurements. Samples of quinine bisulfate, anthracene, and Rhodamine B were analyzed with the equipment.

INDEX TERMS: Instrumentation, Data processing, Fluorescence, Digital computers, Rhodamine, Spectrophotometers, Spectrofluorimeters, Absorbance, Quinine bisulfate, Anthracene.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6844

"PERSISTENCE AND REACTIONS OF C-14-CACODYLIC ACID IN SOILS", Woolson, E. A., Kearney, P. C., Environmental Science and Technology, Vol. 7, No. 1, January 1973, pp 47-50.

Carbon-14-labeled cacodylic acid (hydroxydimethyl-arsine oxide) was prepared by reacting C-14 methyl iodide with methyl dichloroarsine. Concentrations of 1, 10, and 100 ppm of cacodylic acid were established in three soils of varying iron and aluminum content. At 2, 4, 8, 16, 24, and 32 weeks, soils were analyzed for C-14 and total arsenic in the water-soluble (ws), calcium (Ca), iron (Fe), and aluminum (Al) fractions. Initially, cacodylic acid was distributed in the following fractions: ws much greater than Al greater than Fe greater than Ca. After 32 weeks, the distribution was ws greater than Al greater than Fe greater than Ca. In contrast, inorganic arsenate (5 plus) was largely present in the Fe and Al fractions. Cacodylic acid persistence was a function of soil type and after 32 weeks the following amounts of C-14 were recovered in each soil type by combustion: Christiansa (23 percent), Hagerstown (53 percent), Lakeland (62 percent). A decrease in both total C-14 and total arsenic occurred in all soils with time. A pungent garlic odor was detected in soils receiving 100 ppm, suggesting the production of a volatile alkyl arsine. The loss of arsenic suggests that one route of cacodylic acid loss from aerobic and anaerobic soils is by alkyl arsine volatility. Degradation under aerobic conditions also occurred by cleavage of the C-As bond, presumably yielding CO<sub>2</sub> and AsO<sub>4</sub> (3 minus). This degradation is presumably due to microbiological action.

INDEX TERMS: Arsenicals (pesticides), Pesticide kinetics, Soil types, Persistence, Chemical reactions, Soil contamination, Herbicides, Cacodylic acid, Chemical distribution.

AMIC-6862

"EFFECT OF PULPMILL EFFLUENT ON DISSOLVED OXYGEN IN A STRATIFIED ESTUARY--I. EMPIRICAL OBSERVATIONS", Parker, R. R., Sibert, J., Water Research, Vol. 7, No. 4, April 1973, pp 503-514.

That pulpmill effluent discharged at the water's surface does suppress photosynthesis, thus oxygen production, in the stratum beneath the halocline by restricting light penetration has been examined empirically in the Alberni Inlet, Canada. Measurements were made of salinity, DO, primary productivity, color, light transmission, and solar radiation. The data indicate that the p.lpmill effluent adversely affects DO levels in the estuary, and several possible causes are discussed. Net primary productivity was diminished by the light-absorbing stain. The situation cannot be remedied by removal of BOD from the effluent, rather the staining properties must be diminished or removed.

INDEX TERMS: Dissolved oxygen, Pulp wastes, Water pollution effects, Stratification, Estuaries, On-site investigations, On-site tests, Laboratory tests, Chemical analysis, Water analysis.

AMIC-6866

"A NOTE ON THE IRON-ORGANIC RELATIONSHIP IN NATURAL WATER", Plumb, R. H., Jr., Lee, G. F., Water Research, Vol. 7, No. 4, April 1973, pp 581-585.

Water samples were collected at the 15 m depth of Lake Mary, a small, highly colored meromictic lake in Wisconsin, for use in studies of iron-organic relationships. Most of the samples were fractionated on a Sephadex G-25 fine column. Iron concentrations were determined by a colorimetric method using 2,4,6-tripyridyl-s-triazine (TPTZ). Organic matter was monitored with a fluorometer. The iron elution pattern for the Sephadex column was investigated using two approaches. The first consisted of passing ionic iron through the column and determining recovery of iron in the effluent. The second consisted of tying up the iron with a complexing agent and determining the amount that would pass through the column. The results showed that complexed iron, that associated with organic matter, could not pass through the column. A second approach in which natural water was treated with TPTZ strengthened the observation. It is concluded that gel filtration is potentially useful for evaluating organic-inorganic interactions. However, the use of concentrated samples distorts and overemphasizes the importance of the iron-organic systems in the environment. The use of unconcentrated samples with Sephadex columns should be a means for evaluating the amount of iron associated with organic matter.

INDEX TERMS: Iron, Separation techniques, Organic compounds, Colorimetry, Fractionation, Gel filtration, Preconcentration.

AMIC-6867

"SORPTION OF COPPER ON LAKE MONONA SEDIMENTS--EFFECT OF NTA ON COPPER RELEASE FROM SEDIMENTS", Sanchez, I., Lee, G. F., Water Research, Vol. 7, No. 4, April 1973, pp 587-593.

Sediment samples from Lake Monona, Wisconsin were dried and solutions prepared in flasks by adding distilled water and a standard solution of Cu. The solutions were shaken for 24 hr, left stand for 12 hr, and/or centrifuged through membrane filters and the filtrate analyzed for copper. Wet sediment was also aerated by shaking for one month to oxidize Fe, Mn, sulfide, and organics to determine their effect on the binding capacity of the sediment for copper. Additional studies were conducted with large quantities of NTA added to sediment solutions to determine its effect on the release of heavy metals. Copper, iron, and manganese were determined by AA after 24 hr of contact. The results show that the binding capacity of Cu by Lake Monona sediments is primarily related to the alkalinity (Ca, Mg carbonates present in the sediments). Apparently organics and sulfides play a minor role in binding copper to sediments; in the case of sulfides most probably for reasons of low content rather than for reasons of solubility of cupric sulfides. Over very dilute copper solutions, sulfide in the sediment should control the binding mechanism. The sediments investigated show a relatively large binding capacity amounting to approximately 26 mg of copper being fixed per gram of dry sediments. The addition of large amounts of NTA to Lake Monona sediments resulted in an increase in the amounts of iron and manganese leached from the sediments. However, the copper released from the sediments decreased with increasing NTA.

INDEX TERMS: Sediments, Iron, Copper, Manganese, Nitrilotriacetic acid, Carbonates, Leaching, Sorption, Binding capacity, Mobilization.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6873

"PULSE POLAROGRAPHY IN PROCESS ANALYSIS. DETERMINATION OF FERRIC, FERROUS, AND CUPRIC IONS", Parry, E. P., Anderson, D. P., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 458-463.

A form of pulse polarography was described which can be used for automated analysis of process streams. The technique is rapid, has good sensitivity, and is not severely affected by small amounts of oxygen. For the automated analysis, a sample (5-10 microliters) was drawn from the sample stream and added to the polarographic cell. Sulfuric acid was added, the solution bubbled for 3 minutes, and the potential pulse was applied to determine Cu. Pyrophosphate solution adjusted to 0.1 M and 0.002 percent in Triton X-100 was added and the ferric and ferrous ions were determined. Only one 50-millisecond pulse to the diffusion plateau for each species to be analyzed was all that was required for the analysis after suitable calibration. The choice of supporting electrolyte(s) is of great importance in the successful application of the technique. For determination of two different oxidation states of the same species (or where both oxidation states can be present), it is necessary that the pulse polarographic wave be irreversible. The kinetic parameters are discussed. Pyrophosphate solution was shown to be a suitable medium for the simultaneous determination of ferric and ferrous ions and the pulse polarographic behavior of these ions, as well as cupric ion in this medium, is described in detail.

INDEX TERMS: Polarographic analysis, Chemical analysis, Pollutant identification, Sampling, Cations, Iron, Copper, Electrolytes, Methodology, Automation, Kinetics, Pulse polarography, Process streams, Chemical interference, Pyrophosphate, Sensitivity, Reproducibility,

AMIC-6877

"GAS-SOLID CHROMATOGRAPHY OF ORGANIC ACIDS AND AMINES USING STEAM CONTAINING FORMIC ACID OR HYDRAZINE HYDRATE AS CARRIER GASES", Nonaka, A., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 483-487.

Gas-solid chromatography can be carried out for samples of free organic acids and amines using carrier steam containing 10 percent formic acid or 10 to 20 percent hydrazine hydrate. The mixed carrier vapors are introduced into the column by pumping aqueous solutions of formic acid or hydrazine hydrate into a vaporizing port set in the GC system. The adsorbents, such as diatomaceous firebrick and porous glass beads, can be used as stationary solids, without any coating. The FID can be employed as a detector with the mixed carriers. The effect of stream and the added polar vapors is so significant that acid and amine samples are eluted very rapidly without any marked tailing. By changing the carrier vapor from the acidic to a basic one, acid and amine samples can be analyzed on the same column. Chromatography of lower and higher fatty acids and their alkaline salts, lower and higher fatty amines, etc. is reported. (Reprinted from Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 483-487. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Organic acids, Methodology, Organic compounds, Acidity, Alkalinity, Laboratory equipment, Amines, Steam carrier gas solid chromatography, Gas solid chromatography, Carrier gas, Formic acid, Hydrazine hydrate, Adsorbents, Flame ionization detector, Sample preparation, Chromatography columns.

AMIC-6879

"SEPARATION OF POLYAROMATIC HYDROCARBONS BY LIQUID-SOLID CHROMATOGRAPHY USING 2,4,7-TRINITROFLUORENONE IMPREGNATED CORASIL I COLUMNS", Karger, B. L., Martin, M., Lohac, J., Gulochon, G., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 496-500.

The purpose of this study was to illustrate the combination of selective separations via charge transfer complexation with the speed and efficiency possible from porous layer beads (PLB). In connection with such an illustration, the use of trinitrofluorene (TNF) impregnated Corasil I columns was investigated. A technical problem encountered involved the shifting of maximum absorbance in the UV region to longer wavelengths as the number of fused aromatic rings increased. However, by adjusting the percent of TNF, mobile phase water content, and temperature, it was possible to optimize the column for rapid analysis for the separation of 3-, 4-, 5-, 6- or even 7-fused ring polyaromatic systems. The Corasil I porous layer beads used as support contributed partly to the retention. This effect was markedly reduced by using water saturated heptane as the mobile phase.

INDEX TERMS: Chemical analysis, Separation techniques, Pollutant identification, Organic compounds, Aromatic hydrocarbons, Liquid solid chromatography, 2,4,7-trinitrofluorene, Corasil I, Retention time, Chromatography columns, Charge transfer, Adsorbents.

AMIC-6885

"MICRODETERMINATION OF VOLATILE ORGANICS BY GALVANIC COULOMETRY", Anusiem, A., Hersch, P. A., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 592-594.

The principle of determining organic gases and vapors carried by an inert gas stream upon adding a constant proportion of O<sub>2</sub> to the stream, passing the stream through a hot tube for complete combustion, and determining the O<sub>2</sub> left over in the effluent, can be extended to hydrocarbons and other slightly soluble species in an aqueous sample. Experiments conducted using stock solutions prepared from recrystallized nitrosobenzene confirm that combustion of trace organics followed by galvanic coulometry of the residual oxygen yields accurate analyses in the microgram range with only modest demands on time, training, and equipment. The range can probably be extended to much smaller quantities, given electronic amplification of the signal, before limitations by various types of noise are encountered. Ultimate sensitivity is expected to exceed that of flame ionization which contributes about 1 in 100,000 carbon atoms to the signal. Coulometry utilizes every carbon and hydrogen atom combusted. This principle should be applicable to effluent analysis in both gas and liquid chromatography and to many micro-analytical requirements of organic and biological chemistry.

INDEX TERMS: Organic compounds, Volatility, Aqueous solutions, Electrolytes, Oxygen, Pollutant identification, Chemical analysis, Methodology, Galvanic coulometry, Trace levels, Hydrocarbons, Nitrobenzene, Sensitivity.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6888

"ANALYSIS OF HALOGENATED BIPHENYLS BY PULSED SOURCE-TIME RESOLVED PHOSPHORIMETRY", O'Donnell, C. M., Harbaugh, K. F., Fisher, R. P., Winefordner, J. D., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 609-611.

Pulsed source, time resolved phosphorimetry has been used for the quantitative analysis of several mixtures of halogenated biphenyls. The procedure followed was identical to that of Fisher and Winefordner (1972) except for changes involving delay and sweep times with reference to recording the phosphorescence decay curve. The sweep time was chosen to temporally compress the shorter-lived species with respect to the longest-lived phosphor; the resulting phosphorescence signal of the longest-lived species extrapolated to zero delay time was subtracted from the sum of the two longest-lived phosphors to determine the phosphorescence signal of the intermediate lived species. Analysis of a 4-halobiphenyl mixture in ethanolic solvent resulted in a maximum absolute error in concentration of 5 percent or less for 4-chlorobiphenyl and 4-bromobiphenyl and 14 percent for the shortest-lived species, 4-iodobiphenyl. A mixture of 2-chlorobiphenyl and 4-chlorobiphenyl similarly measured resulted in errors of 5.4 and 10 percent, respectively. With this method it is possible to analyze structurally and spectrally similar molecules. Quantitative information and qualitative identification of species aided by phosphorescence lifetimes can be obtained. For very complex mixtures, a simple thin layer or gas chromatographic separation prior to analysis may also be needed, but overall, the time for analysis of a multicomponent mixture should be considerably reduced as compared to methods previously used.

INDEX TERMS: Chemical analysis, Methodology, Halogenated biphenyls, Quantitative analysis, Pulsed source time resolved phosphorimetry, Mixtures, Errors, Precision.

AMIC-6892

"RAPID METHYLATION OF MICRO AMOUNTS OF NONVOLATILE ACIDS", Levitt, M. J., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 618-620.

A Diazomethane Generating System is described which permits microgram or smaller amounts of complex organic acids to be quantitatively esterified without detectable side-product formation. Multiple samples can be processed in sequence at two-minute intervals. The methyl esters produced are suitable for further analysis by electron-capture gas chromatography. The apparatus is constructed from components present in most laboratories, and may be dismantled easily for storage. Details are given on the construction and operation of the esterification apparatus.

INDEX TERMS: Organic acids, Laboratory equipment, Chemical analysis, Research equipment, Design, Pollutant identification, Methodology, Methylation, Nonvolatile acids, Esterification, Sample preparation, Diazomethane generating system, Electron capture gas chromatography, Methyl esters, Lithocholic acid.

AMIC-6894

"IMPROVED EXPERIMENTAL TECHNIQUE FOR REVERSE ISOTOPE DILUTION METHOD", Graham, W. H., Bornak, W. E., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 623-624.

The CARRIER-ADDITION or reverse isotope dilution (RID) method is a useful technique for both qualitative and quantitative identification of radioactive compounds in complex mixtures. Described here are the principles involved, the apparatus and procedures used, and the results obtained in trials of a modified RID technique. In the modified RID method, the test of constant specific radioactivity is determined differently. Instead of isolating the crystalline material after each recrystallization, it is necessary to radioassay only the mother liquor. Two consecutive recrystallizations of a chemically pure but radiolabeled material will contain the same amount of radioactivity in the same volume of mother liquor at constant temperature. At that point, the crystalline material may be isolated and radioassayed to determine its specific activity and complete the analysis. The advantages of the method are speed and simplicity; the small amount of cold carrier and radioactive material needed; ease of handling sensitive carrier compounds; and increased boiling range of solvent systems, including mixed solvents, available through use of pressure vials. The RID method is particularly useful in pesticide residue analysis because trace levels of multiple degradation products can be determined quantitatively from the radioactive parent pesticide.

INDEX TERMS: Radioactivity techniques, Methodology, Pollutant identification, Radiochemical analysis, Pollutants, Chemical analysis, Pesticides, Pesticide residues, Radioactivity, Laboratory equipment, Radioisotopes, Reverse isotope dilution method, Quantitative analysis, Metabolites, Carrier-addition method.

AMIC-6901

"GAGING AND SAMPLING INDUSTRIAL WASTEWATERS", Rabosky, J. G., Koraido, D. L., Chemical Engineering, Vol. 80, No. 1, January 8, 1973, pp 111-120.

The generally accepted techniques for determining waste water flow (gaging) and collecting representative samples for the identification and quantification of pollutants are discussed. Selection of sampling sites and the method of sampling are very important. In obtaining samples for laboratory analysis, composite sampling (manual or automatic) is preferred to grab sampling since the former results in samples which represent average plant conditions over a relatively long period. Wastewater streams can be continuously and automatically monitored and analyzed by reliable onstream effluent-monitoring equipment currently on the market. More than 40 parameters can be monitored and analyzed by such equipment. In addition to the selection of sample points and the methods of sampling, the volume of sample required, analyses required, and proper handling and preservation of the samples must be taken into account. Methods for gaging flows in large open channels include (1) numerical methods which consider depth, area, velocity and discharge at points along the stream; and (2) the use of current meters (the various types are briefly described). For other types of streams, (1) water meters on influent pipes, (2) a bucket and stopwatch, and (3) pumping rate and length of discharge may be used. Additional methods of measuring flow and their specific applications are tabulated and discussed.

INDEX TERMS: Waste water (pollution), Water sampling, Flow measurement, Methodology, Monitoring, Equipment, On-site investigations, Pollutant identification, Water pollution sources, Mathematical studies, Industrial wastes, On-site tests, Laboratory tests, Waste identification, Path of pollutants, Effluent streams.



# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6921

"WATER QUALITY CRITERIA DATA BOOK. VOLUME 4. AN INVESTIGATION INTO RECREATIONAL WATER QUALITY", Mechals, B. J., Hekimian, K. K., Schinazi, L. A., Dudley, R. H., Aerojet-General Corporation, Envirogenics Co. Division, El Monte, California, Water Pollution Control Research Series 18040 DAZ 04/72, Contract No. 14-12-539, April 1972, 256 pp.

The Envirogenics Co., under sponsorship of the EPA, has developed a new technique for establishing firm criteria for health risks associated with recreational water bodies. Initial analysis of data required in this methodology has demonstrated that scientifically valid standards for recreational water quality can be formulated that should replace the present rather arbitrary standards. The basis of the method is a mathematical treatment of medical dose-response data in conjunction with the probability of exposure over a period of time to a given level of the potentially harmful 'factor' such that a quantitative risk can be assigned to the recreational activity. Once a public health jurisdiction has established an acceptable level of risk (perhaps in association with Federal quality guidelines), curves produced by electronic data processing equipment can be used to ascertain whether a particular water should be open to the public. While sufficient data have been found on both the health effects and the distribution of key factors to verify the effectiveness of the recommended procedure, informational gaps prevent the immediate adoption of the system. The gathering of information to establish realistic standards for key health-oriented factors would be an undertaking that could be accomplished in a relatively modest program. Once the essential information is obtained, it will be possible to put into practice the new Envirogenics-developed criteria procedure with the most critical factors.

AMIC-6922

"RAPID DETECTION SYSTEM FOR ORGANOPHOSPHATES AND CARBAMATE INSECTICIDES IN WATER", Goodson, L. H., Jacobs, W. B., Midwest Research Institute, Life Science Division, Kansas City, Missouri, Report No. EPA-R2-72-010, Contract No. 68-01-0038, August 1972, 66 pp.

An apparatus for the detection and monitoring of water supplies for hazardous spills of organophosphate and carbamate insecticides has been designed and fabricated. The new unit is called the Cholinesterase Antagonist Monitor, CAM-1, because it produces an alarm in 3 min when toxic or subtoxic levels of cholinesterase antagonists are present in water. Response of this apparatus to subtoxic levels of azodrin, sevin, dimethilan, malathion, parathion and DDVP has already been demonstrated. CAM-1 uses immobilized cholinesterase for the collection of cholinesterase inhibitors from the water supplies. The activity of the immobilized cholinesterase is determined automatically in an electrochemical cell by passing a substrate solution over the enzyme at regular time periods. A minicomputer is used to automate the detection process and to signal an alarm when there is a rapid loss of enzyme activity--a situation which occurs in the presence of organophosphate and carbamate insecticides in the water sampled.

INDEX TERMS: Monitoring, Carbamate pesticides, Organophosphorus pesticides, Water analysis, Pollutant identification, Pesticide toxicity, Equipment, Automation, Chemical reactions, Cholinesterase Antagonist Monitor, Enzyme activity, Cholinesterase, Sensitivity, Immobilization.

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INDEX TERMS: Bodies of water, Recreation, Methodology, Public health, Water quality standards, Water quality control, Viruses, Coliforms, Epidemiology, Water pollution effects, Physical properties, Chemical properties, Bioindicators, Pesticide residues, Water pollution sources, Mathematical models, Oily water, Pathogenic bacteria, Swimming pools.

AMIC-6930

"A. THE ROLE OF LICHENS IN ROCK WEATHERING AND SOIL FORMATION. B. MERCURY IN SEDIMENTS", Iskandar, I. K., University of Wisconsin, Madison, Wisconsin, Dissertation Abstracts No. 72-24,886, 1972, 177 pp. (Complete report not available from AMIC.)

The results of the present study showed that low but significant amounts of lichen compounds dissolve in water. Lichen compounds and water solutions of lichen compounds formed soluble metal complexes, frequently colored, when shaken with silicate materials for 96 hours, as shown by spectrophotometric and chemical analyses of the extracts. Release of cations from the silicate materials resulted largely from metal-complex formation rather than from reactions directly involving hydrogen ions. Similar amounts of Fe, Al, Ca, and Mg were released from the silicates by water solutions of lichen compounds and by solid lichen compounds. Contrary to popular belief, lichen compounds are sufficiently soluble in water to form soluble metal complexes and to cause chemical weathering of minerals and rocks. A highly sensitive and precise procedure was developed for the quantitative determination of total Hg in sediments and soils. Undried samples were treated with concentrated HNO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub>, KMnO<sub>4</sub>, and K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> for digestion and oxidation of all forms of Hg to Hg<sup>2+</sup> plus, which is subsequently determined by flameless atomic absorption spectrophotometry. Recovery of Hg ranged from 98 to 105 percent. The developed procedure extracted more Hg from sediments and soils than did extraction with concentrated HNO<sub>3</sub>. The vertical distribution of Hg in sediment cores from a range of hard- and soft-water lakes in Wisconsin was evaluated in terms of potential sources of Hg during the nineteenth and twentieth centuries. For the Madison lakes, the trends in Hg distribution were related to variations in sewage inputs during the last 80 years. It is unlikely that either inputs of sewage or erosional products are responsible for the observed

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6930 (Continued)

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accumulation of Hg. Background levels varied from 0.06 to 0.24 ppm of Hg in precultural sediments from the Wisconsin lakes investigated.

INDEX TERMS: Path of pollutants, Mercury, Sediments, Soils, Lichens, Lakes, Sewage, Mobilization, Sample preparation, Atomic absorption spectrophotometry.

AMIC-6953 (Continued)

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established through batch equilibration procedures which have been developed. The equilibration time in this procedure was established. The dependence of metal uptake by the resins on the pH of the solution was also determined. The polyamine resins were applied to the preconcentration of trace metals by utilizing them in a column mode of operation to sequester trace heavy metal cations. The metals were then quantitatively analyzed by AAS using normal procedures. The ability of the polyamine resins to sequester trace metal ions and then release the metals upon acidification was assessed by passing known, dilute concentrations of the desired metals through the resin, eluting with hydrochloric acid, then determining the percentage recovery of the metal ions. Various parameters were studied in this procedure in order to optimize the conditions for the simultaneous concentration of Cd, Co, Cu, Mn, Ni, Ag, and Zn. With a concentration factor of X1000, the successful analysis of these metals was achieved at the low concentration of 0.2 ppb. Other chelating ion exchange resins were synthesized for use as substrates in the metal sequestration study. These include poly(thiourea) and poly(dithiocarbamic acid) resins which form stronger metal chelates than the amine resins. Their synthesis on solid supports provides the most effective substrate in column chromatography for trace metal sequestration.

INDEX TERMS: Aqueous solutions, Separation techniques, Heavy metals, Analytical techniques, Chelation, Chemical reactions, Water analysis, Preconcentration, Ion exchange resins, Polyamine resins, Polyurea resins, Chelating, Resin synthesis, Trace levels, Metal complexes.

AMIC-6953

"ANALYTICAL APPLICATIONS OF POLYAMINE-POLYUREA CHELATING RESINS", Dingman, J. F., Jr., University of Massachusetts, Amherst, Massachusetts, Dissertation Abstracts No. 73-5534, 1972, 150 pp. (Complete report not available from AMIC.)

The objective of the study was to investigate the analytical applications of a family of weak base, polyamine ion exchange resins with regard to their ability to form transition metal ion complexes from aqueous solutions. The resins are selective for those metals which readily form amine complexes, and hence alkali and alkaline earth elements are not adsorbed. This is a desirable capability in the separation, concentration, and measurement of ultra-trace heavy metal cations from natural waters which are abundant in the Groups IA and IIA elements. The program consisted of three distinct but interrelated phases: the resin synthesis, the study of the metal-amine complex formation on the resin, and the study of the ability of the polyamine resins to selectively sequester trace heavy metal cations from aqueous solutions for preconcentration purposes. Toluene diisocyanate was used to polymerize and cross-link monomeric soluble polyamines from the polyethylenimine family. In this way, resins from ethylenediamine, triethylenetetraamine, tetraethylenepentamine, and polyethylenimine monomers having average molecular weights of 1200 and 1600 have been synthesized. A number of different resin synthesis methods were developed to determine the most efficient and reliable method for resin production. One goal was to produce a resin which had a high capacity but which was cross-linked to such a degree that it would not swell dramatically upon the addition of strong acids. Such a resin would be utilized in column chromatography. Methods were developed to coat effectively these resins on solid supports. Adsorption isotherms of some heavy metal cations on the resins were

AMIC-6968

"SEPARATION OF LIGNIN FROM AQUEOUS SOLUTION BY ADSORPTIVE BUBBLE SEPARATION PROCESSES", Wang, M. S., Rutgers University, New Brunswick, New Jersey, Dissertation Abstracts No. 73-4791, 1972, 255 pp. (Complete report not available from AMIC.)

An experimental investigation is reported of the feasibility of using suitable types of adsorptive bubble separation methods to remove lignin from pulp-mill effluents as well as from river waters. Specific processes investigated include: foam fractionation, bubble fractionation, precipitate flotation, adsorbing colloid flotation, and ion flotation. Although lignin is a surface-active substance, foam fractionation and bubble fractionation do not appear to be effective processes for the separation of lignin from concentrated and from dilute aqueous solutions. The effective processes for the removal of lignin include: ion flotation, with cetyltrimethylbenzylammonium chloride as the collector as well as the frother; adsorbing colloid flotation, with colloidal dialkyldimethylammonium chloride as both the collector and the frother; and precipitate flotation, with aluminum sulfate as the precipitation agent, and with cetyltrimethylbenzylammonium chloride as the collector and the frother. High recoveries of lignin can be achieved, provided that an optimum ratio of lignin to collector is used. If an insufficient amount of collector is used, redispersion of insoluble lignin-collector complexes occurred because the foam produced will not support it. If an over dose of the collector is used, the lignin-collector complexes are excluded from the gas bubbles or become coated by a double layer of collector to give a hydrophilic film. Since the effective pH range for the lignin-cetyltrimethylbenzylammonium chloride system is from 3.5 to 8.5, normally, pH adjustment is not necessary. Potential applications of the ion flotation process

# 1. PHYSICAL AND CHEMICAL METHODS

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include the removal of kraft lignin from the kraft pulpmill effluent, lignin sulphonate from the sulfite pulpmill effluent, and dilute lignin from river water.

INDEX TERMS: Separation techniques, Aqueous solutions, Pulp wastes, Lignins, Rivers, Foam fractionation, Chemical precipitation, Water quality control, Methodology, Pollutant removal, Bubble fractionation, Precipitate flotation, Ion flotation, Adsorbing colloid flotation, Recovery.

AMIC-6971 (Continued)

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Concentrations of Cs-133 and fallout Cs-137 in trout muscle were significantly correlated which indicated that the kinetic behavior of the isotopes was similar.

INDEX TERMS: Path of pollutants, Kinetics, Ecosystems, Neutron activation analysis, Radiochemical analysis, Water analysis, Lake sediments, Seston, Amphipoda, Zooplankton, Trout, Colorado, Aquatic plants, Cs-133, East Twin Lake, Montane lake, Bioaccumulation.

AMIC-6971

"CESIUM KINETICS IN A MONTANE LAKE ECOSYSTEM", Hakonson, T. E., Colorado State University, Fort Collins, Colorado, Dissertation Abstracts No. 73-2791, 1972, 166 pp. (Complete Report not available from AMIC.)

This study was initiated to determine the kinetics of cesium in East Twin Lake, a 5 hectare, natural semi-drainage lake which lies at an elevation of 2880 meters in the north-central Colorado Rockies. One kilogram of Cs-133 was introduced into the water of East Twin Lake on September 15, 1970. Samples of water, seston, sediment, amphipods, zooplankton, trout and three species of vegetation were obtained over a 393 day period following the dosing event. Stable cesium was measured by neutron activation analysis. Loss of Cs-133 from the water occurred in a rapid phase, which resulted in the loss of 60 percent of the cesium from water and had a loss half-time of 0.5 days and a slow phase which had a loss half-time of 130 days. The seston fraction of each water sample contained from 25 percent to 80 percent of the Cs-133 present in each liter of unfiltered water. Bottom sediments were identified as the major site of deposition of the Cs-133 dose. Amphipods and zooplankton reached equilibrium with the water within about three weeks after the Cs-133 administration and achieved concentration factors of about 700 and 150, respectively. Trout accumulated the Cs-133 more slowly than the invertebrates and reached a maximum concentration factor of about 5500 some 260 days following the dosing event. The simulation of the kinetics of Cs-133 in the East Twin Lake ecosystem was approached by utilizing the observed in-growth data to solve for the intercompartmental transfer rate constants. The constant coefficient model described the general behavior of the observed data very well. The use of Cs-133 as a tracer for Cs-137 was both reliable and feasible. Absolute quantities as small as 0.01 micrograms of Cs-133 were detectable.

AMIC-6976

"THE EFFECT OF PASSAIC RIVER BENTHAL DEPOSITS ON DEOXYGENATION IN OVERLYING WATERS", Donovan, O. M., Rutgers University, New Brunswick, New Jersey, Dissertation Abstracts No. 73-4738, 1972, 161 pp. (Complete report not available from AMIC.)

Field work was carried out on natural benthic deposits on the upper Passaic River using a benthic respirometer. The deposits investigated showed an average areal oxygen demand of 2.22 grams/sq m/day, with a range of from 1.13 grams/sq m/day to 3.79 grams/sq m/day. Studies on the areal extent of the deposits allowed calculation of the average benthic demand on the overlying water as a function of the stream discharge rate. This demand ranged from 0.26 mg/l/day at 200 cfs to 0.12 mg/l/day at a discharge rate of 1400 cfs. Benthic deposits from the Passaic River, along with samples of the overlying water, were brought back to the laboratory for examination under more carefully controlled conditions. Resulting oxygen sag curves in the laboratory apparatus were examined and provided graphic examples of the capacity of pollutional sediments in the causation of adverse effects on stream oxygen balance. Quantitative studies with oxygen sag curves generated in the laboratory apparatus showed that a very close fit could be obtained between predicted and observed data. This indicated that the methods used to experimentally determine constants for use in the oxygen sag expression were reasonably accurate and could be put to use in engineering examinations of polluted rivers and streams. Corollary studies on NH<sub>3</sub>, nitrate, and phosphate concentrations in the water overlying the deposits showed that the benthic deposits released ammonia to the overlying waters and sorbed nitrate from the overlying waters. Comparative studies on the reaeration rates of highly polluted Passaic River waters as opposed to clean waters revealed no significant differences in the reaeration coefficients observed.

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INDEX TERMS: Reaeration, Oxygen sag, Water pollution effects, Water pollution, Ammonia, Nitrates, Phosphates, Streamflow, Discharge (water), Water analysis, Chemical analysis, Dissolved oxygen, Oxygen demand, Rates, Passaic River, Benthic deposits, Reaeration coefficients.

AMIC-6978 (Continued)

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conditions, the reverse seems to be true; (4) natural bottom sediments containing oil, consolidate under their own weight with time; (5) oils which reach the bottom sediments of rivers and other water bodies have lost all their lighter fractions corresponding to a carbon chain length of 20; and (6) there is an increased percentage of partially oxidized hydrocarbons in oils extracted from natural bottom sediments.

INDEX TERMS: Degradation (decomposition), Oil, Bottom sediments, Pollutants, Rivers, Aerobic conditions, Anaerobic conditions, Soil analysis, Aquatic soils, Persistence, Chromatography, Pollutant identification, Consolidation, Fate of pollutants, Infrared spectrophotometry, Chemical composition, Degradation products.

AMIC-6978

"DECOMPOSITION OF OIL POLLUTANTS IN NATURAL BOTTOM SEDIMENTS", Shelton, T. B., Rutgers University, New Brunswick, New Jersey, Dissertation Abstracts No. 73-4778, 1972, 165 pp. (Complete report not available from AMIC.)

An aerobic and anaerobic experimental system was designed to study the decomposition of oil pollutants in natural bottom sediments and to answer 3 questions: (1) What is the relative persistence of oils compared with other organics from a natural bottom sediment containing oil? The relative persistence of aliphatic, aromatic and oxy-compound components of the oil were also determined; (2) How is this relative persistence influenced by anaerobic conditions in the overlying water? and (3) Is organic carbon released from a natural bottom sediment during the decomposition process? The aerobic system was a constant flow apparatus and the anaerobic system operated on a fill and draw basis with nitrogen gas used to achieve anaerobic conditions. A suitable bottom sediment containing approximately 8 percent oil on a dry weight basis was used. Appropriate samples of the sediment were placed on the aerobic and anaerobic experimental systems and the course of decomposition followed for a 33 week period. At weekly intervals measurements of dissolved oxygen, pH, TOC, BOD were made on the aerobic system. H<sub>2</sub>S, pH, COD, TOC, and color were determined on the anaerobic system. Measurements of dry solids, volatile solids, nitrogen, phosphorus, hexane extractables, benzene extractables were performed on the bottom sediment. The hexane extractable oils were further subjected to chromatographic separation using a silica gel technique. These fractions were examined by infrared spectrophotometry for changes in functional groups. It was found that: (1) the oxygen utilization rate of the sediment varied from 1.5 to 1.73 g/sq m/day; (2) oils are lost and there is a steady release of organic C from natural bottom sediments with time with both aerobic and anaerobic conditions present in the overlying water; (3) under aerobic conditions oils persist in the bottom sediment longer than do other organics. Under anaerobic

AMIC-6987

"CESIUM-137 AND STABLE CESIUM IN A HYPEREUTROPHIC LAKE", Eymann, L. D., Michigan State University, East Lansing, Michigan, Dissertation Abstracts No. 73-5367, 1972, 113 pp. (Complete report not available from AMIC.)

The inputs of Cs-137 and stable Cs and their distribution among the various components of an aquatic ecosystem were studied in a lake exhibiting an advanced stage of eutrophy. Components sampled and analyzed for these two isotopes of cesium included water, sediments, macrophytes, filamentous algae, zooplankton, and several species of fish. Most of the cesium pool (87 percent Cs-137; 98 percent Cs) was associated with the sediments. A trend of increased Cs-137 concentration at higher trophic levels was demonstrated for those fish that are free-ranging limnetic feeders. No such trend was evident for stable Cs. Forms closely associated with sediments had higher Cs-137 concentrations than expected based on their feeding habits. On the dates samples were collected, specific activity in limnetic fishes was constant but was variable in other forms. The degree of association of biotic forms with sediments was reflected in their specific activity.

INDEX TERMS: Ecosystems, Lakes, Eutrophication, Path of pollutants, Stable isotopes, Radiochemical analysis, Cesium, Water analysis, Aquatic plants, Aquatic algae, Zooplankton, Freshwater fish, Lake sediments, Aquatic environment, Soil analysis, Aquatic soils, Trophic level, Cs-137, Cesium radioisotopes, Macrophytes, Fate of pollutants.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-6996

"TRACE METAL RELATIONSHIPS IN A MARINE PELAGIC FOOD CHAIN", Knauer, G. A., Stanford University, Stanford, California, Dissertation Abstracts No. 73-4534, 1972, 156 pp. (Complete report not available from AMIC.)

Surface water samples collected over a one year period from Monterey Bay, California were analyzed for Cd, Cu, Mn, Pb and Zn. Mixed phytoplankton and zooplankton samples were analyzed for Na, Mg, Ca, K, Sr, Si (phytoplankton), Ba, Al, Zn, Fe, Cu, Mn, Ni, Ti, Ag, Cd, and Pb. Samples of the northern anchovy *Engraulis mordax* were analyzed for Pb, Cd, Ag, Ni, Mn, Cu, Fe, Zn, Al, and Ba. Analysis was by conventional atomic absorption spectrometry. Phytoplankton samples were separated into acid soluble and silica fractions before analysis. The acid soluble fraction contained large amounts of Na, K, Mg, Ca and Si and low concentrations of the remaining elements. Titanium usually was not detected in this fraction. In the silica fraction, Na, K and Mg were found to have the highest concentrations followed by Al, Ca, Fe and Sr. The lowest levels found in this fraction were for the elements Cu and Zn with Ba, Mn and Cd detected only occasionally. The metals Pb, Cd, Ag, Ni, Mn, Cu, Fe, Zn, Al and Ba were also compared in phytoplankton, zooplankton and anchovy samples in order to determine existing relationships in this simple food chain. In general, concentrations of biologically active metals were relatively constant in all three trophic levels. For non-biologically active metals (e.g., Cd, Ni, Pb) little evidence for food chain amplification was found. Phytoplankton concentration factors (relative to seawater) were found to be highest for Pb, Fe, Si, Cd, Al, and Ti respectively while relatively low values were obtained for Ba, Zn, Cu, Mn, Ni and Ag. Except for K, Sr, and Ba, the alkali and alkaline earth metals were not concentrated relative to seawater. Mercury levels in this food chain were also found to be low.

INDEX TERMS: Heavy metals, Food chains, Phytoplankton, Zooplankton, Fish, Bioaccumulation.

AMIC-7014

"RESULT OF FLUVIAL ZINC POLLUTION OF THE ZINC CONTENT OF LITTORAL AND SUB-LITTORAL ORGANISMS IN CARDIGAN BAY, WALES", Ireland, M. P., Environmental Pollution, Vol. 4, No. 1, January 1973, pp 27-35.

A study has been made of the distribution of fluvial zinc in sea water, five littoral animals and one species of seaweed, together with two sub-littoral animals at varying distances from the source of pollution. Water samples were taken 15 cm below the surface, and filtered. Fresh water samples were concentrated 50 times by boiling and acidifying with HCl (Aristar, BDH) to a concentration of 0.06 N. Sea water samples were concentrated with organic solvents, as described by Willis (1961). Littoral animals were collected in the area where kelp was located and sublittoral species were collected at a low spring tide by SCUBA divers. Allowed to purge themselves overnight, the animal samples were rinsed in distilled water, dried at 105 C to a constant weight, pulverized, and digested in 6 N HCl. Whole-bodied specimens were used except for a species of barnacle and the kelp. Zinc was estimated by AAS at 214 nm. The Zn content of sea water was indicative of polluted water becoming progressively more dilute. The distribution of Zn in the various species was found to be related to tidal flow, diet, and species specificity for the metal.

INDEX TERMS: Chemical analysis, Zinc, Path of pollutants, Pollutant identification, Ecological distribution, Water analysis, Kelp, Littoral, Tidal effects, Mollusks, Crustaceans, Food habits, Sampling, Methodology, Atomic absorption spectrophotometry, Macroinvertebrates, Sponges, Sublittoral, Sample preparation.

AMIC-7017

"MERCURY IN SEDIMENTS FROM THE THAMES ESTUARY", Smith, J. D., Nicholson, R. A., Moore, P. J., Environmental Pollution, Vol. 4, No. 2, February 1973, pp 153-157.

Fresh unconsolidated surface sediment samples from the outer Thames estuary and samples from a museum collection were analyzed for mercury by flame atomic absorption spectrophotometry. The fresh samples were collected using a cone dredge. Sample preparation involved shaking a quantity of the sediment overnight with 1N H<sub>2</sub>SO<sub>4</sub> containing 0.5 g of KMnO<sub>4</sub> in a polypropylene bottle. The excess KMnO<sub>4</sub> and MnO<sub>2</sub> formed were reduced by adding 30 percent H<sub>2</sub>O<sub>2</sub> solution. The mercury was amalgamated on a silver wire coil and determined by flameless AAS. Comparison of results for the two groups indicates that there has been little overall change in this period, but levels in the recent sediments were generally higher than those obtained for samples of London clay deposited in Eocene times (approximately 50 million years ago). Mercury contents of the sediments range from 0.012 to 0.550 ppm, with the higher concentrations usually occurring in sediments containing a high proportion of fine particles.

INDEX TERMS: Mercury, Sediments, Soil analysis, Chemical analysis, Estuaries, Aquatic soils, Heavy metals, Saline soils, Sampling, Pollutant identification, Thames estuary, Flameless atomic absorption spectrophotometry, Sample preparation.

AMIC-7019

"LAND DEVELOPMENT AND HEAVY METAL DISTRIBUTION IN THE FLORIDIA EVERGLADES", Horvath, G. J., Harriss, R. C., Matraw, H. C., Marine Pollution Bulletin, Vol. 3, No. 12, December 1972, pp 182-184.

In order to make a quantitative appraisal of the impact of Big Cypress land development on the distribution and abundance of heavy metals in the Everglades estuaries, a study was conducted to elucidate the geochemistry of manganese, cobalt, copper, zinc, cadmium and lead in the canal-estuary system of the region. The hydrological system chosen for the study consists of farmed lands to the north connected by the Barron River canal system of Chokoloskee Bay to the south. Water samples were collected during moderate to high flow conditions, iced, filtered, and subjected to nitric acid-persulfate oxidation. Total dissolved metals were concentrated using Chelex-100 ion-exchange resin columns with an efficiency of 80-100 percent. Metal concentrations were determined by atomic absorption spectrophotometry, using the standard addition method for all samples. Analytical precision was between plus or minus 2 and 8 percent. The highest concentration of total dissolved metals occurred in the portion of the canal adjacent to cultivated areas. Data demonstrate that Chokoloskee Bay is enriched in the metals investigated by factors of 2.6-4.8. A comparison of dissolved metal concentrations in the developed canal area with water from estuarine areas indicates that copper, cadmium, and lead exhibit maximum concentrations in Chokoloskee Bay. Both of the Everglades estuaries investigated have higher dissolved Mn, Co, Cd, and Pb contents than have been previously reported for coastal marinewaters.

INDEX TERMS: Manganese, Cobalt, Copper, Zinc, Cadmium, Lead, Hydrologic systems, Estuaries, Florida Everglades, Atomic absorption spectrophotometry.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-7029

"THE APPEARANCE AND VISIBILITY OF THIN OIL FILMS ON WATER", Horstein, B., U. S. Environmental Protection Agency, Edison Water Quality Laboratory, Edison, New Jersey, Report No. EPA-R2-72-039, August 1972, 95 pp.

Oil films of controlled thickness up to 3000 nanometers, upon water surfaces in the laboratory, confirm an inherent and orderly thickness-appearance relationship which is independent of oil type and water type. These laboratory studies also investigated the effects of viewing conditions upon the ease of visibility of these thin films. Out-of-doors observations were made; these and the observations reported by other sources were found to correspond with the laboratory results. The visibility of a thin oil film depends not only upon its thickness-dependent inherent appearance, but also upon conditions external to the film. These include nature of illumination and sky conditions, sun angle, color and depth of water, color of bottom, and viewing angle. Color photographs are included for illustration of the points discussed.

INDEX TERMS: Thin films, Oily water, Optical properties, Oil-water interfaces, Color, On-site investigations, Laboratory tests, Pollutant identification, Visibility, Color photography, Crude oil, Diesel fuel, Fuel oil.

AMIC-7034

"A METHOD FOR THE QUALITATIVE AND QUANTITATIVE INFRARED SPECTROSCOPIC ANALYSIS OF METAL-TETRAMETHYLENEDITHIOCARBAMATE MIXTURES WITHOUT PRIOR SEPARATION", Malissa, H., Kellner, R., *Analytica Chimica Acta*, Vol. 63, No. 2, February 1973, pp 263-275.

A method for the direct i.r. analysis of metal-tetramethylenedithiocarbamate mixtures without preceding separation is proposed. Because of the remarkable shifts of the M-S-stretching vibrations and the small losses of energy by stray light, the region beyond 400/cm is the most useful for a determination in potassium bromide. Model analyses with standard mixtures of Pb(II)- and Hg(II)-TMDTC, and Fe(III)-, Co(III)- and Ni(II)-TMDTC are described. The method can be used for the determination of trace amounts of heavy metals in aqueous solutions after complexation with Na-TMDTC and extraction with chloroform. The detection limit for application of the 13-mm standard KBr method and a routine spectrometer (without ordinate expansion) is about 10 micrograms of metal. (In German)

INDEX TERMS: Chemical analysis, Methodology, Pollutant identification, Trace elements, Aqueous solutions, Chelation, Heavy metals, Mercury, Iron, Cobalt, Nickel, Sodium, Alkali metals, Metal complexes, Infrared spectrophotometry, Quantitative analysis, Mixtures, Infrared spectra, Metal chelates, Detection limits, Lead-tetramethylenedithiocarbamate, Mercury-tetramethylenedithiocarbamate, Iron-tetramethylenedithiocarbamate, Cobalt-tetramethylenedithiocarbamate, Nickel-tetramethylenedithiocarbamate.

AMIC-7033

"DIRECT QUALITATIVE AND QUANTITATIVE INFRARED SPECTROSCOPIC ANALYSIS OF ZINC-DIALKYL DITHIOCARBAMATE WITHOUT PRIOR SEPARATION", Sztark, W., Malissa, H., Kellner, R., *Analytica Chimica Acta*, Vol. 63, No. 2, February 1973, pp 285-293.

A new method for the i.r. analysis of zinc-dialkyldithiocarbamate mixtures has been developed. The identification and detection limits were improved, compared to the standard method, by the use of microtechniques (identification limit 2 micrograms, detection limit 30-80 micrograms). Binary and ternary mixtures can be analyzed without preliminary separation, because the other components of the mixtures have very little influence on the measured absorption band. Beer's law was obeyed for the binary and two ternary mixtures. The relative standard deviations and the coefficients of correlation were calculated for the macro- and micromethods. A comparison of statistical data shows that i.r. spectroscopy is suitable for quantitative analysis even in the region of 80-10 micrograms of substance. (In German)

INDEX TERMS: Pollutant identification, Chemical analysis, Heavy metals, Methodology, Mixtures, Zinc-dialkyldithiocarbamates, Infrared spectrophotometry, Infrared spectra, Detection limits, Quantitative analysis, Zinc-dimethyldithiocarbamate, Zinc-diaethyldithiocarbamate, Zinc-dibutyldithiocarbamate, Zinc-dibenzylthiocarbamate, Organometallic compounds.

AMIC-7035

"SPECTROPHOTOMETRIC DETERMINATION OF P.P.B. LEVELS OF LONG-CHAIN AMINES IN WATERS AND RAFFINATES", Florence, T. M., Farrar, Y. J., *Analytica Chimica Acta*, Vol. 63, No. 2, February 1973, pp 255-261.

A method has been developed for the determination of traces of long-chain amines in river and sea water and uranium processing raffinates. The amine is extracted as an ion-association complex with chromate from sulfuric acid solution into chloroform and the extracted Cr(VI) is determined spectrophotometrically with diphenylcarbazide. Alamine 336, a mixture of tric-n-octyl and tri-n-decylamines, was studied using this method. Tests for adsorption losses showed that polyethylene containers are unsuitable for collection or storage but glass containers are safe for up to a week. Several metal ions (Cu(II), Fe(III), Mg(II), Mn(II), Ni(II), U(VI) and Zn(II)) were found to have no effect on the determination of Alamine 336 by the chromate method, even when present at 500 times the amine concentration. Chloride, nitrate, and phosphate at concentrations of 25, 5, and 250 ppm, respectively, could be tolerated in determining 1 ppm Alamine 336 by a single chromate extraction. The limits of detection for Alamine 336 with a 100-ml and a 250-ml sample were 15 and 7 ppb, respectively. The relative standard deviation of the method at 1.5 ppm Alamine 336 level was found to be 1.9 percent. The application of the chromate method to the determination of some other commercial amines (Aliquat 336, Primene JM-T, Amberlite LA-1) indicates that primary, secondary, and quaternary long-chain amines can also be determined.

INDEX TERMS: Chemical analysis, Water analysis, Spectrophotometry, Methodology, Pollutant identification, Rivers, Sea water, Solvent extractions, Uranium processing raffinates, Aliphatic amines, Alamine 336, Ionic interference.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-7036

"TRACE DETERMINATION OF MERCURY IN BIOLOGICAL MATERIALS BY FLAMELESS ATOMIC ABSORPTION SPECTROMETRY", Omang, S. H., Analytica Chimica Acta, Vol. 63, No. 2, February 1973, pp 247-253.

A new, rapid, wet digestion procedure which utilizes a mixture of hydrobromic acid and nitric acid has been used for preparing biological materials for analysis for the presence of mercury. The samples are boiled for 5-10 min in a mixture of nitric and hydrobromic acid under reflux. Mercury is then determined by the flameless cold-vapour, atomic absorption technique and complete release is shown to occur even when the fat present is not fully decomposed. The results are discussed with regard to the normal bromine and iodine content of marine samples. The enhancement obtained with bromine can easily be compensated by digesting the standards. Iodine, however, reduces the peak heights and the content of this element must be judged separately for samples other than fish, which can always be safely analyzed without interference.

INDEX TERMS: Mercury, Chemical analysis, Methodology, Heavy metals, Iodides, Bromides, Anions, Pollutant identification, Sample preparation, Wet ashing, Biological samples, Flameless atomic absorption spectrophotometry, Chemical interference, Trace levels.

AMIC-7039

"SEPARATION OF MATRIX ABSORPTION AND ENHANCEMENT EFFECTS IN THE DETERMINATION OF SULFUR IN SEA WATER BY X-RAY FLUORESCENCE", Taylor, D. L., Zeitlin, H., Analytica Chimica Acta, Vol. 64, No. 1, March 1973, pp 139-142.

An investigation has been made of the relationship between matrix absorption and enhancement effects as observed in the determination of sulfur in sea water. Standard sulfate solutions were prepared from lithium sulfate monohydrate and sodium and chlorine were added as matrix variants in various forms. The intensity of SK sub alpha fluorescence (I sub F) at a wavelength of 5.372 A as well as the intensity of scattered bremsstrahlung (I sub SR) at 5.299 A were measured by X-ray fluorescence. The scattered radiation method with soft scattered bremsstrahlung affords only slight compensation for matrix effects in X-ray analysis for sulfur in sea water. However, the technique offers an effective means by which the effects of instrumental variations and sample inhomogeneities may be diminished.

INDEX TERMS: Sea water, X-ray fluorescence, Sulfur, Chemical analysis, X-ray analysis, Separation techniques, Sodium, Chlorine, Radiation, Matrix effects, Matrix absorption, Chemical interference.

AMIC-7037

"A RADIOREAGENT METHOD FOR THE DETERMINATION OF TRACES OF BISMUTH", Menon, M. P., Analytica Chimica Acta, Vol. 64, No. 1, March 1973, pp 151-155.

A method has been described for the determination of traces of bismuth in aqueous solutions with radiiodide. It makes use of the reaction between soluble iodide and an acidic solution of Bi to convert Bi ion to radioactive tetraiodobismuthic acid by treatment with excess of I-131. The active product is extracted into n-butyl acetate and the gamma-ray activity of a portion of the extract is determined. The relationship between the net activity of the reaction product and the concentration of bismuth was linear over the range 1-25 micrograms of bismuth. The sensitivity of the proposed method appears to be better than that of any other method except the dithizone method, which has been applied only to biomaterials. Elements such as Cd, Pb, Cu, Ag, Hg, Sb and V interfere with the direct determination of bismuth, but bismuth can still be determined directly in solutions containing iron, nickel, or chromium, or in most biological samples. The results of the analyses of the N.B.S. reference standards with the preliminary extraction were in fairly good agreement with the values certified by N.B.S.

INDEX TERMS: Radioactivity techniques, Iodine radioisotopes, Chemical reactions, Heavy metals, Bismuth, Trace levels, Tetraiodobismuthic acid, Chemical interference.

AMIC-7040

"GRAPHITE ROD ATOMIZATION AND ATOMIC FLUORESCENCE FOR THE SIMULTANEOUS DETERMINATION OF SILVER AND COPPER IN JET ENGINE OILS", Patel, B. M., Winefordner, J. D., Analytica Chimica Acta, Vol. 64, No. 1, March 1973, pp 135-138.

Silver and copper can be determined simultaneously by atomic fluorescence without altering any conditions for sample atomization. Both of the elements are atomized simultaneously from a heated graphite rod at an intermediate temperature (1800 K), and the two separate fluorescence peaks result. This procedure has been applied to the analysis of used jet engine oils using 0.5-microliter samples. The samples were ashed at 42 A (645 K) for 18 s. Silver and copper were simultaneously atomized by suddenly increasing the current to 98 A for 3 s to give a temperature of about 1800 K. The resulting atoms produced two resolved atomic fluorescence peaks. An atmosphere of argon and hydrogen (with flow rates 6.4 l/min and 1.2 l/min, respectively) was maintained around the graphite rod atomizer. The results for Ag and Cu in the oil samples, determined by atomic fluorescence, were compared with the mean values from the U.S. Air Force S.O.A.P. (supplier of the samples analyzed) laboratories by emission and flame atomic absorption methods. There was reasonable agreement among the values, and the results from the simultaneous atomization technique usually fell within the standard deviations of the results from the S.O.A.P. laboratories. The relative standard deviations calculated from 10-15 determinations for different oil samples by this technique were between 6 and 12 percent. The slight loss in precision is compensated by the saving in time achieved.

INDEX TERMS: Copper, Chemical analysis, Methodology, Heavy metals, Oil, Pollutant identification, Atomic fluorescence spectroscopy, Silver, Jet engine oil, Spectrochemical Oil Analysis Program, Fluorescent spectra, Accuracy.



# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-7045

"REVERSED-PHASE FOAM CHROMATOGRAPHY. REDOX REACTIONS ON OPEN-CELL POLYURETHANE FOAM COLUMNS SUPPORTING TETRACHLOROHYDROQUINONE", Braun, T., Farag, A. B., Klimes-Szmik, A., *Analytica Chimica Acta*, Vol. 64, No. 1, March 1973, pp 71-76.

The use of elastic polyurethane foam as a support for chloranil in reversed-phase foam chromatography was proved successful. Reductions of cerium(IV), vanadium(V) and iron(II) on foam-filled columns were carried out quantitatively and rapidly. The effect of flow-rate and temperature on the reduction of each metal ion was examined in detail. Cerium(IV) was reduced quantitatively on passing through the foam-redox column at flow-rates of 2-11 ml/min at room temperature. The reduction of vanadium(V) and iron(III) was slower; complete reduction occurred only at flow-rates up to 4 and 2 ml/min for V(V) and Fe(III), respectively. At 35 degrees, however, it was possible to use flow-rates of 7 and 6 ml/min for the quantitative reduction of V(V) and Fe(III), respectively.

INDEX TERMS: Chemical reactions, Heavy metals, Pollutant identification, Iron, Cations, Temperature, Flow rates, Reduction (chemical), Oxidation, Reversed phase foam chromatography, Open cell polyurethane foam, Support columns, Chloranil, Polyurethane foams, Cerium, Vanadium, Tetrachlorohydroquinone.

AMIC-7049

"ION EXCHANGE IN AQUEOUS AND IN AQUEOUS-ORGANIC SOLVENTS. PART I. ANION-EXCHANGE BEHAVIOUR OF ZR, NB, TA AND PA IN AQUEOUS HCL-HF AND IN HCL-HF-ORGANIC SOLVENT", Kim, J. I., Lagally, H., Born, H.-J., *Analytica Chimica Acta*, Vol. 64, No. 1, March 1973, pp 29-43.

Ion-exchange behaviours of Zr(IV), Nb(V), Ta(V), and Pa(V) on the anion exchanger Dowex 1-X8 were investigated first in a wide variety of aqueous mixed hydrochloric acid-hydrofluoric acid and secondly in the same aqueous system mixed with various organic solvents. Equilibrium adsorptions of these four elements as a function of hydrochloric acid concentration as well as hydrofluoric acid concentration, or both acid concentrations, were found to be strongly differentiated. This fact can be utilized for convenient separations of these elements from each other. Based on the equilibrium results, the possible complex formation of the metal ions and the separation possibilities for the elements are discussed.

INDEX TERMS: Anion exchange, Radioactivity techniques, Adsorption, Separation techniques, Aqueous solvents, Organic solvents, Zirconium, Niobium, Protactinium, Tantalum, Ion exchange resins, Gamma spectrometry, Pa-233, Zr-95, Nb-95, Ta-182, Pa-231.

AMIC-7048

"ION-EXCHANGE FOAM CHROMATOGRAPHY. PART I. PREPARATION OF RIGID AND FLEXIBLE ION-EXCHANGE FOAMS", Braun, T., Ekeffy, O., Haklits, I., Kadar, K., Majoros, G., *Analytica Chimica Acta*, Vol. 64, No. 1, March 1973, pp 45-54.

In order to be able to apply the principles of foam chromatography to ion-exchange processes, preparative methods for open-cell ion-exchange foams were investigated. Homogeneous ion-exchange foams were prepared by introducing ion-exchange groups on previously prepared phenol-formaldehyde, polyurethane and polyethylene foams. The maximum capacity of the produced sulfonated phenol-formaldehyde cation-exchange foams was 1.85 meq/g, that of the styrene-polyurethane interpolymer anion-exchange foams was 2.2 meq/g. Weak carboxylic ion-exchange foams were prepared by radiation grafting of polyurethane and polyethylene foams; the maximum capacity of these foams was 4.02 meq/g. Heterogeneous ion-exchange foams were prepared by foaming a fine powder of a commercially available cation exchanger with the precursors of open-cell polyether-type polyurethane foam. The capacity of such a foam containing 26 percent ion-exchange powder was 1.0 meq/g. The kinetics of the cation-exchange process on the heterogeneous foams was measured with Sr-85.

INDEX TERMS: Construction, Strontium radioisotopes, Pollutant identification, Cation exchange, Separation techniques, Ion exchange foam chromatography, Ion exchange foams, Foaming, Sr-85, Chloromethylation, Amination, Radiation grafting, Polyurethane foams, Polystyrene foams, Polymerization.

AMIC-7051

"THE SIMULTANEOUS DETERMINATION OF TRACES OF COBALT, CHROMIUM, COPPER, IRON, MANGANESE AND ZINC BY ATOMIC FLUORESCENCE SPECTROMETRY WITH PRECONCENTRATION BY AN AUTOMATED SOLVENT EXTRACTION PROCEDURE", Jones, M., Kirkbright, G. F., Ranson, L., West, T. S., *Analytica Chimica Acta*, Vol. 63, No. 1, January 1973, pp 210-215.

A description is given of the assembly and operation of an automated solvent extraction system for preconcentration; the subsequent simultaneous determination of Co, Cr, Cu, Fe, Mn and Zn by atomic fluorescence spectrometry in a manner similar to that described elsewhere is also reported. The application of this system to the rapid determination of trace amounts of Cu, Fe, Mn and Zn in sea-water is also described. Detection limits and extraction efficiencies were obtained for all 6 elements in aqueous and organic solutions. Except for chromium, an improvement of 6-10-fold in the detection limit was achieved by the extraction procedure. The analysis rate of the spectrometer is limited by the rate of the automated solvent extraction process; under the conditions used the maximum analysis rate was 25 samples per h. Recovery of the analyte elements from the sea water samples was checked by making standard additions of each of the elements to an analyzed sample; recoveries exceeded 90 percent, indicating that the accuracy sufficed for the routine determination of these metals (less than ca. 0.1 ppm) in sea water. The automated solvent extraction method developed can be successfully employed for simultaneous determinations of six elements with a multichannel atomic fluorescence spectrometer. Improved detection limits are obtained, but only a 4:1 sample:solvent mixing ratio is tolerable if the system is to be successfully interfaced with the nebulizer of the flame spectrometer.

# 1. PHYSICAL AND CHEMICAL METHODS

AMIC-7051 (Continued)

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INDEX TERMS: Heavy metals, Aqueous solutions, Chemical analysis, Pollutant identification, Water analysis, Solvent extractions, Trace elements, Cobalt, Chromium, Copper, Iron, Manganese, Zinc, Sea water, Sample preparation, Preconcentration, Automated solvent extraction, Atomic fluorescence spectroscopy, Multielemental analysis, Detection limits, Recovery.

AMIC-7068

"THE DETERMINATION OF ORGANOCARBON IN CLAY MATERIALS", Ferris, A. P., Jepson, W. B., Analyst, Vol. 97, No. 1161, December 1972, pp 940-950.

A dry-combustion method is described for the determination of organocarbon in clay materials. The essential features are the use of purified oxygen; slow insertion of the sample into the furnace to avoid rapid dehydroxylation of the kaolinite and attendant loss of pyrolysis fragments in the atmosphere of steam that is generated; and the use of traps to remove gaseous fluorine compounds, steam and sulphur dioxide. Extensive tests on the apparatus with calcium carbonate and with mixtures of kaolin with glucose and with tannic acid are described. Tests with a commercial kaolin containing organic matter equivalent to about 550 micrograms of carbon per gram of material indicated a standard error of 8 micrograms, or plus or minus 1.5 per cent. A published method in which the kaolin is heated in a stream of oxygen containing 2 per cent V/V of ozone has been re-investigated; the organocarbon was only partially oxidized so that the method has no analytical value. Two wet-combustion methods involving the separate use of potassium dichromate and potassium persulphate, which are used in soil analysis, were evaluated. The organic matter on the clay was again only partially oxidized to carbon dioxide under the experimental conditions.

INDEX TERMS: Clays, Chemical analysis, Methodology, Soil analysis, Laboratory equipment, Kaolinite, Storage, Organic carbon, Kaolin, Dry ashing, Chemical interference, Sulfur dioxide, Silicon tetrafluoride, Hydrogen fluoride, Wet ashing, Precision.

AMIC-7066

"THE ANALYSIS OF ORGANICALLY BOUND ELEMENTS (AS, SE, BR) AND PHOSPHORUS IN RAW, REFINED, BLEACHED AND HYDROGENATED MARINE OILS PRODUCED FROM FISH OF DIFFERENT QUALITY", Lund, G., Journal of the American Oil Chemist's Society, Vol. 50, No. 1, January 1973, pp 26-28.

The purpose of this study was to study how the selenium, arsenic, phosphorus, and bromine contents varied in oils produced from raw fish materials of differing quality and to follow these elements in the oils during the alkaline-refining, the bleaching, and the hydrogenation processes. Herring, mackerel, and capelin oils, were produced from raw materials stored for varying lengths of time and consequently were of varying quality. Neutron activation analysis of samples showed that when the raw material deteriorates during storage, an increase in the selenium and phosphorus content in the oils produced from these materials is observed, whereas the bromine and the arsenic content is nearly constant. During the refining the arsenic and phosphorus disappear almost completely from the oils, whereas the selenium content is reduced to about two-thirds and the bromine content is nearly unaffected. In the hydrogenation step the selenium disappears relatively fast and the bromine more slowly.

INDEX TERMS: Neutron activation analysis, Biomass, Phosphorus, Fish oil, Arsenic, Selenium, Bleaching, Oil refining.

See also: Category 2, AMIC-6899, 6960, 7015, 7078  
Category 4, AMIC-6692, 6893  
Category 5, AMIC-6886, 6889.

## 2. BIOLOGICAL METHODS

AMIC-6562

"DIATOM COMMUNITY RESPONSE TO PRIMARY WASTEWATER EFFLUENT", Bahls, L. L., Journal Water Pollution Control Federation, Vol. 45, No. 1, January 1973, pp 134-144.

A study was made of the diatom community in the East Gallatin River above and below the Bozeman, Montana, wastewater treatment plant. Water samples for chemical and physical analyses and diatom collections from natural substrates were made monthly. The water quality parameters measured were water temperature, pH, Ca, Mg, alkalinity, sulfate, orthophosphate, fluoride, chloride, nitrite, nitrate, ammonia, silica, turbidity, specific conductivity, Na, and K. The diatom taxa identified were correlated with the nutrients that were present in the forms of phosphate,  $\text{NH}_3\text{-N}$ , and nitrate-nitrogen. Of the 12 major taxa identified, *Nitzschia dissipata* was the most frequently occurring diatom. Just below the wastewater outfall a nitrogen heterotroph, *Nitzschia epiphytica*, was most abundant. Together these two taxa accounted for 50 percent of the mean abundance of all the taxa in the river. Calculations were made to determine simple and multiple correlation coefficients between diatom diversity and individual taxa and the various nutrients. Overall, diversity correlated negatively with ammonia and positively with phosphate.

INDEX TERMS: Water pollution effects, Biological communities, Diatoms, Sewage treatment, Waste water (pollution), Water analysis, Chemical analysis, Nutrients, Bioindicators, Nitrogen, Montana, Plant populations, East Gallatin River, Species diversity.

AMIC-6605

"A NEW FRESHWATER SPECIES OF RHODOCHORTON (RHODOPHYTA, NEMALIALES) FROM VENEZUELA", D'Iacoste, L. G., Ganesan, E. K., Phycologia, Vol. 11, Nos. 3/4, December 1972, pp 233-238.

A new freshwater species of *Rhodochorton*, *R. venezuelensis* (Nemaliales, Rhodophyta), is described from eastern Venezuela. The plants are up to 4 mm long and heterotrichous. The basal portion of erect filaments may or may not be covered by many septate, branched, downward rhizoids. Cells of erect filaments contain numerous small discoid to elongate parietal chromatophores without pyrenoids. Monosporangia were the only reproductive structures observed in the material studied.

INDEX TERMS: Rhodophyta, Systematics, Aquatic algae, Plant morphology, Venezuela, *Rhodochorton venezuelensis*, Speciation.

AMIC-6606

"A FURTHER CONTRIBUTION TO THE DIATOM FLORA OF SEWAGE ENRICHED WATERS IN SOUTHERN AFRICA", Schoeman, F. R., Phycologia, Vol. 11, Nos. 3/4, December 1972, pp 239-245.

The systematics and autecology of the diatoms observed in an algal sample from a maturation pond of the Walvis Bay (South West African coast) sewage works are discussed. Fourteen diatom species are recorded. A new species, *Amphora subacutiuscula*, is described. The diatom association was subjected to a statistical analysis to determine the relative abundance of the different species in the association. Since the structure of the diatom association is the result of environmental conditions, it is possible to employ the association to determine the ecological conditions prevailing in the water. The chemical results of the maturation pond water suggest eutrophic, alkaline water with a high concentration of dissolved solids. Therefore, species favouring these conditions are expected to occur in this water. Except for the new species, *Amphora subacutiuscula*, whose autecology is still unknown, all the other species recorded in this sample are alkaline water inhabitants. Many of these are brackish species or are able to tolerate certain fluctuations in osmotic pressure. The dominant species, *Amphora tenerrima*, suggests brackish conditions. *Cyclotella meneghiniana*, a sub-dominant species, is known to be nitrogen heterotrophic and, therefore, grew well in the pond.

INDEX TERMS: Diatoms, Eutrophication, Water pollution, Systematics, Sewage, Ecology, Aquatic algae, Chrysophyta, Water analysis, Chemical analysis, Walvis Bay, South Africa, Organic nitrogen.

AMIC-6609

"PHOTOSYNTHESIS AND RESPIRATION OF SOME ARCTIC SEaweeds", Healey, F. P., Phycologia, Vol. 11, Nos. 3/4, December 1972, pp 267-271.

Both laboratory and in situ measurements of photosynthesis and respiration were made of some Arctic seaweeds in order to determine: (1) the ability of the algae to show positive net photosynthesis under natural or simulated conditions, and (2) growth of the specimens suspended beneath ice as well as adaptations to low temperatures. Conventional manometric techniques were used for laboratory measurements and clear and darkened BOD bottles were used in in situ measurements. The temperature optima of these reactions were similar to those of temperate seaweeds and much higher than the local temperatures. However, reaction rates at low temperatures (as a percentage of the maximum rate) were higher than those reported for plants grown or collected at higher temperatures. Laboratory and in situ measurements resulted in similar estimates of compensating intensities. They also showed that little or no growth could be expected beneath snow-covered ice, but growth could occur beneath about 70 cm of ice cleared of snow.

INDEX TERMS: Photosynthesis, Respiration, Plant physiology, Marine algae, On-site tests, Laboratory tests, Chaetomorpha, Haloseccion glandiforme, Fucus.

## 2. BIOLOGICAL METHODS

AMIC-6635

"TECHNIQUES FOR SAMPLING SALT MARSH BENTHOS AND BURROWS", Frey, R. W., Bass, P. B., Scott, R. M., The American Midland Naturalist, Vol. 89, No. 1, January 1973, pp 228-234.

Several methods have been developed to reduce the difficulty of sampling salt marsh epibenthos and endobenthos where grass root masses occur. Mobile animals such as crabs were collected using high-walled quadrat frames. These frames are placed while tide water stands on the marsh. When the water ebbs away, the crabs return to the surface and can be collected. Grass is cropped and removed to eliminate obstructions while collecting the samples. Other studies showed that about 80 percent of the crabs present can be collected this way. Can cores 14x22x33 cm high were used to sample the endobenthos by cutting grass roots around the can and digging the sample out. Time for each sample collected was 2-4 minutes. Organisms were separated from the core samples containing dense grass roots by sieving-staining-flotation equipment constructed from a table containing a 1 mm sieve and two No. 3 washtubs, one fitted with a sieve bottom and one fitted with a drain hole. Casts of burrows have been successfully made using polyester plastic and hardener.

INDEX TERMS: Sampling, Benthic fauna, Separation techniques, Muds, Laboratory equipment, Burrow casts, Staining, Sieving.

AMIC-6680

"A TECHNIQUE FOR THE ESTIMATION OF INDICES OF REFRACTION OF MARINE PHYTOPLANKTERS", Carder, K. L., Tomlinson, R. D., Beardsley, G. F., Jr., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 833-839.

Measurements of light scattering and particle size distribution were performed on a growing culture of the unicellular phytoplankter *Isochrysis galbana*. The culture represented a narrow, polydisperse distribution of nearly spherical particles. Assuming the culture to be homogeneous in refractive index, a technique was developed that provided an estimate of the index of refraction of the culture for the wavelengths 5,460 Angstrom and 5,780 Angstrom. The relative index of refraction (relative to that of seawater) of the culture varied with time from 1.026 to 1.036 over a 12-day sampling period and seemed to be related to changes in the surface area:volume ratio of the cells. The indices of refraction determined using green light (5,460 Angstrom) corresponded closely with those found using yellow (5,780 Angstrom), with slight fluctuations perhaps due to changes in cells pigmentation ratios. (Reprinted from Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 833-839. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Phytoplankton, Cultures, Distribution patterns, Growth rates, *Isochrysis galbana*, Index of refraction, Optical systems.

AMIC-6636

"DEVELOPMENT OF *SIMULIUM (PSILOZIA) VITTATUM* ZETT. (DIPTERA: SIMULIIDAE) FROM LARVAE TO ADULTS AT THERMAL INCREMENTS FROM 17.0 TO 27.0 C", Becker, C. D., The American Midland Naturalist, Vol. 89, No. 1, January 1973, pp 246-251.

Blackfly larvae were exposed to 2.5 C thermal increments ranging from 17.0-27.0 C to determine whether increased temperatures might increase the organism's rate of development. Larvae were grown in 1000-ml filtration flasks connected by syphon to a source providing a controlled mix of heated and unheated water from the Columbia River. The tests show that the thermal increments proportionally increase the rate of development through the pupal to the adult stage. A 10 C rise in temperature reduces the subsequent mean development span by about half, from 8 days at 17 C to 4 days at 27 C. Temperatures of 27 C appear to be within the upper thermal tolerance of the species. It is concluded that thermal increments from reactor discharges in the Columbia River have probably exerted some effect on the development of blackflies, particularly by advancing the emergence of the first spring generation.

INDEX TERMS: Bioassay, Thermal pollution, Life cycles, Columbia River, Nuclear reactors, Growth rates, Water pollution effects, Period of growth, Water temperature, Larvae, Blackflies, *Simulium (Psilozia) vittatum*, Diptera.

AMIC-6681

"DISTRIBUTION AND FORMS OF NITROGEN IN A LAKE ONTARIO SEDIMENT CORE", Kemp, A. L. W., Madrochova, A., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 855-867.

Fixed ammonium nitrogen is the dominant inorganic form of nitrogen in the sediments of Lake Ontario. The fixed ammonium nitrogen concentration is around 300 micrograms/g of sediment at the top of a 10-m core and increases gradually to 525 micrograms at 150 cm, below which it remains constant. As nitrification is precluded in the reduced sediments below 3 cm, the ammonium ion is either fixed within the sediment clay lattices or migrates upward in the sediment interstitial waters. The uniform fixed and exchangeable ammonium concentrations below 150 cm in the core indicate that the sediment is saturated with respect to ammonium fixation, and the decrease in these concentrations above 150 cm in the core suggest that equilibrium is not attained with the ammonium ion. The deeper sediments probably do not regenerate nitrogen to Lake Ontario, but most of the nitrogen released to the hypolimnion by the sediments is from nitrification, denitrification, and ammonification reactions at the sediment-water interface. A minimum of 20 percent of the organic nitrogen input to the sediments is regenerated to the lake from the top 6 cm of sediments. About 90 percent of the nitrogen in the surface muds is organic: 28-46 percent as amino acid-N, 4-7 percent as hexosamine-N, and 21-31 percent as hydrolyzable unidentified-N. From 29-57 percent of the total nitrogen could not be accounted for as amino acids, hexosamines, fixed and exchangeable ammonia, nitrate, and nitrite in the surface sediments. (Reprinted from Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 855-867. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

## 2. BIOLOGICAL METHODS

AMIC-6681 (Continued)

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INDEX TERMS: Nitrogen, Lake sediments, Cores, Lake Ontario, Sediment-water interface, Spatial distribution, Amino acids, Soil analysis, Chemical analysis, Nitrates, Nitrites, Path of pollutants, Bottom sediments, Ammonium, Hexosamine, Fate of pollutants, Surface sediments.

AMIC-6688

"A METHOD FOR THE IN SITU STUDY OF ZOOPLANKTON GRAZING EFFECTS ON ALGAL SPECIES COMPOSITION AND STANDING CROP", Porter, K. G., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 913-917.

method for in situ study of the effects of grazing on the species composition and standing crop of a natural phytoplankton assemblage is described. Polyethylene enclosures 0.5 cu m in volume are filled with whole lake water or water filtered through 125-micron (No. 10) mesh to remove the major grazers. After 4 days of incubation, contents are sampled and cells counted by species. The bagged whole lake water is also compared with natural lake water. The total number of small algal cells (2-30 microns), small flagellates, large dinoflagellates, large chrysophytes, and ciliates are higher and gelatinous greens are lower in the absence of grazers. There is no detectable experimental effect on the total number of large cells (greater than 30 microns), blue-greens, desmids, small chrysophytes, diatoms, and nonblue-green filaments. (Reprinted from Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 913-917. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Grazing, Zooplankton, Standing crops, Plant populations, Phytoplankton, Cyanophyta, Diatoms, Chlorophyta, Chrysophyta, Dinoflagellates, Pyrrophyta, On-site tests, Protozoa, Diaptomus minutus, Epischura lacustris, Daphnia galeata mendotae, Cyclops scutifer, Macroinvertebrates, Desmids, Flagellates.

AMIC-6686

"ATP CONTENT OF CALANUS FINMARCHICUS", Balch, N., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 906-908.

Measurements of adenosine triphosphate (ATP), carbon, and nitrogen were made on Calanus finmarchicus held in a food-free environment in the laboratory. Over a 23-day starvation period there were significant reductions of absolute amounts of carbon, nitrogen, and ATP, but no significant changes in the relationship between ATP and body carbon. Relative ATP levels in organisms remain sufficiently constant over a range of physiological conditions so as to make them good indicators of biomass. ATP:carbon ratios in lipid-storing copepods is also considered. (Reprinted from Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 906-908. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Biomass, Food abundance, Calanus finmarchicus, Adenosine triphosphate, Organic carbon.

AMIC-6690

"EDAPHIC FACTORS OVERRIDE A POSSIBLE GRADIENT OF ECOLOGICAL MATURITY INDICES IN A SMALL STREAM", Motten, A. F., Hall, C.A.S., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 922-926.

The objective of this study was to apply Margalef's (1963, 1965) maturity indices to two regions of New Hope Creek, North Carolina to test the hypothesis that upstream regions are less ecologically mature than downstream regions. Two parameters were measured at three locations in the streams: pigment ratios, or the ratios of the optical densities at 430 and 665 millimicrons, and the ratio of gross productivity to community respiration (P:R). Oxygen was measured by both the Winkler method and a galvanic probe recorder. Pigment analyses were based on random samples of benthic communities. These samples were centrifuged, ground in acetone, and the absorbance of the extracted pigment read on a spectrophotometer. Within the limited scope of this study no support was found for the original proposition that the upstream region of the stream was less ecologically mature than the downstream region. If differences in ecological maturity do exist between the two sites studied, they are not properly measured by pigment ratios or P:R ratios, or, more probably, they are overridden by local or edaphic factors.

INDEX TERMS: Trophic level, Respiration, Primary productivity, Pigments, Sample preparation.

## 2. BIOLOGICAL METHODS

AMIC-6744

"ENDRIN TOXICOSIS IN RAINBOW TROUT (*Salmo gairdneri*)", Grant, B. F., Mehrle, P. M., *Journal of the Fisheries Research Board of Canada*, Vol. 30, No. 1, January 1973, pp 31-40.

In mature rainbow trout (*Salmo gairdneri*) receiving sublethal doses of endrin (4.3-145 micrograms/kg body wt/day in 0.215-7.25 mg/kg of food) for 163 days and then forced to swim for 1 hr, the insecticide affected serum electrolytes, osmolality, total protein, cholesterol, cortisol, lactate, glucose, liver glycogen, and growth. Forced swimming alone altered 9 of 16 serum parameters examined. Apparent increases in serum Na and Cl and significant increases in osmolality and liver glycogen were directly related to dosage. A biphasic distribution of phosphate, total protein, and cholesterol with dosage was apparent. Glucose was increased about 50 percent by 145 micrograms/kg but was unaffected by lower doses. Variance analysis of zone electrophoretic patterns disclosed an interaction between serum protein distribution and dose. Mobilization of liver glycogen was apparently inhibited by low doses and almost totally blocked by high doses. Correspondingly, trout given 14.5 micrograms/kg or more had lowered serum cortisol levels whereas the lowest dose elevated cortisol. Growth was inhibited appreciably by 145 micrograms/kg but not by lower doses. Visceral fat accumulated 4.8-8.7 micrograms endrin/g tissue in the 43 and 145 micrograms/kg exposures. It is concluded that endrin caused dysfunction of physiologic processes critical to survival.

INDEX TERMS: Rainbow trout, Endrin, Pesticide toxicity, Fish physiology, Bioassay, Water pollution effects, Insecticides, Chlorinated hydrocarbon pesticides, Lethal limit, Survival, Laboratory tests, Electrolytes, Animal growth, Proteins, *Salmo gairdneri*, Biochemical tests, Serum, Cholesterol, Cortisol, Lactate, Glucose, Glycogen, Liver, Fat tissue.

AMIC-6745

"EFFECTS OF BUNKER C OIL ON INTERTIDAL AND LAGOONAL BIOTA IN CHEDABUCTO BAY, NOVA SCOTIA", Thomas, M. L. H., *Journal of the Fisheries Research Board of Canada*, Vol. 30, No. 1, January 1973, pp 83-90.

In February 1970, a large spill of Bunker C oil occurred in Chedabucto Bay, Nova Scotia. Observations were made on the effects of the oil on the intertidal and lagoonal biota from seven sites in the Isle Madame area where oiling was heavy and repeated. Transects delineated the observational area at each station. Initial effects of oil involved minor smothering of fauna and tearing loose of algae. Longer term effects involved extensive mortalities of *Fucus spiralis* on rocky shores and *Nya arenaria* and *Spartina alterniflora* in lagoons. Other biota were not visually affected. In all three affected species, mortalities took place either continuously or only in the second year of pollution. Causes of death are unknown. It is recommended that in all intertidal areas very heavy oil deposits should be mechanically removed and the remainder of the oil left to natural degradation.

INDEX TERMS: Water pollution effects, Oil pollution, Oil spills, Intertidal areas, Lagoons, Biota, Marine plants, Marine animals, Mortality, Bunker C oil, Isle Madame, Chedabucto Bay.

AMIC-6753

"A MALLONONAS BLOOM IN A BULGARIAN MOUNTAIN LAKE", Kristiansen, J., *Nova Hedvigia*, Vol. 21, Nos. 2-4, 1971, pp 877-882.

Electron microscopic examinations were made of samples of *Mallomonas* taken from Lake Wapako, south of Sofia, Bulgaria. At the time of sampling the water temperature was 10 C and the water was quite turbid due to a mass development of *Mallomonas*. The samples were fixed in Bouin's fluid, and the material for electron microscopy was repeatedly washed in distilled water by means of a centrifuge, dried on to carbon-coated grids, and shadowcast with chromium. The preparations were examined in a JEM-T 7 electron microscope. Other grids with material were coated with gold, and examined in a Cambridge Stereoscan Mk IIa scanning electron microscope. The samples were shown to contain only one species, *Mallomonas acaroides* var. *acaroides* (syn. *M. a. var. galeata*), and is a confirmation of previously published data concerning its distribution.

INDEX TERMS: Electron microscopy, Pollutant identification, Eutrophication, Phytoplankton, Chrysophyta, Aquatic algae, Sampling, Protozoa, Ultrastructure, *Mallomonas acaroides* var. *acaroides*, Lake Wapako, Sample preservation, Sample preparation, Bulgaria, *Mallomonas acaroides* var. *galeata*, Flagellates.

AMIC-6780

"SILICA AND NITRATE DEPLETION AS RELATED TO RATE OF EUTROPHICATION IN LAKE MICHIGAN, LAKE HURON, AND LAKE SUPERIOR", Schelske, C. L., The University of Michigan, Great Lakes Research Division, Ann Arbor, Michigan, Report No. COO-2003-11, Contract No. AT(11-1)2003, 1972, 48 pp.

Eutrophication of the Laurentian Great Lakes is accelerated by inputs of phosphorus from combined sources on land. Silica and nitrate nitrogen are depleted by phosphorus inputs due to an imbalance between the proportions of these nutrients required by phytoplankton assemblages and the proportions in either polluted tributary inputs or supplies in the lake. A model is used to relate increased phosphorus inputs, silica depletion, and nitrate depletion and to predict the trophic state or rate of eutrophication in Lakes Huron, Michigan, and Superior. Water quality is affected by inputs of phosphorus because standing crops of phytoplankton increase and because dominant groups of phytoplankton may change as the result of nutrient depletion. Silica depletion results in a shift from the characteristic diatom assemblages to blue-green or green algae and nitrate depletion favors assemblages with blue-green algae that fix nitrogen. These conclusions are based on data from three sources: (1) nutrient enrichment experiments conducted by the Great Lakes Research Division, The University of Michigan, (2) monitoring of water chemistry and productivity conducted on research and student training cruises of The University of Michigan, and (3) data from the literature.

INDEX TERMS: Eutrophication, Water quality, Water pollution effects, Silica, Nitrates, Phytoplankton, Diatoms, Phosphates, Withdrawal, Great Lakes, Dominant organisms, Trophic level, Limiting factors.

## 2. BIOLOGICAL METHODS

AMIC-6796

"ROLE OF PHOSPHORUS IN EUTROPHICATION", Bartsch, A. F., U. S. Environmental Protection Agency, National Environmental Research Center, Corvallis, Oregon, Report No. EPA-R3-72-001, August 1972, 45 pp.

The process of eutrophication is a natural one, often accelerated greatly by man's activities that contribute nutrients. The key nutrient is phosphorus. Although there is no simple relationship, it is clear that increasing phosphorus content frequently leads to accelerated eutrophication. Of all important nutrients, phosphorus is most controllable. Sources of phosphorus include runoff from undisturbed agricultural and urban lands; waste from water craft; industrial and domestic wastes; biological sources; and precipitation. Also, the most important single source is municipal sewage, fortunately, the most potentially controllable of all inputs. Control efforts follow five basic directions: Limiting fertility; improving food webs; stimulating plant diseases and parasites; recycling nutrient-laden water to agricultural and forest lands; and using toxic chemicals to kill vegetation. Limitation of nutrients is the most desirable approach, particularly through curtailing phosphorus inputs.

INDEX TERMS: Eutrophication, Nutrients, Phosphorus, Water pollution sources, Water pollution, Water pollution effects, Cycling nutrients, Agricultural runoff, Municipal wastes, Urban runoff, Industrial wastes, Domestic wastes, Precipitation (atmospheric), Detergents, Food-processing industry, Dairy industry, Fertilizers, Primary productivity, Photosynthesis, Water quality control, Rainfall, Boats, Ships, Gasoline.

AMIC-6841

"PHOTOGRAPHING FUNGI", Weiss, C. M., Industrial Photography, Vol. 21, No. 11, November 1972, pp 20, 21, 43-45.

Techniques for photographing fungi for species identification include (1) photomacrography used to record gross morphology of fungal cultures, and (2) photomicrography used to record the microscopic morphology of the fungus specimens. Petri dishes (glass or plastic, non-opaque, with shallow sides to minimize shadows) should be used for those cultures to be photographed because they present less difficult problems of lighting, diffraction, and focus than other containers. Badly scratched agar will produce light flare and distortion during photography. Portable equipment can be used but stationary apparatus was used by this author. The equipment consisted of a Polaroid MP-3 camera with 75-, 127-, and 35-mm photomacrography lenses. By using such a fixed setup, those plates requiring serial photography during several weeks of culture growth will not have equipment or photographic variables introduced. Lighting is perhaps the most important photographic requirement and directional lighting is suggested. Since color is a major factor in species identification, several color films were tested for use under controlled photographic conditions and those that work best are listed.

INDEX TERMS: Methodology, Pathogenic fungi, Pollutant identification, Laboratory equipment, Systematics, Plant morphology, Photomicrography, Photomacrography, Speciation, Color photography.

AMIC-6863

"EFFECT OF PULPMILL EFFLUENT ON DISSOLVED OXYGEN IN A STRATIFIED ESTUARY. II. NUMERICAL MODEL", Silbert, J., Parker, R. R., Water Research, Vol. 7, No. 4, April 1973, pp 515-523.

A numerical model is presented which simulates the biological and physical processes of oxygen supply in a stratified inlet. The results of the model show that the introduction of pulpmill effluent into the upper layer of the inlet causes a decrease in the dissolved oxygen concentration of the water due to blockage of photosynthesis in the stratum of water immediately below the halocline. Removal of the biochemical oxygen demand from the effluent has very little effect on the oxygen concentration in the upper layer since the supply of oxygen from the lower layer is blocked by the stain. Removal of 90 percent of the stain from the effluent restores the oxygen concentrations to near normal.

INDEX TERMS: Mathematical models, Dissolved oxygen, Estuaries, Stratification, Pulp wastes, Color, Light intensity, Nutrients, Inlets (waterways), Inhibition, Photosynthesis.

AMIC-6868

"TOXIC EFFECTS OF CUPRIC, CHROMATE AND CHROMIC IONS ON BIOLOGICAL OXIDATION", Lamb, A., Tollerfson, E. L., Water Research, Vol. 7, No. 4, April 1973, pp 599-613.

Using a completely mixed, continuously operated, lightly loaded, laboratory activated sludge system, the toxic effects of cupric, chromic and chromate ions under conditions of shock loading were observed. These were determined with the aid of a total carbon analyzer and simple mass balance techniques in terms of conversion of the organic nutrient fed. The distribution of the metal ion between aqueous solution and suspended solids was measured using atomic absorption spectrophotometry. Toxic effects were in the order: cupric greater than chromate greater than chromic while the reductions in conversion were 90, 50 and 20 percent, respectively, for concentrations of 5 ppm metal ion. Cupric ion toxicity was directly proportional to the weight of copper absorbed per unit mass of suspended matter within the total copper concentration range (0-5.5 ppm) studied. This toxicity decreased markedly with increased suspended solids concentration: an 80 percent decrease in conversion at 210 ppm suspended solids was reduced to a negligible quantity (3 percent) by increasing the suspended solids to 4000 ppm. At 210 ppm suspended solids, 34 percent of the added copper was removed by the sludge in 7 h. The results of this work suggest that the toxic effect of metal ions on a sewage plant activated sludge system could be reduced by rapidly increasing the suspended solids concentration, possibly by the addition of dried sludge. This work supports a mechanism involving rapid adsorption of the cupric ion by both viable and dead sludge followed by a slower rate determining step resulting in the toxic effect. The first order rate constant for substrate utilization was found to be  $1.07 \pm 0.6/\text{hr}$ .

INDEX TERMS: Toxicity, Cations, Chromium, Copper, Activated sludge, Laboratory tests, Pollutant effects, Biological oxidation.



## 2. BIOLOGICAL METHODS

AMIC-6899

"PHOSPHORUS DYNAMICS IN LAKE WATER", Lean, D.R.S., Science, Vol. 179, No. 4074, February 16, 1973, pp 678-680.

Radioactive phosphate was used in conjunction with gel filtration to identify biologically important forms of P in lake water and the rate constants for their formation. Water samples from Heart Lake (Ontario), a small eutrophic lake, were spiked with tagged phosphate, filtered, and analyzed. The experiments revealed that a steady state is rapidly attained between tagged P and lake water in the summer with the following composition: a particulate fraction containing the bulk of the P plus small amounts of a soluble high-molecular-weight organic P compound; a low-molecular-weight organic P compound; and soluble inorganic phosphate, the turnover time of which is very short. It is concluded that an exchange mechanism exists in lake water between phosphate and plankton, but the excretion of an organic phosphorus compound by the plankton is also a significant process. It results in the extracellular formation of a colloidal substance, and most of the nonparticulate phosphorus in lake water is in this form.

INDEX TERMS: Cycling nutrients, Phosphorus, Metabolism, Plankton, Nutrients, Phosphates, Absorption, Lakes, Separation techniques, Path of pollutants, Excretion, Gel filtration, Organophosphorus compounds, Heart Lake, Canada, Colloids, Biotransformation.

AMIC-6907

"FRESHWATER DIATOMS IN THAILAND", Foged, N., Nova Hedwigia, Vol. 22, Nos. 1-2, 1971, pp 267-370.

In freshwater material collected in 1966 in the central and northern part of Thailand about 378 diatom taxa are found, among which there are 8 new species, 5 new varieties and 2 new forms. All the diatoms found are listed and drawings and photographs from the researched material are given.

INDEX TERMS: Diatoms, Chrysophyta, Aquatic algae, Aquatic plants, Systematics, Thailand.

AMIC-6906

"CHARACEAE OF AUSTRALIA", Wood, R. D., Nova Hedwigia, Vol. 22, Nos. 1-2, 1971, pp 1-9.

A floristic study of the Characeae of Australia was made based upon extensive collecting in 1960-61 throughout the continent together with a re-examination of available herbarium specimens. Twenty-nine species are treated in accordance with the author's revised classification; and a key, brief descriptions, figures, and lists of specimens cited are provided. Five genera are represented--Chara, Lamprothamnium, Lychnothamnus, Nitella, and Tolypella. The most common species in decreasing order of frequency of occurrence are C. corallina, N. pseudolabellata, Lamp. papulosum, N. cristat, and N. lhotzkyi. Examples of species widespread in the world which are least common in Australia are C. zeylanica and N. acuminata. Eight species are endemic--C. leptopitys, N. congesta, N. cristat, N. lhotzkyi, N. penicillata, N. subtilissima, N. tumida, and N. verticillata. Of these, all but the last are known to be dioecious. The results generally support the author's earlier revision, but newly-rediscovered type material (MEL) requires several changes and reinterpretations of the literature. In addition, four new varieties are described, and seven new varietal combinations are made.

INDEX TERMS: Australia, Chlorophyta, Aquatic algae, Systematics, Aquatic plants, Plant morphology, Pollutant identification, Ecological distribution, Stoneworts, Characeae, Speciation.

AMIC-6924

"REFERENCES FOR THE IDENTIFICATION OF FRESHWATER MACROINVERTEBRATES", Lewis, P. A., U. S. Environmental Protection Agency, Analytical Quality Control Laboratory, Cincinnati, Ohio, Report No. EPA-R4-72-006, October 1972, 23 pp. NTIS Report No. PB 213 379/1.

A set of references has been compiled which were specifically chosen because of their pertinence in helping field and laboratory investigators identify those macroinvertebrates that are being used as indicators of freshwater pollution. The organisms of concern are oligochaetes, leeches, beetles, phantom midges, midges, mayflies, true bugs, alderflies and relatives, spongilla flies, caddisflies, dragonflies and damselflies, stoneflies, crustaceans, bryozoans, mollusks, turbellarians, water mites, moths, and spongillids.

INDEX TERMS: Bibliographies, Aquatic animals, Bioindicators, Water pollution, Documentation, Aquatic insects, Annelids, Invertebrates, Crustaceans, Mollusks, Macroinvertebrates, Arthropods, Turbellaria, Bryozoans, Sponges, Water mites.

## 2. BIOLOGICAL METHODS

AMIC-6925

"SEASONAL SUCCESSION OF PHYTOPLANKTON AND A MODEL OF THE DYNAMICS OF PHYTOPLANKTON GROWTH AND NUTRIENT UPTAKE", Koonce, J. P., The University of Wisconsin, Madison, Wisconsin, Dissertation Abstracts No. 72-24,888, 1972, 204 pp. (Complete report not available from AMIC.)

Seasonal succession in phytoplankton associations has been observed in freshwater and marine lentic environments. The appearance and disappearance of algal populations has been correlated with variations in physical, chemical, and biological factors in aquatic ecosystems. To study the succession of phytoplankton, a series of weekly observations for one year were made at Lake Wingra, Madison, Wisconsin. In addition to enumeration and identification of phytoplankton species, analyses were conducted for major algal nutrients (Si, C, N, and P), and light and temperature were measured. The results of this study revealed species's succession and nutrient depletion patterns similar to other lakes. Proceeding from an assumption that growth optimization was the dominant process in the observed succession pattern, a mathematical model was derived from theoretical considerations of algal physiology. The prediction of the model was rate of algal growth, and model parameters were related to efficiencies of biological processes (such as nutrient uptake). The model was tested against unialgal cultures of *Selenastrum capricornutum* and was found to predict adequately the time course of algal growth and uptake of N and P in batch cultures of algae. The verified model was then related to morphological variation and physiological adaptation of phytoplankton species. Through appropriate use of mathematical optimization routines, model parameters could be varied to simulate maximum growth rates under an imposed set of nutrient concentrations (such as low P and high N or low N and high P concentrations). By relating values of model

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parameters to cell morphology and physiological adaptation such procedure suggests the possibility of predicting morphological variation--thus succession of phytoplankton populations. The derived model is useful only for variation in concentration of N and P.

INDEX TERMS: Phytoplankton, Mathematical models, Growth rates, Absorption, Nutrients, Plant populations, Aquatic environment, Lentic environment, Carbon, Nitrogen, Phosphorus, Marine algae, Aquatic algae, Model studies, Cytological studies, Seasonal succession, Marine environment, Silicon.

AMIC-6926

"GROWTH AS RELATED TO INGESTION IN A STREAM ISOPOD, *LIRCEUS BRACHYURUS* (HARGER) FED A MACROPHYTE OR PERIPHYTON", Hawkes, C. L., The Pennsylvania State University, University Park, Pennsylvania, Dissertation Abstracts No. 72-33,170, 1972, 57 pp. (Complete report not available from AMIC.)

The role of a macrophyte *Elodea canadensis* and periphyton as food for the isopod *Lirceus brachyurus* were compared by investigating growth as related to ingestion. Ingestion rates, growth rates, percentage growth rates, and the ratios of growth rates to ingestion rates were obtained for isopods fed these two plant types. Ingestion was measured using C-60 labeled plants with a method involving a one hour feeding period and a direct counting of the whole live animal with the radioactive meal. Growth was based on the area of the frontal outline of each isopod calculated by multiplying the length by the width of a calibrated photographic image of the animal. Ingestion rates for small and medium sized isopods feeding on the macrophyte were significantly higher than those on periphyton with the medium sized animals having the largest difference. The highest growth rates and percentage growth rates were obtained when the isopods were fed periphyton. The ratios of growth rates to ingestion rates were higher for all size classes of isopods fed periphyton.

INDEX TERMS: Food habits, Growth rates, Isopods, Periphyton, Invertebrates, Crustaceans, Crustaceans, Digestion, Radioactivity techniques, Cobalt radioisotopes, Aquatic plants, Aquatic weeds, *Lirceus brachyurus*, *Elodea canadensis*, Ingestion rates, Macrophytes, Macroinvertebrates, Waterweeds, Animal growth.

AMIC-6927

"GROWTH AND SURVIVAL OF AMURAN TADPOLES (*BUFO BOREAS* AND *RAMA AURORA*) IN RELATION TO ACUTE GAMMA RADIATION, WATER TEMPERATURE, AND POPULATION DENSITY", Fish, J. L., Washington State University, Pullman, Washington, Dissertation Abstracts No. 73-44, 1972, 91 pp. (Complete report not available from AMIC.)

Effects on growth and survival of amuran tadpoles (*Bufo boreas* and *Rana aurora*) in relation to acute gamma radiation, water temperature, and population density were studied in continuous-flow laboratory test chambers utilizing a factorial randomized block design. Approximately one week after hatching, tadpoles were exposed to radiation doses ranging from 0-2000 Roentgen (R), then reared for 28 days at three temperatures (15, 20, or 25 C) and at four densities (5, 15, 35, or 100 animals). Survivors were measured (total length) and counted weekly. Comparisons between species indicated that *R. aurora* was more radio-sensitive than *B. boreas*. Densities greater than 35 animals in a half gallon of water significantly slowed growth and adversely affected survival. There appeared to be increased radiation damage at greater densities. Growth and survival were enhanced by higher temperatures, and radiation damage developed faster at higher temperatures. A temperature of 25 C with densities greater than 35 animals slowed growth in *B. boreas*. The three-way interaction of these variables was not conclusively demonstrated.

INDEX TERMS: Bioassay, Water temperature, Gamma rays, Growth rates, Water pollution effects, Frogs, Toads, Laboratory tests, Tadpoles, *Rana aurora*, *Bufo boreas*, Survival, Population density, Continuous flow techniques.

## 2. BIOLOGICAL METHODS

AMIC-6931

"INTERIDIAL SUBSTRATE RUGOSITY AND SPECIES DIVERSITY", Risk, M. J., University of Southern California, Los Angeles, California, Dissertation Abstracts No. 73-763, 1972, 92 pp. (Complete report not available from AMIC.)

A study of the relationship in the middle and upper intertidal between small-scale rugosity and species diversity was undertaken, restricting sample substrates to basalt flows. A total of fifty-five samples was taken in Panama and the Virgin Islands, and on the coasts of California and Baja, California. Species diversity was calculated both by numbers of individuals and by ash-free dry weights. Duplicates of the rock surfaces were produced by a technique involving field molding with an alginate impression material, casting a positive with plaster of paris, and finally producing a negative with latex compound. Rugosity was determined by calculating the variance of the differences between profile heights on the original surface and smoothed profile heights produced by taking a moving average of the original profile heights. Values for tidal height, total surface area exposed, standing crop (both in numbers and in weights) and latitude were also obtained for each sample area. Results indicate that the measured environmental parameters are much better predictors of weight species diversity than of number species diversity. Both measures of diversity correlate strongly with rugosity, and not as strongly (or not at all) with total surface area exposed. Rugosity is seen to increase with a decrease in tidal height, perhaps as a result of wave action and biological boring and rasping activities. Tropical intertidal diversity is low, and tropical areas seem to have lower species-carrying abilities. The tropical intertidal seems then to be an exception to the generally noted diversity increase in the tropics.

INDEX TERMS: Intertidal areas, Standing crops, Aquatic habitats, Water levels, Species diversity, Rugosity, Substrates.

AMIC-6939

"STATISTICAL METHODS FOR THE DETECTION OF POLLUTION UTILIZING FISH MOVEMENTS", Hall, J. W., Virginia Polytechnic Institute and State University, Blacksburg, Virginia, Dissertation Abstracts No. 73-5872, 1973, 114 pp. (Complete report not available from AMIC.)

A statistical technique was developed for using fish movement patterns measured by light beam interruptions to continuously monitor water for the presence of zinc. The sequence of light beam interruptions per hour, which is the realization of a stochastic process, was studied by analyzing some of Waller's (1971) data. It was determined that the mean of the process varied with time, having a twenty-four hour cycle and that the observations were serially correlated. Although a shortage of data prevented a firm conclusion, it was decided provisionally that the observations for a single hour were distributed negative binomially. Using the Camp-Paulson approximation as a transformation and making some additional assumptions allowed the process to be transformed to a strictly stationary one for which critical values could easily be calculated. The procedure was compared with Waller's method both on the data which had been analyzed and on some additional data. The procedure worked as well as Waller's method for low concentration of zinc and detected the presence of zinc faster when the concentration was high. The procedure allowed some statement about the probability of the errors involved whereas Waller's method did not.

INDEX TERMS: Zinc, Statistical methods, Monitoring, Pollutant identification, Fish behavior, Movement, Heavy metals, Stochastic processes, Mathematical studies, Water pollution effects, Fish physiology, Camp-Paulson approximation.

AMIC-6942

"SIGNIFICANCE OF CELLULOSE PRODUCTION BY PLANKTONIC ALGAE IN LACUSTRINE ENVIRONMENTS", Rho, J., University of Massachusetts, Amherst, Massachusetts, Dissertation Abstracts No. 73-6704, 1972, 112 pp. (Complete report not available from AMIC.)

Numbers and types of cellulose-containing algae were observed in an eutrophic pond, a dystrophic pond and an oligotrophic lake. The cellulose-containing algae, members of Chlorophyceae, Dinophyceae and Chrysophyceae, were estimated to be approximately 70 percent of the total phytoplankton population observed. Fourteen algal species representing the dominant cellulose-containing phytoplankton were investigated for cellulose content which accounted for 2-39 percent on a dry weight basis of the cells studied. The amounts of cellulose present in the water column ranged from 110-1,185 micrograms/l, which accounted for 4-50 percent of the total dry weight of particulate matter. A comparison of absorption spectra of the extracts from algae, higher plants, particulate matter from bodies of water studied and purified cellulose, indicated that the cellulosic material present in particulate matter was of algal origin. It was estimated that less than 30 percent of cellulose in the water column was actually contributed by the viable algal cells present at the time of sampling. There was more cellulose found in the water column than could be accounted for by the number of algal cells observed.

INDEX TERMS: Phytoplankton, Cellulose, Aquatic algae, Aquatic environment, Lakes, Chlorophyta, Chrysophyta, Pyrrophyta, Eutrophication, Oligotrophy, Dystrophy, Ponds, Carbohydrates, Fate of pollutants.

AMIC-6943

"INITIAL RESPONSES OF PHYTOPLANKTON AND RELATED FACTORS IN LAKE SAMMAMISH FOLLOWING NUTRIENT DIVERSION", Emery, R. M., University of Washington, Seattle, Washington, Dissertation Abstracts No. 72-28,594, 1972, 244 pp. (Complete report not available from AMIC.)

A two-year study on Lake Sammamish was carried out to evaluate the responses of phytoplankton and related factors to a sewage diversion project completed in September, 1968. Trophic indices of pre-diversion years were compared to those in nearby Lake Washington to determine the relative extent of eutrophication. Post-diversion trophic indices were compared to those of pre-diversion years to determine the extent of recovery. In addition, post-diversion changes of indices were compared to those in Lake Washington, a lake with an established pattern of response to diversion. This study shows that, so far, only minor changes which suggest recovery have occurred in Lake Sammamish since diversion. This lack of early response is not consistent with the predicted recovery time of 2.8 year, calculated using a lake restoration model. Considerations of P and N in Lake Sammamish have not changed significantly since 1968, with one exception. Seasonal levels of phytoplankton production and biomass have not decreased significantly since nutrient diversion, although there was a noticeable change in the composition of phytoplankton populations. Statistical multivariate analyses indicate that Si and C, rather than P and N, have the most influence on algal activity. Results indicate that urban runoff was not a significant source of nutrient enrichment.

INDEX TERMS: Trophic level, Nutrients, Phytoplankton, Primary productivity, Biomass, Lake Sammamish, Sewage diversion, Restoration.

## 2. BIOLOGICAL METHODS

AMIC-6947

"NUTRIENT PATHWAYS IN SMALL MOUNTAIN STREAMS", Woodall, W. R., Jr., University of Georgia, Athens, Georgia, Dissertation Abstracts No. 73-5809, 1972, 139 pp. (Complete report not available from AMIC.)

Population sizes of benthic organisms in streams draining four small watersheds were estimated. The watersheds, which were located in the southern Appalachian mountains, were each covered in a different vegetation type. Microflora were not included in the model which was devised. Grazers performed a minor function in Covesta's small, shaded streams. Crayfish and salamanders were responsible for most of the standing crops biomass in the detritivore and predator compartments respectively and also account for most of the fluxes in their compartments. They are important in small stream nutrient flow by forming a sink in the remineralization process. An increase in potassium concentrations and a decrease in calcium and magnesium concentrations was associated with an increase in trophic levels. Since the food material was richer in calcium and magnesium than potassium, detritivores concentrated proportionately more potassium than calcium or magnesium. Some insects showed a positive correlation between calcium concentrations and degree of sclerotization. An inverse relationship between potassium concentration and degree of sclerotization was even more pronounced. Most taxa, however, showed neither the positive correlation with calcium nor the inverse relation with potassium. The principal mechanism of potassium release from detritus was through leaching. For calcium and magnesium, which are chemically bound in leaf tissue, the principal mechanism for release was the feeding activity of detritivores. Streams are important in the watersheds because they are the primary mechanism for nutrient removal from the system.

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INDEX TERMS: Nutrients, Biodegradation, Decomposing organic matter, Leaves, Cycling nutrients, Benthic fauna, Detritus, Potassium, Calcium, Magnesium, Crayfish, Salamanders.

AMIC-6948

"EFFECTS OF SIZE-SELECTIVE PREDATION ON COMMUNITY STRUCTURE IN LABORATORY AQUATIC MICROCOSMS", Weill, W. E., The University of Texas, Austin, Texas, Dissertation Abstracts No. 73-7607, 1972, 191 pp. (Complete report not available from AMIC.)

The impact of size-selective fish predation on competition between crustacean species for limited algal food resources was studied in replicated laboratory microcosms. Data were collected on changes in crustacean population sizes, biomass, and productivity and algal numbers, biomass, and productivity. Supporting data were also collected on changes in crustacean morphology, food consumption patterns, and demographic parameters. Predation on the dominant species (*Ceriodaphnia quadrangula*) resulted in reduced grazing efficiency on the planktonic algae which in turn resulted in higher productivities and standing crops of plant material as well as reductions in the free nutrient pool. Less efficient grazers were able to use the enhanced supplies of algal resources, and total herbivore diversity, productivity, and biomass increased as a result. Herbivore impact on algal productivity was lower than when the dominant competitor was present and relative losses of algal biomass to grazers were reduced. Instead losses through bacterial (detrital) food chains became more important and both bacterial populations and the amount of nutrients tied up in decaying material increased. The effect of predation on *Ceriodaphnia* was to reduce competitive pressure on the young of other species, increase juvenile survivorship and development rates, but to increase intraspecific and interspecific competitive pressure on adults, with consequent reductions in adult survivorship and fecundity. These results are discussed in light of recent developments in competition theory, systems modeling, and large scale manipulations of natural communities. Parallels are drawn between the changes in system behavior found in this study and those resulting from predator manipulations in both computer models and natural systems.

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INDEX TERMS: Predation, Algae, Grazing, Dominant organisms, Nutrients, Competition, Primary productivity, Biomass, Population, Species diversity, *Ceriodaphnia quadrangula*.

## 2. BIOLOGICAL METHODS

AMIC-6949

"THE DISTRIBUTION, SUBSTRATE SELECTION AND SEDIMENT DISPLACEMENT OF *COROPHIUM SALMONIS* (STIMPSON) AND *COROPHIUM SPINICORNE* (STIMPSON) ON THE COAST OF OREGON", McCarthy, J. E., Oregon State University, Corvallis, Oregon, Dissertation Abstracts No. 73-7840, 1973, 68 pp. (Complete report not available from AMIC.)

The amphipods, *Corophium salmonis* (Stimpson) and *C. spinicorne* (Stimpson) were examined from three aspects. The first study involved the distribution and natural habitat of these species on the Oregon coast. Both species were found in fresh-water (less than 0.4 percent salinity) and in estuarine water up to 1.0 percent salinity (*C. spinicorne*) and 2.9 percent salinity (*C. salmonis*). Both species disappeared in winter months, reoccurring in increasing numbers during spring months and reaching highest densities in the summer. Under natural conditions *C. salmonis* was found most frequently in mud sediments while *C. spinicorne* occurred more often in sand. Both species formed burrows in sediments and tubes upon submerged surfaces. The second study was to determine how specific these animals were in selecting substrates. The animals were exposed simultaneously to their native sediments, acid-cleaned sand and a foreign mud or sand. These multiple choice experiments demonstrated that these species of *Corophium* can readily determine their native substrate. Both species, when occurring in sand, could distinguish the native sand from similar sand of other areas. The third study determined the amount of material removed when the animal established. The average for both species was 0.07977 gm (0.032 ml)/burrow.

INDEX TERMS: Distribution patterns, Habitats, Sediments, Laboratory tests, *Corophium spinicorne*, *Corophium salmonis*, Substrate selection.

AMIC-6950

"COMPARATIVE HABITAT DIVERSITY AND FAUNAL RELATIONSHIPS BETWEEN THE PACIFIC AND CARIBBEAN DECAPOD CRUSTACEA OF PANAMA", University of Miami, Miami, Florida, Dissertation Abstracts No. 73-5817, 1972, 124 pp. (Complete report not available from AMIC.)

The community struc

The community structure of the decapod crustacean fauna of seven tropical, shallow water, marine habitats was examined. Sandy beaches, mangrove swamps and rocky intertidal habitats on both the Pacific and Caribbean coasts of Panama were sampled. The Pocillopora coral habitat of the Bay of Panama was also sampled. The species composition and their relative abundances were noted for each habitat. Four thousand three hundred and seventy-two specimens representing 247 species were collected from the seven habitats. An index of faunal similarity was calculated for each pair (Pacific-Caribbean) of habitats. This is the number of ecologically and taxonomically similar species which occurred in both habitats expressed as a percentage of the total number of species present in the pair of habitats. A few specialized species dominated each of the communities. It is demonstrated that the number of species present in a habitat increases as the structural complexity of the habitat increases. Structural complexity of the habitats was approximated by the number of different types of substrates present.

INDEX TERMS: Distribution patterns, Habitats, Beaches, Mangrove swamps, Dominant organisms, Biological communities, Pacific Ocean, Species diversity, Decapods, Caribbean Sea.

AMIC-6954

"INVERTEBRATE DRIFT IN AN OHIO STREAM AND ITS UTILIZATION BY WARM-WATER FISHES", Sisk, M. E., Jr., Ohio State University, Columbus, Ohio, Dissertation Abstracts No. 73-2128, 1972, 80pp. (Complete report not available from AMIC.)

The drift pattern of aquatic and terrestrial invertebrates in a Central Ohio stream (Alum Creek) supporting a warm-water fish fauna of shiners, darters and sunfishes was investigated. The study was intended to ascertain what fishes fed on drift and to what extent, whether or not the drift-food resource was shared by the fishes, whether or not the feeding activity of fishes was correlated with greatest drift activity, how abundant drift organisms were on a diel and seasonal basis, what portion of the drift was allochthonous in origin and what taxa were represented in the drift. Eleven 24-hour collections were taken at a riffle site during the period of August, 1969 and July, 1970. Each monthly collection consisted of 10-minute drift net samples taken every two hours to determine quality and quantity of drift, four collections of fishes for stomach analysis and two bottom samples for determination of benthic biomass. Maximum drift of aquatic invertebrates in numbers and biomass occurred at 2300 hours. Baetidae was represented in the drift by five genera. The Chironomidae exhibited the most regular drift pattern and occurred in greatest numbers. Maximum drift in numbers and biomass of aquatic species occurred in May. Terrestrial adults contributed 74 percent in biomass and 24 percent by numbers to the annual drift and were collected mostly during daylight hours. The fishes fed heavily on both aquatic and terrestrial organisms but stomach contents of the fishes did not correlate with aquatic drift peaks.

INDEX TERMS: Streams, Food habits, Fish, Mayflies, Diptera, Food abundance, Dominant organisms, Population, Drift organisms.

AMIC-6956

"EFFECTS OF DIELDRIN ON WALLEYE EGG DEVELOPMENT, HATCHING AND FRY SURVIVAL", Hair, E. M., The Ohio State University, Columbus, Ohio, Dissertation Abstracts No. 73-2012, 1972, 52 pp. (Complete report not available from AMIC.)

The objectives of this study were to determine whether walleye eggs absorb dieldrin from water during incubation, and if so, whether uptake is concentration-dependent, and whether absorbed dieldrin affects embryo development, hatchability, or fry development and survival through the yolk sac stage. Eggs were reared in a miniature jar hatchery and were continuously exposed to 0.0, 1.0, 10.0, or 100.0 ppb dieldrin from spawning until hatching. Water and egg samples were taken daily to monitor HEOD concentration and embryo development. After hatching fry were held in glass battery jars until yolk sac absorption was complete. Samples were taken daily to monitor their development and HEOD content. Eggs absorbed dieldrin from the water at all levels of exposure. The amount absorbed depended on the concentration in water and varied with the duration of exposure. Corresponding with the appearance of eyes in the embryos there was a sharp increase in dieldrin uptake. After 5 days of exposure eggs had concentrated levels in the water by factors of 800 (exposure to 1 ppb), 1210 (10 ppb), and 914 (100 ppb). Dieldrin absorbed by developing walleye eggs did not affect embryo development, rate of development or hatchability. At the higher levels of exposure (10 and 100 ppb) fry survival was affected. After exposure to 10 or 100 ppb, fry became pigmented sooner and were more active than the controls.

INDEX TERMS: Bioassay, Absorption, Fish eggs, Dieldrin, Mortality, Animal physiology, Fry, Bioaccumulation.

## 2. BIOLOGICAL METHODS

AMIC-6958

"DEOXYRIBONUCLEIC ACID IN ECOSYSTEMS", Canoy, M. J., University of North Carolina, Chapel Hill, North Carolina, Dissertation Abstracts No. 73-4806, 1972, 355 pp. (Complete report not available from AMIC.)

Thirteen temperate and tropical ecosystems were sampled for DNA content per gram dry weight of major species making up 90 percent or more of the biomass. Mean DNA/g/ species data were used to derive mean DNA/sq m concentrations. Tropical and temperate producers were found to have a range of DNA contents from 0.02 mg/g to 0.72 mg/g with a mean of 0.36 mg/g for aquatic plants and a range of 0.22 mg/g to 1.20 mg/g for terrestrial producers with a mean of 0.46 mg/g. Mean DNA content was very similar for all systems studied. That of producer systems was 0.40-0.50 mg/g and that of consumers was 4.50-6.00 mg/g. Mean DNA concentration per square meter was also similar for normal systems of similar type. Attached aquatic systems had 83.00-420.00 mg/sq m. Calculations of DNA by trophic level indicate that for mature systems, where most major elements are considered, the trophic level biomass pyramid can be converted essentially to a rectangle by multiplying biomass by mean DNA content for each trophic level. Evidence is presented indicating that large deviations in one trophic level's DNA may be due to stress, input of energy from an outside source, or failure of the researcher to account for the major portion of a trophic level. DNA per square meter increased in a roughly linear fashion proportional to community production or chlorophyll a concentrations, DNA concentration varied logarithmically with respiration. Control functions of DNA, including effects on biochemical pools, time constants and exchange rates, are discussed and a model is developed to illustrate effects of changes in DNA concentrations.

INDEX TERMS: Trophic level, Biomass, Primary productivity, Respiration, Ecosystems, Stress, DNA, Chlorophyll a.

AMIC-6959

"BIOLOGICAL NITROGEN FIXATION IN LAKE MENDOTA", Torrey, M. L. S., The University of Wisconsin, Madison, Wisconsin, Dissertation Abstracts No. 72-27,352, 1972, 452 pp. (Complete report not available from AMIC.)

The present study investigated the validity of prior estimates of N fixation in Lake Mendota, the factors influencing algal fixation, and the possibility of heterotrophic fixation in the sediments and the water column. All nitrogen fixation studies were performed with acetylene. In addition the ratio of acetylene reduced to nitrogen was estimated. Physical, chemical, and biological analyses were performed at each depth sampled. Short, medium, and long-term studies all showed that heterocyst content was significantly related to the activity and efficiency of acetylene reduction. In long-term studies, temperature was positively correlated with acetylene reduction activity and efficiency. The depth at which the sample was collected was negatively correlated with acetylene reduction activity and efficiency. Dissolved oxygen had a positive regression coefficient in the multiple linear regression analysis of acetylene reduction. pH also was related to acetylene reduction. Available data do not distinguish whether dissolved oxygen and pH were affecting acetylene reduction or whether these were a result of changes in water quality caused by active photosynthesis. Bacterial acetylene reduction activity in the waters from which colonial phytoplankton had been removed was very low. Sediment acetylene reduction activities were also low, but can be significant over a long period of time. Nitrogen fixation contributed about ten percent or about 39,800 kg of the annual input of nitrogen to Lake Mendota during 1970 and 1971. While this is much less significant than groundwater, rural runoff, or dry fallout, most of it is added at a period of time when combined nitrogen is depleted and thus may be significant during the summer months in maintaining blue-green algal nuisances in the surface waters.

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INDEX TERMS: Nitrogen fixation, Bacteria, Phytoplankton, Cyanophyta, Water temperatures, Dissolved oxygen, Hydrogen ion concentration, Acetylene reduction, Lake Mendota.

AMIC-6960

"EXCRETION MEASUREMENTS OF NEKTON AND THE REGENERATION OF NUTRIENTS NEAR PUNTA SAN JUAN IN THE PERU UPWELLING SYSTEM DERIVED FROM NEKTON AND ZOOPLANKTON EXCRETION", Whittleage, T. E., University of Washington, Seattle, Washington, Dissertation Abstracts No. 73-3803, 1972, 126 pp. (Complete report not available from AMIC.)

The excretion of nutrients and organic substances was examined for eight species of fish from several regions of the world's oceans. The excreted substances measured were ammonia, nitrate, orthophosphate, silicate, creatine, and urea. In addition soluble organic nitrogen excretion, oxygen utilization, and physical parameters were determined. Automated and manual methods for the determination of creatine in seawater were developed. The analysis consists of the addition of (1,2-cyclohexylenedinitrilo)tetraacetic acid, ninhydrin, and potassium hydroxide after which the fluorescence of the solution is measured. Concentrations of 0.05 to 30 microgram-at/creatine-N/liter were measured with the analysis. Regenerated production derived from the uptake of ammonia nitrogen was found to be 28 percent of the nitrogen utilized by phytoplankton near Punta San Juan in Peru while new production derived from nitrate was used for the remaining 72 percent of the nitrogen. Of the ammonia nitrogen required for primary production 71 percent was estimated to be supplied by the excretion of anchoveta and 8 percent by zooplankton. The bacterial uptake of creatine was two times the quantity excreted by anchoveta. Phytoplankton uptake of urea was estimated to be three times the combined excretion of nekton and zooplankton. Excretion produces 37 and 4 percent respectively of the phosphorus and silica requirements of primary production in the Peru upwelling area. Silicate may limit the growth of diatoms. Anchoveta consume 72 to 80 percent of primary production.

INDEX TERMS: Water analysis, Fish, Ammonia, Nitrates, Silicates, Ureas, Primary productivity, Cycling nutrients, Plankton, Bacteria, Creatine, Excretion.

## 2. BIOLOGICAL METHODS

AMIC-6973

"SECONDARY PRODUCTION OF SELECTED INVERTEBRATES IN AN EPHEMERAL POND", Becker, P. R., Texas A&M University, College Station, Texas, Dissertation Abstracts No. 73-3511, 1972, 154 pp. (Complete report not available from AMIC.)

#15 Between September, 1970 and August, 1971, an ecological study was made of a small ephemeral pond located in Brazos County, south-central Texas. The pond exhibited swift succession of physico-chemical characteristics between filling and drying. As drying proceeded, there was a general decrease in the total amount of dissolved materials. Concentrations of most materials increased; however, the concentrations of orthophosphate and nitrate decreased. Rainfall and surface runoff modified the above patterns by diluting the concentrations of most materials, but increasing nitrate and orthophosphate. Biotic succession was rapid. Typical ephemeral pond species such as rotifers, copepods, anostracans, and mosquito larvae appeared first. These were followed by amphipods, isopods, insects, and other forms more characteristic of permanent ponds. Secondary production of *Streptocephalus seali*, *Diaptomus clavipes*, and *Asellus militaris* appeared high when compared to published values for similar organisms. The ratio of daily production to standing biomass was initially high, then decreased as the pond dried. It is proposed that the ephemeral pond is maintained in early low maturity stages of succession by the external physical disturbance of drying. The physico-chemical patterns of the pond coupled with the low species diversity and the high ratio of production to standing biomass indicates a system of low maturity and instability.

INDEX TERMS: Trophic level, Succession, Temporary pond stage, Amphipoda, Rotifers, Copepods, Isopods, Insects, Phosphates, Nitrates, Secondary productivity, Species diversity.

AMIC-6974

"EFFECTS OF PHENOLIC INHIBITORS ON GROWTH, METABOLISM, MINERAL DEPLETION, AND ION UPTAKE IN PAUL'S SCARLET ROSE CELL SUSPENSION CULTURES", Croak, M. L., The University of Oklahoma, Norman, Oklahoma, Dissertation Abstracts No. 73-4940, 1972, 67 pp. (Complete report not available from AMIC.)

Cinnamic, p-coumaric, and ferulic acids were very inhibitory to the growth of rose-cell suspension cultures when present in low concentrations, while chlorogenic acid and scopoletin were effective as inhibitors only at high concentrations. Treatment of 5-day cells with 0.0001 M ferulic acid and 0.00001 M cinnamic acid resulted in altered patterns of incorporation of C-14 from glucose-UL-C-14 into the following cell constituents: amino acids, organic acids, protein, and lipids. The effect of incubation of cells with 0.0001 M ferulic acid on the rate of depletion of Mg, Ca, K, P, Fe, Mn, and Mo ions from the medium during the 14-day growth cycle varied with age of the cells and the ion under consideration. In general, rates of uptake were higher than control rates in older cells and in very young cells and less than control rates in cells 3-5 days old. The degree of inhibition of uptake of Rb-86 also varied with age in cells treated with 0.0001 M ferulic acid. Young (4-5 day) cells showed approximately 50 percent inhibition at higher concentrations of RbCl (system 2) and approximately 25 percent inhibition at lower concentrations of RbCl (system 1). In contrast, the rate of Rb-86 uptake in 10-day cells was not significantly altered by incubation in ferulic acid at either system 1 or system 2.

INDEX TERMS: Inhibitors, Phenols, Bioassay, Cytological studies, Metabolism, Absorption, Ions, Radioactivity techniques, Rose cell suspension cultures, Pollutant effects, Growth.

AMIC-6975

"ESTUARINE NITRIFICATION", Berdahl, B. J., Rutgers University, New Brunswick, New Jersey, Dissertation Abstracts No. 73-4719, 1972, 334 pp. (Complete report not available from AMIC.)

Nitrification, the oxidation of ammonia to nitrate by specific autotrophic bacteria, was studied in a model estuary system having a total flow (flushing) time of 30 days. During this time interval, the salinity was being increased exponentially until it reached that of coastal (100 percent) seawater. Ammonia-nitrogen was added to this salinity gradient at three points (day 0, day 10 and day 20 of flow) corresponding to 2, 6, and 34 percent seawater. The concentrations ranged from 1 to 9 mg/l NH<sub>3</sub>-N. Daily measurements of ammonia, nitrite and nitrate-nitrogen along with conductivity (salinity), dissolved oxygen, temperature and pH were taken. Only two representative ammonia-nitrogen concentrations, 3 and 5 mg/l, were studied. Upon discharge at 2 and 6 percent seawater, NH<sub>3</sub> was oxidized in two definite kinetic stages that were best described by an autocatalytic first-order equation (Stage 1) and a simple first-order equation (Stage 2). At 34 percent seawater, there was only sufficient time (10 days) for the first (autocatalytic) stage to develop. The 6 percent seawater starting salinity reduced (inhibited) the quantity of oxidized ammonia compared to 2 and 6 percent seawater. Low dissolved oxygen concentrations of 0.5-1.0 mg/l existed for at least 24 hours without any apparent effect upon nitrification.

INDEX TERMS: Estuarine environment, Ammonia, Model studies, Kinetics, Estuaries, Nitrates, Equations, Chemical reactions, Oxidation, Salinity, Nitrification.

AMIC-6988

"THE ECOLOGY OF SOME ARCTIC TUNDRA PONDS", Kangas, D. A., University of Missouri, Columbia, Missouri, Dissertation Abstracts No. 73-7045, 1972, 343 pp. (Complete report not available from AMIC.)

Seventeen tundra ponds in the northernmost tip of Alaskan tundra were selected and surveyed. Morphometric data were collected for seven of these ponds, and physical and chemical data were gathered for waters in all of them. Daily thermal oscillations were recorded in two ponds and predictive equations were derived by multiple linear correlation between U.S. Weather Bureau data on air temperature, wind direction and speed and insolation. Six water chemistry factors including alkalinity, magnesium, chloride, sodium, calcium and conductivity were significantly correlated by linear regression. *Arctophila fulva* and *Ranunculus pallasii* were the more common vascular plants which invaded these ponds. Some 28 genera of phytoplankton were identified in these ponds. Chlorophyll a standing crops were measured and these ranged between 0.3 and 37 micrograms/l. Numerical standing crop data were reported for Cladocera, Anostraca, Copepoda, Diptera and Ostracoda. *Daphnia middendorffiana*, *Branchinecta paludosa*, *Polyartemiella hazeni* and *Artemiopsis (bungei) ?* (this species is questioned as a new North American record) were the largest and most apparent organisms in these ponds. Multiple linear regression analyses were run for densities of each of the four dominant species against 16 physical and chemical variables in order to find predictive relationships between these species and the waters in which they were collected. Density of *Daphnia middendorffiana* was significantly negatively correlated with pH and significantly positively correlated with tannin and lignin-like compounds. *Branchinecta paludosa* density was significantly negatively correlated with carbonate alkalinity and metaphosphate. Significant positive correlations of

## 2. BIOLOGICAL METHODS

AMIC-6988 (Continued)

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*B. paludosa* density were with orthophosphate, tannin and lignin-like compounds and chlorophyll a standing crops. None of the variables included in the regression analyses were significantly correlated with the densities of *Polyartemiella hazeni* or *Artemiopsis (bungei)* (?). Production was defined as all of the biomass accumulated during an interval of time. Actual production estimates were the lowest on record for *Daphnia*, ranging between 2.7 and 63.3 mg/sq m for the 75-day study interval. Total production by *Branchinecta paludosa* ranged between 5.4 and 230.9 mg/sq m. Approximately 28.6 mg/sq m were produced by *P. hazeni*. Two estimates of production by *Artemiopsis (bungei)* (?) were 57.4 and 60.8 mg/sq m.

INDEX TERMS: Tundra, Ponds, Arctic, Secondary productivity, Ecology, Alaska, Standing crops, Crustaceans, Aquatic insects, Invertebrates, Biomass, Diptera, Water chemistry, Aquatic plants, Regression analysis, Trophic level, Efficiencies, Correlation analysis, Lake morphometry, Physical properties, Chemical properties, Macroinvertebrates, Species density, Macrophytes.

AMIC-7015

"POLLUTION OF THE 'EL CARPINCHO' POND (PAMPASIC REGION, ARGENTINA) AND ITS EFFECTS ON PLANKTON AND FISH COMMUNITIES", Freyre, L., *Environmental Pollution*, Vol. 4, No. 1, January 1973, pp 7-40.

A pond in the Southern Pampasic region of Argentina, 'El Caprincho', with highly developed fishing and other recreational activities, has been polluted since 1969 by the effluents from three industrial plants (milk processing plant, plastic bag factory, and an establishment for washing cattle trucks). The effects of this on the plankton and fish communities were investigated by the Institute of Limnology at La Plata University. Chemical analyses showed an increase in Na and sulfite, nitrates and phosphates. Lead and iron were detected in the water for the first time, and there was a high BOD and chloride demand, with an objectionable odor in wastes from the milk industry. Changes in the Mg/Ca ratio caused a reduction in the density of zooplankton, and in the numbers of the freshwater Argentine silverside fish (*Basilichthys bonariensis*). On the other hand, an explosive increase in catfish (*Parapimelodus valenciennesi*) was observed. The diversity index for the relative composition of the fish fauna rose from 0.3093 in 1966 to 1.9384 in 1970.

INDEX TERMS: Water pollution effects, Waste water (pollution), Industrial wastes, Zooplankton, Freshwater fish, Chemical analysis, Water pollution sources, Dairy industry, Catfishes, Silversides, Biological communities, El Carpincho Pond, *Basilichthys bonariensis*, *Parapimelodus valenciennesi*, Plastic bag factory.

AMIC-6989

"THE DYNAMICS OF BROWN TROUT (*SALMO TRUTTA*) AND SCULPIN (*COTTUS* SPP.) POPULATIONS AS INDICATORS OF EUTROPHICATION", Smith, W. L., Michigan State University, East Lansing, Michigan, Dissertation Abstracts No. 73-5491, 1972, 53 pp. (Complete report not available from AMIC.)

Brown trout and sculpin populations were studied in three variously perturbed stream sites in northern Michigan. Intraspecific comparisons were made of several aspects of population dynamics including the intrinsic rate of natural increase (*r*). The upper Jordan River, nearly pristine and with high population densities, exhibited *r* values judged adequate for maintenance of the populations. The other sites were compared with this baseline. The moderately perturbed lower Jordan River had less population densities and survival but greater mean fecundities for both species. This resulted in a positive *r* for the trout but the birth rate of the sculpins could not compensate for the death rate and the population was declining. The Au Sable River, the most eutrophic, also had lesser population densities and greater mean fecundities than the upper Jordan. Survivorship of the sculpins was sufficient to yield a positive *r*. The low survival of the trout resulted in a strongly negative *r*, suggesting inability of the population to sustain itself. The intrinsic rate of natural increase of short-lived, coldwater fish species could be a useful tool in monitoring water quality, especially if studies were continued through several generations.

INDEX TERMS: Brown trout, Sculpins, Bioindicators, Eutrophication, Fish populations, Cold-water fish, Freshwater fish, Fish reproduction, Fish physiology, Survival, Michigan, Pollutant identification, *Salmo trutta*, *Cottus* spp, Jordan River, Au Sable River, Population density.

AMIC-7016

"THE EFFECT OF OIL POLLUTION ON SURVIVAL OF THE TIDAL POOL COPEPOD, *TIGRIOPUS CALIFORNICUS*", Kontogiannis, J. E., Barnett, C. J., *Environmental Pollution*, Vol. 4, No. 1, January 1973, pp 69-79.

An investigation was undertaken to determine if the survival of *Tigriopus californicus*, a harpacticoid copepod, is affected by crude oil contamination and, if so, to determine whether death is caused mainly by oil acting as a physical barrier to O<sub>2</sub> transfer between air and water or because of the presence of toxic chemicals in the oil itself. The experiments conducted involved subjecting adult copepods to (1) crude or mineral oil in sea water, with or without bubbling, at 17.5 C in the dark for 1-7 days; and (2) crude or mineral oil as a surface film on partially deoxygenated sea water. A 1.5 mm thick layer of crude oil on the water surface caused the death of all animals within three days, while a similar layer of mineral oil resulted in complete mortality in five days. When oxygen was added to the water containing crude oil, total mortality was delayed by two days. Approximately 100 percent mortality was extended to seven days when crude oil was enclosed in a dialysis membrane bag immersed in the water and oxygen was supplied. When mineral oil was used and air provided, the animals survived as well as the controls. It was concluded that death resulted because the oil acts as a barrier to oxygen transfer between air and water, and because it contains substances toxic to *Tigriopus*.

INDEX TERMS: Water pollution effects, Oil pollution, Copepods, Bioassay, Toxicity, Crude oil, Mineral oil, *Tigriopus californicus*, Survival.



## 2. BIOLOGICAL METHODS

AMIC-7018

"A SEMI-CONTINUOUS CULTURE TECHNIQUE FOR *DAPHNIA PULEX*", Harvey, A. M., Journal of Applied Ecology, Vol. 9, No. 3, December 1972, pp 831-834.

A semi-continuous culture system based on the bacterial chemostat has been developed for growing laboratory metazoan populations. The apparatus consists of a two-liter culture vessel from the Quickfit range, and agitation funnel for delicate agitation, and a jet and air supply tube of silicon. Sampling and debris removal were two problems encountered with the system but possible solutions are discussed. The operational procedure is as follows. Sterile *D. pulex* are introduced into the autoclaved culture vessel and the agitation system activated. The culture is allowed to increase and equilibrate for 6 days, and the pump is switched on again to give the desired dilution rate. In the conditions described, the doubling time in the phase of unlimited growth was just under 5 days, so a dilution rate of the order of 20 percent/day was used. The air supply producing positive pressure for the overflow is switched on, and overflow samples are counted regularly. The main advantages of the apparatus are of constancy in the environment, simplicity of control, and physiological uniformity. This system allowed successful culture of *D. pulex* through many generations; results were compatible with the classical chemostat theory. The methods used to minimize particular problems presented by *Daphnia* would easily be modified to allow the culture of other aquatic invertebrates in a similar system.

INDEX TERMS: Waterfleas, Laboratory equipment, Invertebrates, Zooplankton, Sampling, Crustaceans, Animal physiology, Methodology, Animal populations, Semi-continuous culture technique, *Daphnia pulex*, Macroinvertebrates, Debris, Arthropods, Culturing techniques, Culturing vessels.

AMIC-7020

"CULTURED RED ALGA TO MEASURE POLLUTION", Edwards, P., Marine Pollution Bulletin, Vol. 3, No. 12, December 1972, pp 184-188.

Because of its small size, simple structure, and rapid growth rate, the red alga, *Callithamnion hookeri*, was cultured to assess its potential as a bioindicator in the marine environment. The ability of the alga to detect eutrophication was investigated by determining the effect of nutrients on growth rates. The effect of copper was also studied. The algae were cultured at 14.5 C in Erlenmeyer flasks containing relatively unpolluted seawater which was inoculated with seawater from seven stations, nitrate, phosphate, or CuCl<sub>2</sub>. The alga grew equally well in seawater samples from unpolluted and polluted localities. The species was insensitive to nitrate and phosphate levels of the medium and thus cannot be used as an indicator of eutrophication. Relatively small copper concentrations depressed the growth of the species. No difference in copper tolerance was demonstrated between isolates from unpolluted north-east Scotland and polluted County Durham, but the isolate from unpolluted south-west England was apparently less resistant to copper.

INDEX TERMS: Cultures, Bioassay, Bioindicators, Growth rates, Nitrates, Phosphates, Sea water, Copper, *Callithamnion hookeri*.

AMIC-7022

"ACUTE TOXICITY OF HEAVY METALS TO SOME MARINE LARVAE", Connor, P. M., Marine Pollution Bulletin, Vol. 3, No. 12, December 1972, pp 190-192.

The toxicity of copper, mercury and zinc to the larvae of oysters, shrimp, crab and lobsters has been examined over periods of up to 64 hours. Mercury was found to be more toxic than copper and zinc, which had similar levels of toxicity. Over the experimental period, the relationship between toxicity and concentration was linear. Larvae were from 14 to 1,000 times more susceptible than adults of the same species. The median lethal concentrations (LC50) of each metal to the most sensitive species of larvae, tested over a 48 hour period, exceeded the concentrations found in natural sea water by a factor of 100. For longer test periods, the LC50 would be considerably less and this factor would then be considerably reduced. Hence the continued addition of these metals to confined waters should give cause for concern.

INDEX TERMS: Toxicity, Heavy metals, Larval growth stage, Shellfish, Crustaceans, Mollusks, Larvae, Copper, Mercury, Zinc, Oysters, Shrimp, Crabs, Invertebrates, Bioassay, Lethal limit, Lobsters, Mortality, Mature growth stage, Marine animals, Laboratory tests, Median tolerance limit, Sensitivity, *Ostrea edulis*, Crangon crangon, *Carcinus maenas*, *Homarus gammarus*, Macroinvertebrates.

AMIC-7023

"PERIPHYTON PRODUCTION AND GRAZING RATES IN A STREAM MEASURED WITH A P-32 MATERIAL BALANCE METHOD", Elwood, J. W., Nelson, D. J., OIKOS, Vol. 23, No. 3, 1972, pp 295-303.

Net production rates and standing crops of periphyton and grazing rates on periphyton were measured in a small, woodland stream in southeastern United States using a material balance method. The material balance of radioactive phosphorus was followed at three times during the year in periphyton, consumer organisms, and stream water for up to six weeks following a one-hr release of P-32 labelled PO<sub>4</sub> to the stream. Rates of decrease of P-32 in periphyton per unit weight, per unit area of substrate, and in the entire study reach of stream were used to compute biomass turnover rates. Periphyton standing crops in July, September, and November were estimated at 200, 198, and 658 mg ash-free dry weight per sq m respectively, while estimates of net production rates were 22, 24, and 16 mg ash-free dry weight per sq m per day, respectively. Estimated grazing rates on periphyton during these periods were 23, 15, and 14 mg ash-free dry wt per sq m per day, respectively. Biomass turnover rates of periphyton suggest that grazing limited periphyton production rates in this stream by controlling the standing crop of periphyton. The method is of wide applicability since less than maximum permissible concentrations of radioactive phosphorus were used in the spike releases.

INDEX TERMS: Standing crops, Grazing, Periphyton, Biomass, Radioactivity techniques, Primary productivity, Phosphates.

## 2. BIOLOGICAL METHODS

AMIC-7024

"ACETYLENE REDUCTION IN SURFACE PEAT", Waughman, G. J., Bellamy, D. J., OIKOS, Vol. 23, No. 3, 1972, pp 353-358.

An investigation was carried out between April and August, 1971, using the acetylene reduction assay for nitrogen fixation. Ten samples were collected from three mire types and from blanket peat and flushed with a gas phase of O<sub>2</sub>, CO<sub>2</sub> and Ar. Acetylene was injected into the sample chambers and the ethylene content was estimated at intervals by gas chromatography. Other time course experiments were carried out to determine the effect of glucose, carbon monoxide and a high ambient oxygen tension on acetylene reduction by the peat. Anaerobic nitrogenase activity and N-15 uptake were also measured using samples of one of the mire types. Nitrogen fixation in the mire system was confirmed by uptake of N-15. The rates were very low and near to the limits of detection by mass spectrometry. Nitrogenase activity measurements indicate that a relationship does exist between mire type and such activity, the highest rate being in rheophilus mire and the lowest in ombrophilous mire.

INDEX TERMS: Peat, Nitrogen fixation, Assay, Ecosystems, Path of pollutants, Gas chromatography, Mass spectrometry, Chemical reactions, Nitrogen, Acetylene reduction, Mire, Ethylene, N-15, Nitrogenase, Enzyme kinetics, Fate of pollutants.

AMIC-7025

"AN AIR-LIFT FOR SAMPLING FRESHWATER BENTHOS", Mackey, A. P., OIKOS, Vol. 23, No. 3, 1972, pp 413-415.

An air-lift has been designed for sampling freshwater sediments with their associated flora and fauna. It consists of a 3-m length of plastic drainpipe of 80 mm internal diameter. The upper end is bent over to discharge into a container. Compressed air from a cylinder at the surface is fed into the lower end of the pipe through natural rubber tubing of 10 mm internal diameter and 2 mm normal wall. This tube joins a U-shaped brass feed pipe. The air cylinder is connected to the rubber tubing by an 'A' clamp of the type used in aqualung diving. When the depth of core taken needs to be regulated, a circular metal disc with a large central hole through which the tube of the air-lift passes, may be fitted. Information is given on the procedure for sampling the various types of sediments. The main advantages of this apparatus are that it is light, cheap to construct, and can be used to sample most freshwater sediments. A preliminary sorting of material can be carried out while the sample is being taken. That the air-lift can sample unionid mussels and flints of approximately 40 mm diameter is an indication of the size of particle that can be sampled. Test results are presented from a comparison between the air-lift and a Maitland core

INDEX TERMS: Sampling, Bottom sediments, Freshwater, Benthos, Aquatic life, Invertebrates, Aquatic insects, Annelids, Mollusks, Crustaceans, Design, Construction, Methodology, Air-lift sampler, Maitland corer, Macroinvertebrates.

AMIC-7028

"BIOLOGICAL SURVEY OF STREAMS OF COLES COUNTY, ILLINOIS - 1967-1970", Durham, L., Whitley, J. S., Eastern Illinois University, Division of Life Sciences, Charleston, Illinois, Water Pollution Control Research Series 18050 DZZ 06/71, June 1971, 147 pp.

Field and laboratory studies were carried out on 20 streams in Coles County, Illinois from 1967 through 1970. A large reservoir (Lincoln Lake) is planned by the Army Corps of Engineers and, if completed, will have considerable impact on Coles County. A record of existing conditions was desired in order to help determine the effects of the reservoir in the area. Studies were made of the bottom fauna, plankton, and fishes in the streams. Physical and chemical characteristics such as pH, hardness, dissolved oxygen, turbidity, nitrites, nitrates, phosphates, sulfates, and carbon dioxide were also measured. These data are listed, relative abundance noted, and a brief discussion is included. Portions of two fairly large rivers (Embarrass and Kaskaskia) are in Coles County. The remaining 18 streams range from good sized creeks to small headwater-type tributary streams. Eighty species of fishes are included in the Coles County list. This study includes a comparison of the present fish fauna with a study published in 1913 by T. H. Hankinson and one by Forbes and Richardson in 1920 in essentially the same streams.

INDEX TERMS: Environmental effects, Domestic wastes, Industrial wastes, Fish, Population, Agricultural runoff, Water quality, Plankton, Hydrogen ion concentration, Hardness (water), Dissolved oxygen, Turbidity, Nitrites, Nitrates, Phosphates, Sulfates, Carbon dioxide, Rivers, Streams, Biological communities, Macroinvertebrates, Illinois, Species diversity.

AMIC-7050

"DETERMINATION OF CHLOROPHYLL A AND B IN PLANT EXTRACTS BY COMBINED SUCROSE THIN-LAYER CHROMATOGRAPHY AND ATOMIC ABSORPTION SPECTROPHOTOMETRY", Loewenschuss, H., Wakelyn, P. J., Analytica Chimica Acta, Vol. 63, No. 1, January 1973, pp 230-235.

A rapid, accurate technique has been described for determining chlorophyll a and b in plant extracts. A plant sample was extracted with MeOH containing MgCO<sub>3</sub> at zero degrees for an hour with constant stirring. The MgCO<sub>3</sub> was added in order to prevent the chlorophylls from decomposing to pheophytins. The extract was filtered, and a portion evaporated in a stream of N<sub>2</sub> to yield a concentrate for pigment separation by sucrose one-dimensional thin-layer chromatography. The Mg content of those separated compounds was determined by AAS, and was used to determine the ratio of chlorophyll a to b. With this system, chlorophyll a and b are well separated from each other and from other pigments as well. The chlorophyll ratio obtained compared favorably with the published value and spectroscopically determined values. The sample size and sensitivity of the method are limited only by the atomic-absorption spectrophotometer available (0.001 microgram Mg/ml can be measured). The proposed method therefore seems preferable to the normal published techniques since it is fast, reliable, and more convenient. The proposed method can also be used to determine total chlorophyll content of a material.

INDEX TERMS: Methodology, Separation techniques, Reliability, Sucrose thin layer chromatography, Atomic absorption spectrophotometry, Chlorophyll a, Chlorophyll b, Plant extracts, Sample preparation, Sensitivity.

## 2. BIOLOGICAL METHODS

AMIC-7078

"DETERMINATION OF SOME CARBAMATES BY ENZYME INHIBITION TECHNIQUES USING THIN-LAYER CHROMATOGRAPHY AND COLORIMETRY", Mendoza, C. E., Shields, J. B., Journal of Agricultural and Food Chemistry, Vol. 21, No. 2, March/April 1973, pp 178-184.

Detection limits were determined by a thin-layer chromatographic-enzyme inhibition technique for aldicarb, Butacarb, C-8353, carbaryl, formetanate (HCl), Meobal, Mesurol, methomyl, and promecarb. Indophenyl and 5-bromoindoxyl acetates were used as substrates of porcine liver esterases. Effects of ultraviolet irradiation and bromine on the pesticides were also studied. Inhibition of esterase activities by these carbamates was determined by spectrophotometry using indophenyl acetate (IPA) substrate. Percent inhibitions were based on IPA hydrolysis rate in the treated solutions at two different periods vs. that in the control enzyme solutions, and the absorbance of the treated solution at 7.5 or 15 min after the addition of substrate vs. the absorbance of the control solution. The results indicate that tlc and colorimetry using IPA are complimentary techniques, and that the same enzyme sites or system are involved. Both techniques can be used to confirm pesticide residues that are enzyme inhibitors. The data also suggested that Butacarb, promecarb, Mesurol, and carbaryl can be classified as strong inhibitors, and aldicarb and formetanate (HCl) can be classified as weak inhibitors of pig liver esterases catalyzing the hydrolysis of IPA. Since the colorimetric procedure used includes incubation of pesticides before the addition of substrates, it can be used directly to assay enzyme activities from insecticide-treated organisms. IPA, as a substrate, can be used in tlc and colorimetry without involving complex preparations. IPA solution is stable, particularly when stored at 4 degrees.

INDEX TERMS: Bioassay, Carbamate pesticides, Colorimetry, Thin layer chromatography, Tlc-enzyme inhibition techniques, Pesticide toxicity, Pesticide residues.

AMIC-7116

"THE DISTRIBUTION AND TISSUE RETENTION OF MERCURY-203 IN THE GOLDFISH (CARASSIUS AURATUS)", Weisbart, M., Canadian Journal of Zoology, Vol. 51, No. 2, February 1973, pp 121-131.

Goldfish weighing between 5.83 and 13.63 g were maintained in aquaria for use in studies of the rate of elimination of mercury. Fish were injected intraperitoneally with 10 microliters of a solution of Hg-203 labelled Hg (NO3)2. At 0 to 672 hours after injection, fish were sacrificed for analysis of mercury residues in whole-body, skin, eyes, brain, gills, heart, gall bladder, liver, gonads, intestines, spleen, kidneys, head kidney, muscle, and swim bladder. Water samples were also analyzed at each period. Hg-203 was determined by gamma counting in a well-type scintillation counter. The results showed that fish lost mercury at an apparent constant rate resulting in a biological half-life of 568 h. Correlated with this loss was a linear increase in the amount of mercury in the water. The mercury-203 content in the tissues displayed four different responses. (1) Gall bladder, gonad, and spleen tissues showed no significant regressions. (2) Eye, kidney, and intestinal tissue manifested significant losses of mercury, but the rate of loss was not significantly different from that of the body as a whole. (3) Gill, heart, skin, and swim bladder tissues lost mercury at rates faster than the body as a whole. (4) Brain, liver, muscle, and head kidney tissues showed no significant losses of mercury.

INDEX TERMS: Mercury, Water analysis, Bioassay, Goldfish, Excretion, Scintillation counting, Tissue.

AMIC-7123

"DEEP-SEA CIRROMORPHS (CEPHALOPODA) PHOTOGRAPHED IN THE ARCTIC OCEAN", Percy, W. G., Beal, A., Deep-Sea Research and Oceanographic Abstracts, Vol. 20, No. 1, January 1973, pp 107-108.

Cirromorphs (cephalopods) were photographed just above the sea floor in the Arctic Ocean during the summer of 1965. Photographs were obtained with a 35 mm EG and G Deep-Sea Camera from the USS Staten Island (AGB-S) at 6 locations north of Point Barrow, Alaska. The camera was positioned above the bottom using a Precision Depth Recorder and pinger attached to the camera. The usual distance above the bottom was six meters. Over 2900 photos were examined. Cirromorphs appeared in 21 photos representing a maximum of 12 separate individuals. The cirromorphs photographed had a prominent oval head, large fins inserted near its well-developed eyes, a web or umbrella that extended to the tips of the arms and long cirri on the arms. A secondary web (a web extending from the arms to the main web) was not evident.

INDEX TERMS: Mollusks, Arctic Ocean, Invertebrates, Marine animals, Systematics, Deep-water habitats, Deep water, Animal populations, On-site data collections, Photography, Cephalopods, Cirromorphs, Macroinvertebrates, Underwater cameras.

### 3. MICROBIOLOGICAL METHODS

AMIC-6448

"POLLUTION EFFECTS ON PHYCIVIRUS AND HOST ALGAE ECOLOGY", Shane, M. S., Cannon, R. E., Demichels, E., Journal Water Pollution Control Federation, Vol. 44, No. 12, December 1972, pp 2294-2302.

Chemical, physical, and biological parameters of pollution were measured at 11 stations along the Christina River (Delaware) which were located from source to mouth. The purpose was to determine the distribution of Lyngbya, Phormidium, and Plectonema viruses in relationship to pollution. Biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, phosphate, nitrate-, nitrite-, NH<sub>3</sub>-nitrogen, heavy metals, hardness, pH, temperature, alkalinity, turbidity, and coliform data are reported. These data give strong indications that Lyngbya, Phormidium, and Plectonema viruses are associated with cultural pollution.

INDEX TERMS: Bioindicators, Cyanophyta, Water pollution, Water pollution sources, Ecological distributions, Hosts, Water pollution effects, Chemical analysis, Plant viruses, Aquatic algae, Delaware, Water sampling, Water analysis, Aquatic plants, Water chemistry, Phycoviruses, Lyngbya, Plectonema boryanum, Christina River, Phormidium.

AMIC-6791

"SOME CHARACTERISTICS OF FLUORESCENT PSEUDOMONADS ISOLATED FROM SURFACE WATERS AND CAPABLE OF GROWTH AT 41 C", Hoadley, A. W., Ajello, G., Canadian Journal of Microbiology, Vol. 18, No. 11, November 1972, pp 1769-1773.

Studies were conducted to establish (1) whether the apyocyanogenic fluorescent pseudomonads capable of growth at 41 C were distinguishable from P. aeruginosa, (2) the extent to which they occurred in surface waters, and (3) their potential as pathogens. Surface water samples enriched in organic matter were obtained from several recreational lakes in North Georgia. The most probable number test was performed to determine the fluorescent pseudomonads capable of growth at 39 C. Twenty-nine apyocyanogenic strains of fluorescent pseudomonads capable of growth at 39C were isolated for use in comparative studies with a typical pyocyanogenic strain of P. aeruginosa. Among the 29 isolates subjected to selected tests, some strains were clearly distinguishable from P. aeruginosa while others possessed characteristics in common with both P. aeruginosa and certain non-fluorescent aerobic pseudomonads. The pathogenicity to mice of representative strains injected intraperitoneally varied within a range reported in the literature for P. aeruginosa, but differed by at least one order of magnitude from that of a control strain of P. aeruginosa examined.

INDEX TERMS: Aquatic bacteria, Surface waters, Biological properties, Pollutant identification, Pathogenic bacteria, Aerobic bacteria, Isolation, Fluorescent pseudomonads, Biochemical characteristics, Pseudomonas aeruginosa.

AMIC-6452

"BACTERIOPHAGES RECOVERED FROM SEPTAGE", Calabro, J. F., Cosenza, B. J., Kolega, J. J., Journal Water Pollution Control Federation, Vol. 44, No. 12, December 1972, pp 2355-2358.

A study was made to (a) determine the presence of bacteriophage in septage where numbers of coliforms are markedly reduced, (b) examine their morphology and host specificity, and (c) detect any biological effects of linear alkyl sulfonate (LAS) on phage attachment in the system. Three active filtrates were recovered, and two distinct morphological types were observed with an electron microscope. The short-tail phage infected Citrobacter freundii, Escherichia coli, and cell-wall mutants of Salmonella typhimurium, and a long-tail phage was specific for Shigella flexneri. Host specificity suggested three different types. Only rough strains of hosts were found to be susceptible to phage. Concentrations of LAS normally encountered in septage showed no deleterious effect on the phage and host model system used.

INDEX TERMS: Bacteriophage, Electron microscopy, Pollutant identification, Septic tanks, Waste water (pollution), Assay, Coliphages, Septage, Citrobacter freundii, Salmonella typhimurium, Shigella flexneri, Host specificity, Sample preparation, Culturing techniques.

AMIC-6799

"BIODEGRADATION OF PETROLEUM IN SEAWATER AT LOW TEMPERATURES", Atlas, R. M., Bartha, R., Canadian Journal of Microbiology, Vol. 18, No. 12, December 1972, pp 1851-1855.

To evaluate the significance of biodegradation in the removal of polluting oil from cold oceans, freshly collected seawater samples were treated with petroleum and were incubated at controlled temperatures between 5 and 20 C. Biodegradation was monitored by the measurement of CO<sub>2</sub> evolution and by quantitative gas chromatographic analysis. Low water temperatures not only resulted in slower degradation rates, but caused increasing lag periods that preceded the onset of measurable biodegradation. A substantial portion of these lag periods was eliminated when, instead of fresh petroleum, a 'weathered' sample was used. The results suggest that some volatile components of petroleum that are inhibitory to oil-degrading microorganisms evaporate only very slowly at low temperatures, and thus retard biodegradation.

INDEX TERMS: Microbial degradation, Biodegradation, Sea water, Water temperature, Gas chromatography, Water sampling, Inhibition, Weathering, Monitoring, Chemical analysis, Crude oil, Fate of pollutants, Carbon dioxide evolution technique, Mineralization, Degradation rates, Sweden crude oil, Coastal waters,

### 3. MICROBIOLOGICAL METHODS

AMIC-6802

"THE ISOLATION AND ENUMERATION OF CYTOPHAGAS", Christensen, P. J., Cook, F. D., Canadian Journal of Microbiology, Vol. 18, No. 12, December 1972, pp 1933-1940.

A comparison of 20 media based on degraded milk, protein or tryptone, yeast extract, and sodium acetate showed that various new formulae were superior to standard media for enumeration of cytophagas from aquatic habitats, for their isolation, and for maximum expression of the spreading characteristic. The use of 0.1 microliter/liter Tween 20 in dilution blanks increased counts of cytophagas up to threefold, but incorporation of Tween 20 into the plating agar had no significant effect on the numbers recovered. Sodium lauryl sulfate (S.L.S.) was examined as a possible screening agent for identification of cytophagas. A concentration of 0.1 percent S.L.S. inhibited the growth of 97 percent of the 66 cytophagas tested, but more than 80 percent of the other 41 organisms tested were also affected. However, 91 percent of the cytophagas were sensitive to S.L.S. and showed proteolysis on skim acetate medium compared to 53 percent of the Flavobacteria and 50 percent of the other organisms tested. None of the third group of organisms could be confused morphologically with the cytophaga group; thus it is suggested that S.L.S. susceptibility performed on skim acetate medium could be a useful screening test for cytophagas.

INDEX TERMS: Aquatic bacteria, Isolation, Pollutant identification, Detergents, Surfactants, Bactericides, Inhibition, Cytophaga, Enumeration, Tween 20, Sodium lauryl sulfate, Culture media, Selective media, Growth.

AMIC-6806

"ENVIRONMENTAL FACTORS CORRELATED WITH SIZE OF BACTERIAL POPULATIONS IN A POLLUTED STREAM", Brasfield, H., Applied Microbiology, Vol. 24, No. 3, September 1972, pp 349-352.

Samples of water were taken from a polluted zone of the Gallinas River and analyzed as to numbers of total bacteria, coliforms, and fecal streptococci. Environmental factors measured were temperature, pH and concentrations of detergent, nitrate plus nitrite nitrogen, sulfate, chloride, bicarbonate, and phosphate. Thirty-two observations were made from 12 March through 22 July 1971. Stepwise multiple linear regression analyses of the data were carried out by computer to determine which of the environmental factors were significantly correlated with numbers of bacteria present. A multiple linear regression equation was constructed for each bacteriological parameter as a function of significant variables only. Log total bacteria was correlated positively with bicarbonate, phosphate, and detergent concentrations. Log coliforms was correlated positively with phosphate and sulfate concentrations and negatively with chloride concentration. Log fecal streptococci was correlated positively with bicarbonate and chloride concentrations. (Reprinted from Applied Microbiology, Vol. 24, No. 3, September 1972, pp 349-352. Copyright 1972 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Water analysis, Population, Bioindicators, Water quality, Streptococcus, Regression analysis, Correlation analysis, Data processing, Coliforms, Water temperature, Hydrogen ion concentration, Detergents, Nitrates, Nitrites, Sulfates, Chlorides, Phosphates, Bicarbonates.

AMIC-6822

"IDENTIFICATION OF VIBRIO CHOLERAE BY PYROLYSIS GAS-LIQUID CHROMATOGRAPHY", Haddadin, J. M., Stirland, R. M., Preston, W. W., Collard, P., Applied Microbiology, Vol. 25, No. 1, January 1973, pp 40-43.

Fifty-seven strains of cholera-like vibrios obtained from a variety of sources were grown individually at 37 C for 20 hr in a 50-ml static culture of nutrient broth. Formalin was added; the bacteria were harvested by centrifugation, washed three times, and resuspended in distilled water. Samples loaded onto the coil filament of the gas chromatograph were pyrolyzed at 800 C for 5 sec. Conventional biochemical tests were also performed to differentiate the biotypes of *V. cholerae*. Those cholera-like vibrios examined by pyrolysis gas-liquid chromatography could be distinguished from other common aerobic gram-negative bacilli, including oxidase-positive organisms, e.g., *Aeromonas*. Vibrios in Heiberg group I were subdivided into three types on the basis of differences in one complex in the chromatogram, and these closely corresponded with the identification as classical, El Tor, or 'intermediate' biotypes of *Vibrio cholerae* by conventional methods.

INDEX TERMS: Pollutant identification, Pathogenic bacteria, Aerobic bacteria, Chemical analysis, *E. coli*, *Salmonella*, *Shigella*, Varieties, Pyrolysis gas liquid chromatography, *Vibrio cholerae*, Sample preparation, *Aeromonas*, Biochemical tests, *Proteus*, *Pseudomonas aeruginosa*, *Vibrio parahaemolyticus*, *Vibrio proteus*.

AMIC-6823

"EDWARDSIELLA TARDA, A NEW PATHOGEN OF CHANNEL CATFISH (*ICTALURUS PUNCTATUS*)", Meyer, F. P., Bullock, G. L., Applied Microbiology, Vol. 25, No. 1, January 1973, pp 155-156.

*Edwardsiella tarda*, an enteric, gram-negative bacterium, causes gas-filled, malodorous lesions in muscle tissue of channel catfish. Incidence and epizootiology of the disease are presented. (Reprinted from Applied Microbiology, Vol. 25, No. 1, January 1973, pp 155-156. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Pathogenic bacteria, Channel catfish, Epizootiology, Enteric bacteria, *Edwardsiella tarda*, *Ictalurus punctatus*.

### 3. MICROBIOLOGICAL METHODS

AMIC-6864

"REGROWTH OF COLIFORMS AND FECAL COLIFORMS IN CHLORINATED WASTEWATER EFFLUENT", Shuval, H. I., Cohen, J., Kolodney, R., Water Research, Vol. 7, No. 4, April 1973, pp 537-546.

Observations made both in the field in chlorinated effluent, and in laboratory experiments show that coliforms and fecal coliforms are capable of regrowth in chlorinated wastewater. Under field conditions regrowth of coliforms in chlorinated effluent held in a storage reservoir for about 3 days appeared inversely correlated to: (1) the residual chlorine in the storage reservoir and (2) the number of coliforms surviving chlorination. In the laboratory experiments regrowth occurred after initial doses as high as 11 ppm total chlorine even when there was no chemical inactivation of the chlorine. Fecal coliforms did not generally show regrowth to the same extent as coliforms. Regrowth occurred even when coliforms were not detectable in 10-ml of samples after chlorination. Since coliforms and fecal coliforms are capable of regrowth in chlorinated sewage effluent and admixtures of it, the sanitary significance of the number of coliforms after storage or in receiving bodies of water is difficult to interpret. Thus standards might be based on the number of coliforms, or fecal coliforms detected in effluents immediately after chlorination. However, this would not be justified if in addition to coliforms, pathogenic bacteria can regrow in chlorinated effluents.

INDEX TERMS: Coliforms, Waste water (pollution), Chlorination, Sewage effluents, Environmental effects, On-site investigations, Laboratory tests, Water quality control, Fecal coliforms, Regrowth, Survival.

AMIC-6865

"ISOLATION OF BACTERIA CAPABLE OF UTILIZING METHANE AS A HYDROGEN DONOR IN THE PROCESS OF DENITRIFICATION", Davies, T. R., Water Research, Vol. 7, No. 4, April 1973, pp 575-579.

Bacteria were isolated which are able to denitrify when methane is supplied as the sole carbon source. These isolates were not found to be specific to methane, but could use other carbon compounds as hydrogen donors. They were capable of using nitrate both as a source of cell nitrogen and as an alternative terminal electron acceptor to oxygen. Results obtained from a laboratory scale denitrifying unit indicated that denitrification with methane as the energy source could become an attractive commercial proposition.

INDEX TERMS: Methane bacteria, Denitrification, Laboratory tests, Isolation, Pollutant identification, Methane, Nitrogen, Hydrogen, Substrate utilization, Energy sources, Enrichment, Culture media, Fate of pollutants, Growth, Methanol, Ethanol, Malate, Lactate.

AMIC-6869

"MASS AND MONOXENIC CULTURE OF VORTICELLA MICROSTOMA ISOLATED FROM ACTIVATED SLUDGE", Sudo, R., Aiba, S., Water Research, Vol. 7, No. 4, April 1973, pp 615-621.

Following previous work on the monoxenic culture of *Vorticella microstoma* isolated from activated sludge, Sudo and Aiba (1971), a mass culture of the protozoa was attempted. An appropriate range of phosphate buffer concentration in cultivating the protozoa, using sludge bacteria as food, was from 1/150 to 1/75 M, and the optimum pH value of the culture medium ranged from 6.5 to 7.5. For a measurement of dry mass of single cells of *Vorticella microstoma*, and also for an assessment of some relationship between protozoan growth and bacterial consumption, a pure culture of *Alcaligenes faecalis* was given as food. The specific growth rate,  $\mu$  (equals 1.5-1.8 /day) observed with the protozoa was independent of the inoculum size, provided the bacterial concentration was less than 200 mg/l (360,000,000/ml). The yield on conversion from *Alcaligenes faecalis* to *Vorticella microstoma* was 0.47.

INDEX TERMS: Protozoa, Growth rates, Activated sludge, Isolation, Animal growth, Cultures, Sewage bacteria, Biomass, Animal populations, Invertebrates, Pollutant identification, Mass cultures, Monoxenic cultures, *Vorticella microstoma*, *Alcaligenes faecalis*, Culture media.

AMIC-6884

"A TECHNIQUE FOR FAST AND REPRODUCIBLE FINGERPRINTING OF BACTERIA BY PYROLYSIS MASS SPECTROMETRY", Meuzelaar, R. L. C., Kistemaker, P. G., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 587-590.

*Neisseria sicca*, *N. meningitidis* and *Leptospira* strains were cultured, washed in isotonic salt solutions, centrifuged, resuspended in distilled water, and freeze-dried for analysis by pyrolysis mass spectrometry. The freeze-dried samples were suspended in carbon disulfide and small drops applied to the ferromagnetic Curie-point pyrolysis wires which were rotated to evenly distribute the sample. The mass spectrometer used was a fast scanning quadrupole mass filter with a multi-channel signal averager for recording the spectra. The pyrolysis wires operated at 510 C, and mass spectra were obtained by the accumulation of 60 scans of 0.5 sec duration. Although the results are preliminary, the method proved to be rapid, reproducible, and able to differentiate the three bacteria. Work is being continued using low-voltage, electron-impact ionization.

INDEX TERMS: Bacteria, Pyrolysis mass spectrometry, Sample preparation, Freeze drying, Characterization, *Neisseria sicca*, *Leptospira*, *Neisseria meningitidis*.

### 3. MICROBIOLOGICAL METHODS

AMIC-6928

"MICROBIAL DEGRADATION OF PARATHION", Gibson, W. L., Mississippi State University, State College, Mississippi, Dissertation Abstracts No. 73-166, 1972, 125 p. (Complete report not available from AMIC.)

An organism capable of utilizing parathion as the sole carbon and energy source was isolated by enrichment culture techniques. The bacterium was characterized and tentatively classified as *Pseudomonas aeruginosa*. A pH of 7.0 - 7.5 and temperature of 30 C were found to be optimum for the consumption of parathion. Virtually no oxygen utilization was observed with resting cell suspensions when nonsolubilized parathion was employed. The use of ethanol as solvent for parathion in resting cell studies or preincubation of cells in ethanol obviated this problem and rapid parathion oxidation was demonstrable. Approximately 80 percent of the parathion consumed by resting cells was present terminally as carbon dioxide. Permeability of the cell to parathion or its metabolites was contingent upon the use of ethanol as either solvent or denaturant. The nature of the enzyme system in parathion utilization was found to be constitutive. Enhanced parathion utilization was noted when grown in a carbon-dioxide-enriched atmosphere. The isolate was capable of growth on parathion, paraoxon, p-nitrophenol, p-aminophenol, and phenol. Metabolites were tentatively identified by thin layer chromatography. Thin layer chromatographic data generally supported the growing evidence for the proposed pathway of parathion metabolism.

INDEX TERMS: Microbial degradation, Phosphothioate pesticides, Metabolism, Biochemistry, Metabolites, *Pseudomonas aeruginosa*, Substrate utilization, Parathion, Fate of pollutants, Ethanol, Growth, Bacterial physiology.

AMIC-6945 (Continued)

Card 2/2

INDEX TERMS: Temperature, Population, Bacteria, Separation techniques, Sewage sludge, *Flavobacterium*, *Achromobacter*, *Vibrio*.

AMIC-6945

"MICROBIAL RESPONSE IN LOW TEMPERATURE WASTE TREATMENT", Henry, J. G. F., University of Toronto, Canada, Dissertation Abstracts, 1971. (Available from the National Library of Canada, Ottawa). (Complete report not available from AMIC.)

This thesis clarifies the relationships between low temperature, psychrophilic population and microbial activity. Full scale treatment plants, batch studies and continuous laboratory models were used in the investigation. Batch studies on pure cultures of 26 psychrophiles and 4 mesophiles were conducted at temperatures of 1, 4, 9, 5, and 18 C with food (nutrient broth) in excess. A comparison of the temperature coefficients for the psychrophiles and the mesophiles revealed a significant difference between them. Continuously fed laboratory models with detention times of 2.4, 9.6, 24 and 96 hours were also investigated at the same temperatures as used in the batch tests. The proportion of psychrophilic bacteria in the continuous models proved to be a function mainly of temperature but also of detention. Microscopic examination, colonial characteristics, Gram-staining and other diagnostic tests were used on the mixed population from the models to show the variation in microorganisms with temperature and detention and also to identify, to genus level the bacterial cultures isolated for the pure culture studies. Psychrophilic *Pseudomonas*, *Flavobacterium*, *Achromobacter* and *Vibrio* all occurred. In the batch tests, with unlimited food, yield decreased at colder temperatures. However, in the continuous experiments, where food was limited, yield increased with colder temperature. Consideration of the relation of substrate concentration to detention, loading and other factors which moderate the effect of temperature on waste treatment systems, led to the conclusion that temperature coefficients, like other activities in the system, must be a function of substrate concentration.

AMIC-6963

"CHARACTERIZATION OF SEVERAL THYMINE-REQUIRING MUTANTS OF *ESCHERICHIA COLI* Y MEL", Maryanski, J. H., University of New Hampshire, Durham, New Hampshire, Dissertation Abstracts No. 73-4362, 1972, 236 pp. (Complete report not available from AMIC.)

*Escherichia coli* Y melt (-), *E. coli* B27T (-), and *E. coli* B9T (-) were isolated from *E. coli* Y mel, *E. coli* B27, and *E. coli* B9, respectively, by trimethoprim selection. *E. coli* B27 and *E. coli* B9 were tryptophan deletion mutants derived from *E. coli* Y mel. Mutants, *E. coli* Y melt (-), *E. coli* B27T (-), and *E. coli* B9T (-) required 2-5 micrograms of thymine/ml for aerobic growth on minimal agar and failed to utilize thymidine as a sole source of carbon. The inability to utilize thymidine indicated the presence of mutations in the genetic regions controlling the production of thymidylate synthetase (thy A) and the catabolism of deoxyribonucleosides. Thymine, thymidine, and thymidylic acid supported growth on agar medium of all thymine-requiring mutants studied. Other nucleic acid bases, nucleosides, nucleotides, thymine analogues, orotic acid, deoxyuridine-5'-monophosphate, and other compounds failed to support growth when added to minimal agar lacking thymine. Increased carbon dioxide tension (5 percent) supported colony-formation of *E. coli* Y melt (-) and *E. coli* B27T (-) but not of *E. coli* B9T (-) on minimal agar lacking thymine. The data were consistent with a hypothesis that *E. coli* B27T (-) possessed an alternate pathway, independent of thymidylate synthetase, for the biosynthesis of thymidine. Mutants *E. coli* Y melt (-) and *E. coli* B9T (-) appeared to be thymine-requiring mutants with characteristics similar to mutants described by other investigators.

INDEX TERMS: Cultures, *E. coli*, Separation techniques, Culture media.

### 3. MICROBIOLOGICAL METHODS

AMIC-6964

"SEROLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF ANAEROBIC, NONSPOREFORMING, GRAM-NEGATIVE BACILLI", Lombard, G. L., University of North Carolina, Chapel Hill, North Carolina, Dissertation Abstracts No. 73-4896, 1972, 136 pp. (Complete report not available from AMIC.)

Fluorescent antibody (FA) reagents were prepared for 10 *Bacteriodes* and 7 *Fusobacterium* species. These included *B. biacutus*, *B. clostridiiformis* ss *glans*, *B. fragilis*, (ss *fragilis*, ss *thetaiotaomicron*, ss *ovatus*, ss *distasonis*, ss *vulgatus*), *B. trichoides*, *B. hypermegas*, *F. fusiforme*, *F. mortiferum*, *F. necrogenes*, *F. necrophorum*, *F. novum*, *F. nucleatum*, and *F. russii*. The morphological, cultural, and physiological characteristics of all bacterial strains used in the study were examined to verify identity. Antisera for each species were prepared in rabbits, and immunoglobulins were precipitated with ammonium sulfate and conjugated with fluorescein isothiocyanate. Most of the antisera were species or subspecies specific by the tube agglutination technique. Also, the majority of the FA conjugates were species or subspecies specific. At least seven different serotypes were detected in the fusiform group. Two FA conjugates prepared from antisera to two different strains of *B. fragilis* ss *fragilis* allowed identification of 41 of 43 strains of this microorganism in a blind study. The results of this study suggest that FA techniques can be developed for rapid identification of *Bacteriodes* and *Fusobacterium* species.

INDEX TERMS: \*Anaerobic bacteria, \*Pollutant identification, Fluorescent antibody techniques, Antisera, *Bacteriodes*, *Fusobacterium*.

AMIC-6965 (Continued)

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INDEX TERMS: Cultures, Toxicity, Heavy metals, Salinity, Characterization, *Pseudomonas* multiflagella, Culture media, Isolation.

AMIC-6965

"THE ISOLATION AND CHARACTERIZATION OF A HITHERTO UNDESCRIBED GRAM-NEGATIVE BACTERIUM", Lassiter, C. B., North Texas State University, Denton, Texas, Dissertation Abstracts No. 73-2916, 1972, 144 pp. (Complete report not available from AMIC.)

A unique undescribed gram-negative rod is extensively characterized in this study. The most distinguishing characteristic of the water isolate is a polar tuft of 35-40 flagella that aggregate to function as a single organelle which is visible under phase contrast. Aging cells deposit poly-beta-hydroxybutyric acid granules. It also possesses an unusual exterior membrane outside the cell wall which contains large fibrils of protein. The organism grows optimally at 37 C, under well aerated conditions. The optimum beginning pH is 7.0. This organism does not ferment carbohydrates nor can it utilize them as a source of carbon and energy. It is catalase negative and reduces nitrates to nitrites. It does not liquefy gelatin or attack starch. It is oxidase-positive but does not produce indole or hydrogen sulfide. It has no vitamin or amino acid requirement and grows well when many of the amino acids in the aspartic acid family are offered as a substrate. It was only able to utilize sodium acetate and malic acid as sources of carbon and energy. It is best cultivated in the laboratory in a medium containing 0.2 percent sodium acetate, 0.01 percent calcium chloride, and 0.05 percent sodium acetate. It cannot survive sodium chloride concentrations above 0.5 percent. Metal ions were found to be toxic to the organism, with the divalent metal ions being approximately twice as toxic as the monovalent ions. After careful evaluation of the findings obtained during this study, the new bacterium was subsequently named *Pseudomonas multiflagella*.

AMIC-6966

"THE ABNORMAL MORPHOGENESIS OF ARTHROBACTER MARINUS UNDER HEAVY METAL STRESS", Gonye, E. R., Jr., University of New Hampshire, Durham, New Hampshire, Dissertation Abstracts No. 73-4358, 1972, 173 p. (Complete report not available from AMIC.)

*Arthrobacter marinus* exhibits alternation of its normal coccoid-rod morphogenesis in the presence of heavy metal ions. Ni caused the most dramatic alterations of cellular morphology at a concentration of 0.0002 to 0.0004 M NiCl<sub>2</sub> in a basal medium. Under Ni stress the cell enlarged from a normal 1-2 to over 25 micromicron in diameter. In comparison to bacterial cultures of a non-marine origin related to the genus *Arthrobacter*, *A. marinus* demonstrated tolerance to the highest concentrations of Ni (0.0005 M) in Nutrient Agar. Only *A. marinus* formed megalomorph cells in the presence of NiCl<sub>2</sub> concentrations approaching toxicity. In the Ni-stressed condition a loss of cell envelope amino acids including alanine, glutamic acid and diaminopimelic acid was observed. Ferrichrome, Putrescine, and Spermidine were ineffective in sparing megalomorph formation of *A. marinus* under Ni stress. Scanning electron microscopy by the freeze-etching technique indicated multivacuolation characterized by vacuole membranes, polybetahydroxybutyric acid granules, and a loss of cell envelope protein granules under Ni stress. An ecological survey of three seawater environments, open ocean, coastal, and estuarine, indicated the open ocean heterotrophic microbial population as the most Ni tolerant.

INDEX TERMS: Toxicity, Nickel, Cultures, *Arthrobacter marinus*, Megalomorphosis.



# 5. MICROBIOLOGICAL METHODS

AMIC-6967

"LEUCOTHRIX MUCOR AS AN ALGAL EPIPHYTE IN THE MARINE ENVIRONMENT", Bland, J. A., Indiana University, Bloomington, Indiana, Dissertation Abstracts No. 73-2688, 179 pp. (Complete report not available from AMIC.)

This study was concerned with the marine bacterium Leucothrix mucor as an algal epiphyte and showed 1) that the algal-bacterial relationship is essential for the survival of Leucothrix; and 2) that Leucothrix is an algal epiphyte throughout the intertidal zone. These conclusions were verified by first selecting and field testing a suitable artificial substrate so that the role of the natural living host might be evaluated more easily. Polypropylene strips were chosen, and found to accumulate the benthic flora of the algae which served as a substrate for attachment by L. mucor. The second technique developed was a method to quantitate populations of Leucothrix on any given substrate. The technique is based on the optical design of the microscope being used. Experimental results showed that Leucothrix would attach and grow on the artificial substrate, but was crowded out rapidly by the other attaching benthic forms. When L. mucor was attached to the strips in the laboratory and then incubated in natural environments, growth occurred, but was poor. When given a choice between natural and artificial substrates, Leucothrix attached preferentially to the natural host. Thus the conclusion that the natural host is essential for the survival of Leucothrix was supported. Particular species of red algae, Bangia and Porphyra, were found to be the preferred hosts.

INDEX TERMS: Cultures, Rhodophyta, Artificial substrates, Hosts, Leucothrix mucor, Survival.

AMIC-6979

"THE USE OF COLIPHAGE AS AN INDEX OF HUMAN ENTEROVIRUS POLLUTION IN AN ESTUARINE ENVIRONMENT", Vaughn, J. M., University of New Hampshire, Durham, New Hampshire, Dissertation Abstracts No. 73-4361, 1972, 68 p. (Complete report not available from AMIC)

Parallel examinations of sewage effluents, shellfish and shellfish growing waters for coliphage and enteric virus indicated a wide dissemination of coliphage throughout the estuary, generally occurring in the absence of detectable enteric virus activity. A majority of the enteric virus isolations were observed in samples yielding no coliphage activity. Under controlled conditions, oysters were observed to accumulate more coliphage than enteric virus. Replication of coliphage in the estuary during the summer months was shown to occur when proper host cell was present. Two major coliphage types were observed in field samples based on their reactivity with different Escherichia coli strains. Survival times of coliphage and enteric virus in estuarine waters along with retention values in oysters were shown to be similar with a slight advantage shown by coliphage. Inability to correlate accurately coliphage and enteric virus occurrence in field samples along with the potential for the presence of more than one dominant coliphage type indicated the serious shortcomings of the coliphage indicator system as a method of enteric virus detection. A secondary characterization study was performed on one of the two dominant bacteriophage types occurring in field samples. Nutritional studies revealed an absolute requirement for copper ions.

INDEX TERMS: Bioindicators, Estuaries, Shellfish waters, Coliphages, Enterovirus, Survival, Characterization, Biological samples.

AMIC-6984

"ON THE MICROBIOLOGY OF SLIME LAYERS FORMED ON IMMERSED MATERIALS IN A MARINE ENVIRONMENT", Sechler, G. E., University of Hawaii, Honolulu, Hawaii, Dissertation Abstracts No. 73-5276, 1972, 114 p. (Complete report not available from AMIC.)

Three separate techniques were used to investigate the development of microorganisms in primary films found on various materials immersed in marine waters. These included microbial viable counts by the traditional swabbing method, and total viable counts by two new direct microscopic observation techniques developed during this study: the Teflon overlay technique and the Parlodion filming technique. A variety of test materials were investigated, including glass; plexiglass, wood, zinc, stainless steel, steel, Monel, aluminum, and phosphor-bronze. Test panels were immersed for intervals ranging from 1 hour to 40 days. Although similar varieties of aerobic heterotrophic bacteria were found on all surfaces regardless of their chemical nature, viable population levels were characteristic of each test material during the first few days following immersion. Wood accumulated the greatest number of bacteria in the shortest period of time (within 3 days). Bacteria were found to attach to Teflon membranes over-lying test surfaces by 1 day and to proliferate in situ by at least 4 days. Using the Parlodion filming technique it was found that the number of bacteria per sq cm of test panel could be accurately determined within the first 10 days after immersion. Diatom counts were accurate for 24 days, while extraneous particle counts were valid at least 75 days. No stable diatom population was recognized on any test surface until 6 days after immersion, indicating that bacterial growth may prepare the test surface for the development of unicellular algae. The more chemically passive test panels (glass, plexiglass, and stainless steel) consistently exhibited the highest diatom population level up to 16 days after immersion.

AMIC-6984 (Continued)

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INDEX TERMS: Sampling, Artificial substrates, Sea water, Diatoms, Bacteria, Microscopy, Pollutant identification.

### 3. MICROBIOLOGICAL METHODS

AMIC-6985

"A COMPARATIVE STUDY OF THE DECOMPOSITION OF CELLULOSIC SUBSTRATES BY SELECTED BACTERIAL STRAINS", Segal, M. C., University of Massachusetts, Amherst, Massachusetts, Dissertation Abstracts No. 73-6723, 1972, 141 p. (Complete report not available from AMIC.)

The decomposition of cellulosic materials by cultures of aerobic mesophilic bacteria were investigated using viscometric techniques. Substrates for decomposition studies included insoluble cotton celluloses of various Degrees of Polymerization, raw cotton linters, wood cellulose, hydroxethyl cellulose and soluble carboxymethyl celluloses of various Degrees of Polymerization and Degrees of Substitution. Viscometric methodologies were found to be readily adaptable for quantitative determinations using whole cells. The most active cultures observed included species of *Cellulomonas*, *Cellvibrio* and *Cytophaga*. Cultures showing less activity than the above species included strains of *Bacillus*, *Bacterium*, *Cytophaga*, *Pseudomonas*. Cultures showing little or no activity included strains of *Arthrobacter*, *Bacillus*, and *Cellvibrio*.

INDEX TERMS: Microbial degradation, Cellulose, Viscometric techniques, *Cellulomonas*, *Cellvibrio*, *Cytophaga*, *Bacillus*, *Bacterium*, *Pseudomonas*, *Arthrobacter*.

AMIC-7085

"THE BACTERIA IN AN ANTARCTIC PEAT", Baker, J. H., Smith, D. G., *The Journal of Applied Microbiology*, Vol. 35, No. 4, December 1972, pp 589-596.

Peat samples were collected from 3 depths on the west coast of Signy Island, South Orkney and prepared for analysis by homogenizing, diluting with distilled water, and dropping on to plates of Oxoid Tryptone-Soya Agar. The characters used for identification of the bacteria were: Gram reaction, morphology of old and young cells, pigmentation, motility, position of flagella, endospore formation, action on litmus milk, nitrate reduction, utilization of cellulose, gelatin, starch, chitin, alginate, phenol, alkylamine and alcohol, and fermentation of glucose and lactose. Of a total of 119 strains of bacteria 52 percent belonged to the genus *Brevibacterium*. Twelve other genera were recorded of which numerically the most important were *Arthrobacter*, *Cellulomonas*, *Kurthia* and *Micrococcus*. 62 percent of the collection were psychrophilic, but only 4 strains were obligate psychrophiles. No pattern could be established for the various genera from different depths. The fine structure of an obligately psychrophilic pleomorphic rod from the peat is illustrated and discussed.

INDEX TERMS: Peat, Antarctic, Pollutant identification, Separation techniques, Cultures, Bacteria, Sample preparation.

AMIC-6986

"ELECTRON MICROSCOPY OF FREEZE-ETCHED PREPARATIONS OF *KLEBSIELLA PNEUMONIAE*", Springer, E. L., University of Georgia, Athens, Georgia, Dissertation Abstracts No. 73-5792, 1972, 150 p. (Complete report not available from AMIC.)

The capsule of *Klebsiella pneumoniae* and slime of *Enterobacter aerogenes* A3(SL) were examined by electron microscopy using the freeze-etch technique, which permits observation of hydrated specimens. The capsule of *K. pneumoniae* was found to be composed of several layers containing many fibers 10 nm thick; while the polysaccharide slime of *E. aerogenes* A3(SL) was found to be composed of a diffuse network of fibrils. This work represents the first time the image of a hydrated bacterial capsule or slime has been observed in the electron microscope. The slime of *E. aerogenes* A3(SL) resembled the layered structure of the capsule of *K. pneumoniae*. Freeze-etching of the bacterial plasma membrane revealed a mosaic of glycoprotein granules (10 nm in diameter) on the fracture surface. A capsule of phagocytized *K. pneumoniae* was observed to be a layered structure resembling the freeze-etched preparations of pure cultures of *K. pneumoniae*.

INDEX TERMS: Freeze etching, Electron microscopy, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, Characterization.

AMIC-7098

"DURATION OF VIABILITY AND THE GROWTH AND EXPIRATION RATES OF GROUP E STREPTOCOCCI IN SOIL", Schmitz, J. A., Olson, L. D., *Applied Microbiology*, Vol. 25, No. 2, February 1973, pp 180-183.

In irradiated and nonirradiated feedlot and pasture soils inoculated with group E streptococci, the organism was not recovered 17 days postinoculation from either the irradiated or nonirradiated feedlot soils incubated at 37 C, but survived in the irradiated pasture soils for 24 and 31 days postinoculation. The streptococci survived in irradiated and nonirradiated soils incubated at 4 C for 116 days and in one irradiated feedlot soil for 165 days. The population of streptococci did not increase in either irradiated or nonirradiated soil, and the expiration rate was greater in the soils incubated at 37 and 25 C than at 4 C. With the relatively prolonged duration of viability of group E streptococci in soil at 4 C, it is suggested that soil contaminated with exudate from draining abscesses of infected swine could act as a source of infection during the colder season. (Reprinted from *Applied Microbiology*, Vol. 25, No. 2, February 1973, pp 180-183. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Feedlots, Streptococcus, Soils, Survival, Irradiation.

### 3. MICROBIOLOGICAL METHODS

AMIC-7099

"SIMPLE METHOD FOR CULTURING ANAEROBES", Davis, C. E., Hunter, W. J., Ryan, J. L., Braude, A. I., Applied Microbiology, Vol. 25, No. 2, February 1973, pp 216-221.

A simple, effective method is needed for growing obligate anaerobes in the clinical laboratory. This report describes a pre-reduced anaerobic bottle that can be used for direct inoculation, provides a flat agar surface for evaluation of number and morphology of colonies, and can be incubated in conventional bacteriological incubators. Its efficiency was evaluated by testing it on a routine basis in the clinical laboratory by three criteria: (i) recovery of bacteria that did not grow aerobically but were observed in Gram stains; (ii) isolation of a wide range of pathogenic anaerobic bacteria; and (iii) comparison to a GasPak jar closed immediately after the inoculation of a single specimen and not opened for 48 hr. Each anaerobic culture set consisted of two bottles containing brain heart infusion agar and CO<sub>2</sub>. Gentamicin sulfate (50 micrograms/ml) was added to one of these to inhibit facultative enteric bacilli. Comparison of the anaerobic bottles with an identical aerobic bottle which was also routinely inoculated permitted early identification of anaerobic colonies. Representative species of most anaerobic genera of proven pathogenicity for man have been isolated from this system during 10 months of routine use.

INDEX TERMS: Anaerobic bacteria, Methodology, Pathogenic bacteria, Pollutant identification, Laboratory tests, Water pollution sources, Culturing techniques, Selective media, Culture media, Pathogenicity, *Actinomyces naeslundii*, *Actinomyces odontolyticus*, *Actinomyces eriksonii*, *Vibrio sputorum*, *Propionobacterium*, *Fusobacterium* spp, *Peptococcus*, *Sarcina*, *Catenabacterium* spp, *Streptococcus lanceolatus*, *Ramibacterium* spp, *Bacteroides* spp.

AMIC-7100

"IN-USE EVALUATION OF A COMMERCIALY AVAILABLE SET OF QUALITY CONTROL CULTURES", Douglas, G. W., Balows, A., Rhoden, D., Tomfohrde, K., Smith, P. B., Applied Microbiology, Vol. 25, No. 2, February 1973, pp 230-234.

Increasing awareness of the need for a uniform quality control program prompted an evaluation of a commercially available set (Bact-Chek) of eight organisms. A protocol was designed in which this set of control cultures was tested simultaneously in the clinical microbiology laboratory of a 400-bed hospital (the Berkshire Medical Center) and in the reference laboratories of the Bacteriology Section of the Center for Disease Control. The results indicate that the Bact-Chek organisms are essentially as advertised: they constitute a basic set of cultures for a quality control program in clinical microbiology. Ninety percent of the media and reagents (excluding mycobacterial media and reagents) in the clinical laboratory were checked with this set of eight cultures. Additional cultures not in the set were used to check the remaining 10 percent of the media and reagents. (Reprinted from Applied Microbiology, Vol. 25, No. 2, February 1973, pp 230-234. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Cultures, Pathogenic bacteria, Quality control, Culture media, Bact-Chek, Evaluation.

AMIC-7101

"APPLICATION OF THE MOST-PROBABLE-NUMBER PROCEDURE TO SUSPENSIONS OF *LEPTOSPIRA AUTUMNALIS* AKIYAMI A", Schiemann, D. A., Applied Microbiology, Vol. 25, No. 2, February 1973, pp 235-239.

Suspensions of washed cells of *Leptospira autumnalis* Akiyami A were diluted and used to inoculate three series of 120 tubes for use in determining the reliability of the MPN procedure for estimating the density of the bacteria. Statistical tests demonstrated that with supplemented Fletchers medium used for cell recovery, the MPN procedure is a reliable technique for estimating the density of suspensions of *L. autumnalis*.

INDEX TERMS: Population, Statistical methods, Most Probable Number test, *Leptospira autumnalis*, Estimating.

AMIC-7102

"SPIRAL PLATE METHOD FOR BACTERIAL DETERMINATION", Gilchrist, J. E., Campbell, J. E., Donnelly, C. B., Peeler, J. T., Delaney, J. M., Applied Microbiology, Vol. 25, No. 2, February 1973, pp 244-252.

A method is described for determining the number of bacteria in a solution by the use of a machine which deposits a known volume of sample on a rotating agar plate in an ever decreasing amount in the form of an Archimedes spiral. After the sample is incubated, different colony densities are apparent on the surface of the plate. A modified counting grid is described which relates area of the plate to volume of sample. By counting an appropriate area of the plate, the number of bacteria in the sample is estimated. This method was compared to the pour plate procedure with the use of pure and mixed cultures in water and milk. The results did not demonstrate a significant difference in variance between duplicates at the alpha equals 0.01 level when concentrations of 600 to 1,200,000 bacteria per ml were used, but the spiral plate method gave counts that were higher than counts obtained by the pour plate method. The time and materials required for this method are substantially less than those required for the conventional aerobic pour plate procedure. (Reprinted from Applied Microbiology, Vol. 25, No. 2, February 1973, pp 244-252. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Bacteria, Laboratory equipment, Pollutant identification, Enumeration, Spiral plate method, Culturing techniques.

### 3. MICROBIOLOGICAL METHODS

AMIC-7104

"AUXOTAB--A DEVICE FOR IDENTIFYING ENTERIC BACTERIA", Rhoden, D. L., Tomfohrde, K. M., Smith, P. B., Balows, A., Applied Microbiology, Vol. 25, No. 2, February 1973, pp 264-266.

A multitest system call the Auxotab that uses ten dehydrated reagents on a paper card has been evaluated with 417 known stock cultures of Enterobacteriaceae. In double-blind studies with the Auxotab, 87 percent of the strains tested were correctly identified. Results of this study indicate that there is a need for modification of the product in regard to ease of handling, time required for use, and accuracy of identification of enteric bacteria.

INDEX TERMS: Pollutant identification, Enteric bacteria, Laboratory equipment, Separation techniques, *E. coli*, *Salmonella*, Auxotab Enteric I System, Accuracy, *Citrobacter freundii*, *Klebsiella pneumoniae*, *Providencia*, *Proteus vulgaris*, *Enterobacter hafniae*, *Edwardsiella tarda*, *Serratia marcescens*, *Arizona hinshawii*.

AMIC-7107

"FLUORESCENT ANTIBODY AS A METHOD FOR THE DETECTION OF FECAL POLLUTION: *ESCHERICHIA COLI* AS INDICATOR ORGANISMS", Abshire, A. L., Guthrie, R. K., Canadian Journal of Microbiology, Vol. 19, No. 2, February 1973, pp 201-206.

A study was made to determine whether fluorescent antibody (FA) techniques, with *E. coli* as an indicator organism, offer a potential as a tool for the very rapid detection of fecal pollution in water. Detection of *Escherichia coli* of fecal origin by this method was compared to DMVIC typing and to detection by the E C Broth method. Reliability of this method was tested by reaction of specific *E. coli* antisera with heterologous bacterial species and with isolates from polluted waste water and unpolluted water and soil sources. There was no attempt to detect individual strains or to differentiate between pathogenic and nonpathogenic strains. Detection of *E. coli* was possible by this method in 2 to 3 hr after filtration of a sample of wastewater effluent and placing the filter in lactose broth at 37 degrees C.

INDEX TERMS: *E. coli*, Bioindicators, Pollutant identification, Methodology, Water pollution, Enteric bacteria, Reliability, Waste water (pollution), Fecal pollution, Fluorescent antibody techniques, Fecal coliforms, Culture media, Sample preparation, Accuracy, Heterologous bacteria.

AMIC-7106

"EVALUATION OF THE REDESIGNED ENTEROTUBE--A SYSTEM FOR THE IDENTIFICATION OF ENTEROBACTERIACEAE", Tomfohrde, K. M., Rhoden, D. L., Smith, P. B., Balows, A., Applied Microbiology, Vol. 25, No. 2, February 1973, pp 301-304.

Because of some discrepancies in analytical results, the Enterotube has been redesigned by the manufacturer. A test for ornithine decarboxylase has been added to one compartment, and lactose has been removed from the lysine decarboxylase compartment. The tests for phenylalanine deaminase and dulcitol fermentation have been combined in a single compartment. An iron salt has been added to this same compartment, thus eliminating the need to add ferric chloride reagent in testing for phenylalanine deaminase activity. To improve the decarboxylase reactions and to allow for the observance of gas production from the fermentation of dextrose, the manufacturer covered the compartments containing tests for dextrose fermentation, lysine decarboxylase, and ornithine decarboxylase with a sterile wax overlay. The redesigned Enterotube has been evaluated with 414 unknown Enterobacteriaceae cultures from the stock culture collection of the Center for Disease Control. When the Enterotube was used as recommended by the manufacturer, an average of 96.4 percent of these cultures were correctly identified. Only two groups (*Salmonella* and *Edwardsiella*) were identified with less than 90 percent accuracy (89.2 and 87.5 percent, respectively). The Enterotube now provides a convenient, rapid, and accurate test system for the identification of typically reacting enteric bacteria.

INDEX TERMS: Pollutant identification, Laboratory equipment, Enteric bacteria, Separation techniques, *E. coli*, Enterotube, Accuracy, *Enterobacter hafniae*, *Citrobacter*, *Klebsiella*, *Serratia*, *Providencia*, *Proteus mirabilis*, *Edwardsiella*.

AMIC-7109

"CHEMOTAXONOMIC FATTY ACID FINGERPRINTS OF BACTERIA GROWN WITH, AND WITHOUT, AERATION", Drucker, D. B., Owen, I., Canadian Journal of Microbiology, Vol. 19, No. 2, February 1973, pp 247-250.

Examinations were made of the differences in qualitative and quantitative fatty acid composition between bacterial species and the extent to which such differences are affected by oxygen availability. Fatty acid fingerprints were obtained for *Bacillus megaterium*, *Corynebacterium xerosis*, *Klebsiella aerogenes*, *Neisseria catarrhalis*, *Serratia marcescens*, *Staphylococcus saprophyticus*, and *Streptococcus faecalis*. The test organisms were grown with, and without, aeration. Freeze-dried cells were methylated and the fatty acid methyl esters examined gas-chromatographically. Fatty acid fingerprints were similar for all the test organisms when grown without aeration and the major fatty acid esters had the retention characteristics of palmitate, then myristate (17.0), palmitoleate (16.4), and oleate (18.4). The cultures grown with aeration showed fairly dissimilar fatty acid fingerprints; the major fatty acid peak having a similar retention time to palmitate (16.0), oleate, isopentadecanoate (14.5), or three unknown fatty acids of carbon numbers 18.25, 18.7, and 19.25, depending on the species tested.

INDEX TERMS: Bacteria, Aeration, Oxygen, Gas chromatography, Pollutant identification, Fatty acids, Chemotaxonomy, Fingerprinting.

### 3. MICROBIOLOGICAL METHODS

#### AMIC-7110

"ULTRASTRUCTURE AND CHARACTERIZATION OF AN ASPOROGENIC MUTANT OF CLOSTRIDIUM BOTULINUM TYPE E", Hawirko, R. Z., Chung, K. L., Emeruwa, A. C., Magnusson, A. J. C., Canadian Journal of Microbiology, Vol. 19, No. 2, February 1973, pp 281-284.

The asporogenic mutant, RSpolIIa, showed septum formation and a nearly completed forespore about 4 hr after onset of sporulation. The cells show defects at a few sites of the forespore membrane, an absence of 'germ cell wall', and within 8 hr lysis of the cytoplasm occurred indicating that the mutant was blocked at stage III. Some aberrant envelopes were seen later. Lysis of the asporogenic mutant was inhibited for up to 36 hr by the addition of 2.4 percent glucose or sucrose to the medium, and 80 percent of the cells showed septum formation. A comparison of the phenotypic characteristics of the asporogenic RSpolIIa and the sporogenic MSp plus mutants, as well as the wild type, showed the same ultrastructural changes during the development of the forespore with the accumulation of intracellular iodophilic granules. In addition, the mutants showed specific immunofluorescence and precipitin lines of identity with antisera against the wild-type strain, but unlike the toxigenic wild type, the mutants were nontoxigenic by mouse pathogenicity tests.

INDEX TERMS: Pollutant identification, Electron microscopy, Ultrastructure, Characterization, Clostridium botulinum type E, Pathogenicity, Biochemical characteristics, Toxigenic bacteria.

#### AMIC-7114

"A CHEMOAUTOTROPHIC AND THERMOPHILIC MICROORGANISM ISOLATED FROM AN ACID HOT SPRING", Brierley, C. L., Brierley, J. A., Canadian Journal of Microbiology, Vol 19, No. 2, February 1973, pp 183-188.

A pleomorphic, acidophilic, and chemoautotrophic microbe is described. The cell is bound by a membrane and a diffuse, amorphous layer. The isolate used either sulfur or iron as a source of energy. Morphological and nutritional similarities as well as corresponding thermophilic and acidophilic requirements suggest a relationship to Sulfolobus. The organism tolerates 80 degrees C for longer than 2 hr, but heat resistance is not attributed to a bacterial spore. The maximum temperature for growth is 70 degrees C; the minimum about 45 degrees C. The DNA base composition is 57 plus or minus 3 mole percent GC. Yeast extract enhances growth of the isolate on iron and sulfur substrates, but does not significantly enhance the isolate's respiration rate on these same substrates. The isolate requires induction by sulfur or iron for maximum respiration on these substrates, respectively. Optimum oxidation of elemental sulfur occurred at pH 2.0 and gave a Q sub 02 of 163; oxidation on iron gave a maximum Q sub 02 of 879.

INDEX TERMS: Thermophilic bacteria, Electron microscopy, Pollutant identification, Biological properties, Hot springs, Acidic water, Isolation, Heat resistance, Respiration, Cytological studies, Chemoautotrophic bacteria, Characterization, Bacterial physiology.

#### AMIC-7111

"RAPID EXTRACTION AND PHYSICAL DETECTION OF POLYOMA VIRUS", Thorne, H. V., Wardle, A. F., Canadian Journal of Microbiology, Vol. 19, No. 2, February 1973, pp 291-293.

In the method for the extraction and purification of polyoma virus from mouse embryo cells in tissue culture, monolayer cultures are infected with the virus and incubated at 37 C in Eagle's medium plus 10 percent calf serum containing H-3-thymidine for 5 days in an atmosphere of 5 percent CO<sub>2</sub>. The cultures are solubilized with Triton-X-100 (20 percent w/v), then treated with RNase, DNase, and trypsin before equilibrium centrifugation in CsCl and collection of the virus band. Analysis of the virus band showed that Triton-X-100 extraction is a satisfactory alternative to earlier procedures for producing virus suspensions suitable for further purification. The total time, including that for purification, is reduced from about 5 days to less than 24 hr.

INDEX TERMS: Pollutant identification, Separation techniques, Isolation, Radioactivity techniques, Polyoma virus.

#### AMIC-7131

"UTILIZATION OF CRUDE OIL HYDROCARBONS BY MIXED CULTURES OF MARINE BACTERIA", Kator, H. I., The Florida State University, Tallahassee, Florida, Dissertation Abstracts No. 73-194, 1972, 257 pp. (Complete report not available from AMIC.)

Mixed populations of marine bacteria were isolated from a variety of marine and estuarine locations and maintained on a medium consisting of a sterile crude oil in a nutrient-salts enriched seawater (ESW). They degraded a variety of pure n-paraffins of chain lengths ranging from C-10 to C-30. While visible growth was not evident on selected examples of branched paraffins, aromatics, and heterocyclic compounds, a substrate transfer experiment revealed that some examples of alkyl benzenes, naphthalene, and anthracene supported growth. A variety of crude oils of different composition (Louisiana, Kuwait, and Venezuelan crude oils) were degraded (in ESW) with consistent utilization of n-paraffins C-10 to C-30. Rates of utilization (20 C) for mixed cultures were 2 to 22 times larger in ESW than in unenriched seawater. Activated silica gel column chromatography of degraded crude oils revealed a preferential utilization of saturated paraffins in Kuwait, Venezuelan and Louisiana crude oils. Relative to the absolute weights of saturated paraffins utilized, aromatic-naphthenic utilization in whole crude oils was limited. Intracellular fatty acids produced by bacterial cells grown on crude oils were similar to fatty acid profiles found in nonhydrocarbon grown bacterial cells.

INDEX TERMS: Marine bacteria, Microbial degradation, Sea water, Oily water, Crude oil, Substrate utilization, n-Paraffins, Fate of pollutants, Bacterial physiology, Column chromatography, Activated silica gel, Aliphatic hydrocarbons, Biosynthesis, Fatty acids, Aromatic hydrocarbons.

#### 4. METHODS AND PERFORMANCE EVALUATION

AMIC-6692

"A COMPARISON AT SEA OF MANUAL AND AUTOANALYZER ANALYSES OF PHOSPHATE, NITRATE, AND SILICATE", Hager, S. W., Atlas, E. L., Gordon, L. I., Mantyla, A. W., Park, P. K., Limnology and Oceanography, Vol. 17, No. 6, November 1972, pp 931-937.

Data are presented from a comparison made at sea of automated and manual methods of analysis for phosphate, nitrate plus nitrite, and silicate. An AutoAnalyzer was used for the automated analyses and colorimetric methods, which are described, were used in the manual analyses. Samples were collected in surface buckets and in NIO (Nat. Inst. Oceanogr.) bottles from standard hydrographic depths. Statistical treatment of the results showed that both methods give comparable precision, plus or minus 1 percent, and no significant systematic discrepancies exist between the two technologies for phosphate and silicate analyses. A small discrepancy was found in the nitrate work.

INDEX TERM: Phosphates, Nitrates, Silicates, Colorimetry, Calibrations, Sea water, Precision, On board analysis, AutoAnalyzer.

AMIC-6839

"AN APPLICATION OF MULTIVARIATE ANALYSIS TO COMPLEX SAMPLE SURVEY DATA", Koch, G. G., Lemeshow, S., Journal of the American Statistical Association, Vol. 67, No. 340, December 1972, pp 780-782.

This article adapts a standard method of multivariate analysis to a highly complex sampling design utilizing the method of balanced repeated replication for calculating valid and consistent estimates of variance. An example illustrates that by doing univariate tests no significant differences are found between two groups. However, the multivariate approach yields a significant result because the directions of the differences between two groups with respect to two positively correlated variables are reversed.

INDEX TERMS: Sampling, Multivariate analysis, Estimating, Variance.

AMIC-6776

"SOME DESIGNS AND ANALYSES FOR TEMPORALLY INDEPENDENT EXPERIMENTS INVOLVING CORRELATED BIVARIATE RESPONSES", Wu, S.-C., Biometrics, Vol. 28, No. 4, December 1972, pp 1043-1061.

Designs and analyses are derived for experiments with two experimental units where responses are correlated within and independent among time periods. Fisher's information function for the treatment parameter is maximized to obtain most informative designs for estimating a treatment effect. In the absence of pre-test or historical data on the two units, the most informative design is always a balanced crossover. With historical data, the design is either a continued covariate or an augmented crossover. Efficient analyses of continued covariate and balanced crossover designs are shown to be examples of maximum likelihood (ML) estimation and the analysis of covariance. For the augmented crossover designs, (ML) methods and Wilks' lambda criterion are used to provide efficient large sample procedures. It is shown that use of a most informative design and efficient analysis instead of more familiar designs and analyses can result in a sizable decrease in the variance of the treatment effect estimator.

INDEX TERMS: Treatment effects, Estimating, Most informative design, Variance.

AMIC-6893

"DESIGN AND EVALUATION OF A LOW COST RECORDING SPECTROPOLARIMETER", Simon, S. J., Pearson, K. H., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 620-623.

A Perkin-Elmer Model 141 polarimeter was modified to obtain continuous optical rotatory dispersion data over the entire spectral region of 650-240 nanometers. Standard solution of sucrose in deionized water, neodymium-D(-)PTDA, and Tris(D-(-)-1,2-propylenediamine)cobalt(III) iodide were prepared and the errors between observed and calculated ORD values determined. The results show that the equipment performed satisfactorily.

INDEX TERMS: Aqueous solutions, Recording spectropolarimeter, Errors, Optical rotatory dispersion, Sucrose, Neodymium-D(-)PTDA, Tris(D-(-)-1 2-propylenediamine)cobalt(III) iodide.

#### 4. METHODS AND PERFORMANCE EVALUATION

AMIC-6940

"DATA PROCESSING ESTIMATIONS FOR SAMPLE SURVEYS", Huang, A. Y.-S., University of Georgia, Athens, Georgia, Dissertation Abstracts No. 73-5717, 1972, 150 p. (Complete report not available from AMIC.)

A new method for summarizing sample surveys called Data Processing Estimation is based upon a regression type estimation technique. This method, which generalizes many of the commonly used standard estimation procedures, utilizes regression relationships of the response variable on the vector of descriptive variables to estimate all unsampled units of the finite population and their corresponding sampling variance-covariances factors. As such, this approach allows these individual estimates to be processed so as to be able to evolve an estimate of the mean of any specified subpopulation by only averaging the sum of the sampled and unsampled units of this particular subpopulation. Since this technique also determines for each estimate the associated sampling error factors, an estimated variance of the estimated means can also be determined by simply processing the variances and covariances factors. The advantages of the technique are: the generality of the approach, the dynamic nature of the procedure and the simplicity of the estimation method.

INDEX TERMS: Data processing, Computer programs, Regression analysis, Data processing estimation, Variance, Covariance.

AMIC-7096

"MATCHING TO REMOVE BIAS IN OBSERVATIONAL STUDIES", Rubin, D. B., *Biometrics*, Vol. 29, No. 1, March 1973, pp 159-183.

Several matching methods that match all of one sample from another larger sample on a continuous matching variable are compared with respect to their ability to remove the bias of the matching variable. One method is a simple mean-matching method and three are nearest available pair-matching methods. The methods' abilities to remove bias are also compared with the theoretical maximum given fixed distributions and fixed sample sizes. A summary of advice to an investigator is included.

INDEX TERMS: Bias, Matched sampling.

AMIC-7094

"THE ANALYSIS OF DESIGNED EXPERIMENTS WITH CENSORED OBSERVATIONS", Taylor, J., *Biometrics*, Vol. 29, No. 1, March 1973, pp 35-43.

An observation is said to be 'censored' if we know only that it is less than (or greater than) a certain known value. Sampford and Taylor (1959) proposed an iterative method of analysis for randomized block experiments with Type I censoring, and this method can also be used for other experimental designs. The method has been applied to stimulated data. The results confirm that parameters can be estimated with only a small bias, and that it is possible to do an approximate t-test to compare treatment means. An approximation due to Tiku will reduce the labour of calculation.

INDEX TERMS: Statistical methods, Methodology, Experimental design, Censored observations, Tiku's approximation, Bias, Errors.

AMIC-7097

"THE USE OF MATCHED SAMPLING AND REGRESSION ADJUSTMENT TO REMOVE BIAS IN OBSERVATIONAL STUDIES", Rubin, D. B., *Biometrics*, Vol. 29, No. 1, March 1973, pp 185-203.

The ability of matched sampling and linear regression adjustment to reduce the bias of an estimate of the treatment effect in two sample observational studies is investigated for a simple matching method and five simple estimates. Monte Carlo results are given for moderately linear exponential response surfaces and analytic results are presented for quadratic response surfaces. The conclusions are (1) in general both matched sampling and regression adjustment can be expected to reduce bias, (2) in some cases when the variance of the matching variable differs in the two populations both matching and regression adjustment can increase bias, (3) when the variance of the matching variable is the same in the two populations and the distributions of the matching variable are symmetric the usual covariance adjusted estimate based on random samples is almost unbiased, and (4) the combination of regression adjustment in matched samples generally produces the least biased estimate.

INDEX TERMS: Sampling, Bias, Matched sampling, Regression adjustment.

## 5. INSTRUMENT DEVELOPMENT

AMIC-6785

"QUANTITATIVE METHODS FOR PRELIMINARY DESIGN OF WATER QUALITY SURVEILLANCE SYSTEMS", Beckers, C. V., Chamberlain, S. G., Grimsrud, G. P., Raytheon Company, Environmental Systems Center, Portsmouth, Rhode Island, Report No. EPA-R5-72-001, Contract No. 68-01-0144, November 1972, 226 pp.

This report presents the development and successful demonstration of quantitative methods for preliminary design of water quality surveillance systems. It includes a comprehensive set of quantitative design procedures in handbook form for use within the existing capabilities of governmental water quality agencies. The quantitative methods are intended for use in design of monitoring systems that satisfy an abatement objective. Preliminary design is that portion of the design process that deals solely with the interface between the surveillance system and the monitored system, the river basin. The preliminary design includes specification of station locations, sampling frequencies, and priorities. Incorporation of such practical engineering concerns as cost, reliability and maintainability, and computerization of the procedure are recommended areas for additional development. The methods are based on a systems approach, in which the performance of the total surveillance system is evaluated as a whole. A new method for establishing sampling frequency is developed, based on an unique formulation of the sampling design problem. The development incorporates a "macroscopic" concept that limits consideration of time and space dimensions to scales compatible with an overview of the river basin. Data availability remains a constraint of the method, even under the "macroscopic" concept; methods are developed for estimation of required design data. The quantitative preliminary design methods are demonstrated to function satisfactorily on the Wabash River Basin. It is

AMIC-6875

"SOLID STATE ION-SELECTIVE MICROELECTRODES FOR HEAVY METALS AND HALIDES", Czaban, J. D., Rechnitz, G. A., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 471-474.

Ion-selective microelectrodes with tip diameters of 100-150 microns of the type (1) metal sulfide/silver sulfide, selective towards Ag, Cu, Pb, and Cd cations, and (2) silver halide/silver sulfide, selective towards sulfide, bromide, chloride, and iodide anions were constructed and evaluated in solution volumes of 0.5-1.0 microliters. Details are given for the preparation of materials, forming of membranes, machining of microtips, and construction of probe electrodes. Successful microelectrodes for Ag, Cu, Cd, Pb, chloride, bromide and iodide are reported.

INDEX TERMS: Construction, Heavy metals, Halides, Anions, Cations, Copper, Cadmium, Lead, Chlorides, Bromides, Iodides, Design, Selectivity, Physical properties, Electrical properties, Microelectrodes, Ion selective electrodes, Silver, Sensors, Solid state electrodes.

AMIC-6785

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concluded that the methods incorporated in the User Handbook represent an acceptable method for use by governmental water quality agencies under the existing constraints.

INDEX TERMS: Sampling, Cost analysis, Design criteria, Systems analysis, Monitoring, Water quality standards, Sites, Characterization, Wabash River, Wildcat Creek, Surveillance.

AMIC-6880

"PRACTICAL CONSIDERATIONS FOR DIGITIZING ANALOG SIGNALS", Kelly, P. C., Horlick, G., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 518-527.

Quantitative measures for the quality of digital data can be obtained by attempting to regenerate an analog signal from digital data. The resulting signal can be compared to the original analog signal. Regeneration may be carried out by use of simple operations on the Fourier transform of a continuous representation of digital data. The effects of sampling interval, sampling duration, quantization, digitization time, aperture time, and random variations in sampling interval are examined. The maximum sampling interval and minimum number of samples needed to digitize triangular, exponential, Lorentzian, and Gaussian peaks for given values of maximum absolute error are tabulated. (Reprinted from Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 518-527. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Sampling, Data processing, Errors, Analog to digital conversion, Signal reconstruction, Digitization.



## 5. INSTRUMENT DEVELOPMENT

AMIC-6886

"CALCIUM ION-SELECTIVE ELECTRODE IN WHICH A MEMBRANE CONTACTS GRAPHITE DIRECTLY", Ansaldi, A., Epstein, S. I., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 595-596.

An ion-selective electrode for calcium was constructed as follows. A membrane 0.5 mm thick was prepared by mixing liquid ion-exchanger and polyvinylchloride and pouring into a polypropylene cap from a 50-ml centrifuge tube. The resulting membrane was cemented to a piece of Tygon tubing. A graphite rod (5 mm dia x 90 mm) was force fitted into the tubing so as to contact the membrane. A copper lead wire was press fitted into the graphite. The performance of the electrode was compared with that of the Orion calcium electrode in calcium solutions prepared by dissolving calcium carbonate in hydrochloric acid, neutralizing excess acid, and diluting with distilled water. The electrodes were calibrated using these solutions. Selectivity coefficients were determined by additions of Mg, Ba, Ni, Zn, and Pb ions. The results showed that electrode potential varied linearly with the log of calcium activity in the range of 0.1 to 0.00001 M Ca(2 plus). The electrode was also sensitive below 0.00001 M. Both the PVC/graphite and Orion electrodes were useful in the pH range 5.5 to 10.5 at Ca Ca(2 plus) concentrations as low as 0.0001 M. The PVC/graphite electrode was less sensitive to Na than the Orion. Responses were similar for Ni and Zn, less for Mg and Ba with the PVC/graphite electrode, and more for Pb with the PVC/graphite electrode.

INDEX TERMS: Calcium, Calibrations, Design, Magnesium, Aqueous solutions, Nickel, Zinc, Lead, Ion selective electrodes, Chemical interference, Sensitivity, Barium.

AMIC-6900

"SOUND VELOCIMETERS MONITOR PROCESS STREAMS", Zacharias, E. M., Jr., Franz, D. W., Chemical Engineering, Vol. 80, No. 2, January 22, 1973, pp 101-108.

Sound velocimeters have been developed which can be used to accurately monitor changes in density, specific gravity, bulk modulus, concentration of solutions, solids content, and percent conversion of monomers to polymers in process streams. The instruments employ an electro-acoustic amplifier, which acts as a transmitter and receiver, and a reflector to form a sonic path of fixed length. Transit time of the signal is a function of the path length, and the composition and temperature of the liquid. By proper calibration of the equipment, it can be used for the aforementioned determinations. By combining two velocimeters with the proper electronics, flow rates can be determined. Results have shown that the equipment is accurate and versatile, and provides repeatable results.

INDEX TERMS: Monitoring, Aqueous solutions, Flowmeters, Flow rates, Specific gravity, Density, Suspended solids, Compressibility, Sound velocimeters.

AMIC-6889

"INFLUENCE OF pH ON THE RESPONSE OF A CYANIDE ION SELECTIVE MEMBRANE ELECTRODE", Mascini, M., Analytical Chemistry, Vol. 45, No. 3, March 1973, pp 614-615.

Chemical reactions are given in contrast with those given previously to better describe the effect of pH on the response of a cyanide ion-selective electrode membrane. Values of iodide and cyanide concentrations as a function of pH obtained with the new equation show that the results from previous determinations agree only above pH 9. It is concluded that the response of the cyanide electrode is affected by undissociated HCN which can generate I ions. The same considerations can be used to explain the behavior of cyanide selective membrane electrodes in the presence of a metal ion that binds CN (-) in strong or weak complexes.

INDEX TERMS: Hydrogen ion concentration, Iodides, Chemical reactions, Ion selective electrodes, Cyanides, Accuracy.

AMIC-6935

"(I) OBSERVATIONS OF SMALL PHOTOCURRENTS ON THE DROPPING MERCURY ELECTRODE AND (II) A STUDY OF THE ADSORPTION OF TRIFLUOROMETHYL SULFONATE ON MERCURY", Kreuser, J. C., Georgetown University, Washington, D.C., Dissertation Abstracts No. 72-34,182, 1972, 332 p. (Complete report not available from AMIC.)

Part I of this thesis deals with the photoemission of electrons from mercury in aqueous solutions. An instrument was built to measure photocurrents, and experimental results obtained with it are described. Mathematical methods used to analyze the data are shown in detail. Threshold potentials  $E_{sub T}$  obtained by extrapolation of current-voltage curves do not show the expected dependence on light energy  $E_{sub L}$ , i.e.,  $d E_{sub T} / d E_{sub L}$  is not equal to 1. Several possible sources of error have been investigated, but no satisfactory explanation has been found. Part II deals with the specific adsorption of the trifluoromethyl sulfonate ( $CF_3SO_3(-)$ ) anion on the dropping mercury electrode, using a constant ionic strength approach. Data were taken with the system described in Part I, and analyzed directly by computer. Results indicated adsorption of  $CF_3SO_3(-)$  is similar to that of  $ClO_4(-)$  and  $NO_3(-)$ .

INDEX TERMS: Adsorption, Aqueous solutions, Electrochemistry, Photocurrents, Dropping mercury electrode, Trifluoromethyl sulfonate.

## 5. INSTRUMENT DEVELOPMENT

AMIC-7046

"THE PREPARATION AND ANALYTICAL EVALUATION OF A NEW HETEROGENEOUS MEMBRANE ELECTRODE FOR CADMIUM(II)", Mascini, M., Liberti, A., *Analytica Chimica Acta*, Vol. 64, No. 1, March 1973, pp 63-70.

A new heterogeneous membrane electrode for cadmium ion was prepared by thermomoulding mixtures of cadmium and silver sulfides and polyethylene. Electrodes were prepared with eight different salt preparations. Calibrations were obtained with pure cadmium nitrate solutions and with sodium nitrate additions to the solutions. Only electrodes prepared using Ag<sub>2</sub>S-CdS mixtures precipitated from acidic solutions with hydrogen sulfide and heat treated exhibited Nernstian behavior. This method of preparation, therefore, was chosen. The electrodes prepared in this manner responded linearly down to 0.00001 M Ca(2 plus) and indicated changes in concentrations down to 0.0000001 M. The effects of mixed solvents, pH variations, and interference from Ag, Hg, Cu, H, Pb, Zn, Co, Ni, and Fe were also investigated. The electrode was shown to be useful in both aqueous and nonaqueous solutions.

INDEX TERMS: Calibrations, Aqueous solutions, Hydrogen ion concentration, Cadmium, Ion selective electrodes, Detection limits, Sensitivity, Chemical interference.

AMIC-7054

"SELECTRODE(TM)--THE UNIVERSAL ION-SELECTIVE ELECTRODE. PART IV. THE SOLID-STATE CADMIUM(II) SELECTRODE IN EDTA TITRATIONS AND CADMIUM BUFFERS", Ruzicka, J., Hansen, E. H., *Analytica Chimica Acta*, Vol. 63, No. 1, January 1973, pp 115-126.

A series of cadmium buffers was prepared and used for calibration of a newly developed cadmium Selectrode activated with CdS/Ag<sub>2</sub>S. The electrode exhibits Nernstian response with a sensitivity close to the theoretical limit imposed by the conditional solubility product of cadmium sulphide, i.e., the response is linear up to pCd 9 at pH 6.7 and up to pCd 11 at pH 9. It is suitable for direct measurements of cadmium ion activities as well as for direct compleximetric titrations of cadmium ions. Prolonged storage or use in acid solutions below pH 3 increases the standard potential value and causes a gradual loss of sensitivity, owing to dissolution of cadmium sulphide. When damaged, the ion-sensitive surface can, however, be readily renewed as with any other Selectrode.

INDEX TERMS: Aqueous solutions, Cadmium, Volumetric analysis, Evaluation, Storage, Calibrations, Selectrode, Ion selective electrodes, Sensitivity, Conditioning.

AMIC-7124

"THE ERROR IN MEASUREMENTS OF ELECTRODE KINETICS CAUSED BY NONUNIFORM OHMIC-POTENTIAL DROP TO A DISK ELECTRODE", Tiedemann, W. H., Newman, J., Bennion, D. N., *Journal of the Electrochemical Society*, Vol. 120, No. 2, February 1973, pp 256-257.

Prior studies have shown that nonuniform ohmic, potential drop with rotating disk electrodes will lead to errors in determining kinetic parameters unless special corrections are applied. Linear electrode kinetics have been used to assess the magnitude of the effect. The apparent surface overpotential is taken to be that measured by a reference electrode with the ohmic potential being determined by interruption of the current. Three reference electrode positions--edge, intermediate, and far away--were used. The results show that serious errors in the measurement of electrode kinetic parameters can result from an electrode which is characterized by a nonuniform current distribution. The errors associated with nonuniform current distribution are smallest when the reference electrode is located far from the disk. However, decreasing the error in this manner increases the ohmic drop which must be compensated for by an interrupter technique. Under certain experimental conditions, the compensated ohmic potential can be as large as 90 percent of the total measured overpotential, with a consequent decrease in the accuracy of the surface overpotential.

INDEX TERMS: Electrochemistry, Disk electrodes, Errors, Electrode kinetics, Current distribution.

AMIC-7129

"STANDARD POTENTIALS OF THE SILVER/SILVER-IODIDE ELECTRODE IN AQUEOUS MIXTURES OF ETHYLENE GLYCOL AT DIFFERENT TEMPERATURES AND THE THERMODYNAMICS OF TRANSFER OF HYDROGEN HALIDES FROM WATER TO GLYCOLIC MEDIA", Kundu, K. K., Jana, D., Das, M. N., *Electrochimica Acta*, Vol. 18, No. 1, January 1973, pp 95-103.

The standard potentials (E) of the silver/silver-iodide electrode in aqueous mixtures of ethylene glycol (containing 10, 30, 50, 70 and 90 wt-percent glycol) have been determined from emf measurement of the cell Pt,H<sub>2</sub>(g, 1 atm)/HOAc(m<sub>1</sub>),NaOAc(m<sub>2</sub>),KI(m<sub>3</sub>),solvent/AgI/Ag at nine temperatures ranging from 5 to 45 C. These E values have been utilized to compute free energy ( $\Delta G_{sub t}$ ), entropy ( $\Delta S_{sub t}$ ) and enthalpy ( $\Delta H_{sub t}$ ) changes accompanying the transfer of HI from water to each of the solvents. These values as well as those for HCl and HBr obtained earlier have also been utilized to evaluate  $\Delta S_{sub t}(i)$  for individual ions by a method of 'simultaneous extrapolation', which in turn furnished the values of  $\Delta H_{sub t}(i)$  for these ions. These quantities and also the 'chemical' contributions for the halide ions as obtained by subtracting the 'electrostatic' contribution computed with the Born equation, have been examined in the light of ion-solvent interactions as well as the structural changes of the solvents. The observed results conform with what is expected from the competitive effects of the preferential solvating capacities of water towards halide ions and that of other solvents towards hydrogen ions, and also of the effects arising from the structural changes of the solvents that are likely to occur in the over-all transfer process.

INDEX TERMS: Thermodynamic behavior, Zeta potential, Aqueous solutions, Mixtures, Ethylene glycol, Ion selective electrodes, Silver/silver iodide electrode.