EPA-R4-73-023j

December 1973

Environmental Monitoring Series

Reviews of Current Literature on Analytical Methodology and Quality Control

No. 23

Office of Research and Monitoring

U. S. Environmental Protection Agency

Washington, D. C. 20460

Circulate to: Ferris Benson
Dr. John Knelson
Dr. Anthony V. Colucci

NOTICE

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

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

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

Mr. Luther Garrett
Data and Information Division
Office of Research and Development
Environmental Protection Agency
404 M Street, S.W.
Washington, D.C. 20024

REVIEWS OF CURRENT LITERATURE ON

ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 23

By

Analytical Methodology Information Center (AMIC)
Information Systems Department
Battelle Memorial Institute
505 King Avenue, Columbus, Ohio 43201

Contract No. 68-01-1832

Prepared for
OFFICE OF RESEARCH AND MONITORING
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM
ANALYTICAL QUALITY CONTROL LABORATORY

REVIEWS OF CURRENT LITERATURE ON ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 23 December, 1973

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

CONTENTS

AMIC-8559
"2,4,5-T", Davis, F. S., In: Water-1972, AIChE Symposium Series No. 129, Vol. 69, 1973, pp 269-278.

Available literature on 2,4,5-T and other chlorophenoxy herbicides was reviewed to assess the effect of these pesticides on the environment. Studies of toxicity, carcinogenicity, tumorigenicity, and teratogenicity indicate that they do not pose any undue threat when used properly. The bulk of the evidence gathered to date suggests that the chlorophenoxy herbicides dissipate rapidly from soils where they serve as a carbon source for the microbial population. Plants metabolize or complex the compounds readily. If domestic animals or wildlife ingest forage containing these herbicides, the chemicals are largely excreted via the urine. The possibilities of biological magnification seem remote. In general, the net effect on the environment has been reflected in increased yields of desirable species for man's use.

INDEX TERMS: 2 4 5-T, Pesticide toxicity, Environmental effects, Reviews, Persistence, Plant metabolism, Biological magnification, Fate of pollutants.

AMIC-9152
"DETECTION OF ORGANOPHOSPHORUS PESTICIDES BY IN SITU FLUOROMETRY ON THIN-LAYER CHROMATOGRAMS", Brun, G. L., Mallet, V., Journal of Chromatography, Vol. 80, No. 1, May 30, 1973, pp 117-123.

Solutions of 35 pesticides were prepared to study the effect of heat treatment alone or spraying the plate with an acid or base prior to heating on fluorescence during thin-layer chromatography. For chromatographic separation, the pesticides were spotted 2 cm from the bottom of the plate, eluted with n-hexane-acetone, dried, and when necessary sprayed with appropriate reagent. Plates were then heated at 50 to 250 C for 10 to 120 minutes to establish optimum conditions for fluorescence. Twelve pesticides, azinphosmethyl, Bayrusil, coumaphos, cythioate, Dursban, Fospirate, Imidan, Maretin, menazon, Noltran, phosalone, and zinophos, gave positive results under various experimental conditions, and spectral data, experimental conditions, and detection limits (0.001-1.0 micrograms) are listed. The use of acid or base improved the limits of detection markedly in the case of Bayrusil, but in other cases there was either little improvement or a slight decrease in fluorescence. The importance of the acid- or base-treatment, however, was reflected more by the changes in the fluorescence excitation and emission maxima. In combining the spectral data of both techniques, a great deal more selectivity should be introduced in practice. Another advantage is that the use of acid or base does not have any effect whatsoever on the background of the plate.

INDEX TERMS: Fluorometry, *Organophosphorus pesticides, Detection limits, Thin layer chromatography, Sample preparation.

AMIC-9154
"DETERMINATION OF AMETRINE AND ATRAZINE RESIDUES IN SOIL BY THIN-LAYER CHROMATOGRAPHY", Huss, M., Adamovic, V. M., Journal of Chromatography, Vol. 80, No. 1, May 30, 1973, pp 137-139.

During a study of the degradation of atrazine and ametrine in soil a procedure for thin layer chromatography was developed. Soil samples were extracted by drying, grinding, shaking with ammonia solution and diethyl ether, filtering through sodium sulfate, evaporating, reconstituting with diethyl ether, evaporating to dryness, and dissolving the residue in chloroform. The dissolved residue was spotted on chromatoplate covered with alumina G to which Uramin A fluorescent color had been added. Near this spot, standard solutions of the pesticides were added, a carbon disulfide-ethyl acetate mixture was applied for separation, and the spots observed and marked under UV lights. These layers were scraped off and eluted with methanol in chloroform into tubes and evaporated. Determinations were made by rinsing the tubes with chloroform, partially evaporating, transferring the remainder to a silica gel chromatoplate, and developing the plate with carbon disulfide-ethyl acetate. The areas of the spots of the unknown compounds were compared with those of standards under UV light at 254 nm. Recovery of ametrine and atrazine was 80-83 percent and 100 percent, respectively. The procedure makes possible the detection of as little as 0.005 ppm triazine. Organochlorines do not interfere in the detection of triazines.

INDEX TERMS: Separation techniques, Sample preparation, Thin layer chromatography, Atrazine, Ametrine, Detection limits, Recovery.

AMIC-9155
"POLLUTION OF THE NORTH SEA", Weichart, G., AMBIO, Vol. 11, No. 4, 1973, pp 99-106.

A literature review indicates that pollutants in the North Sea, which serves as a catchment area for part of Britain, Belgium, Holland, Luxemburg, most of Germany, and parts of Switzerland, Czechoslovakia, Denmark, and Norway are introduced by rivers, direct dumping from the coast, ship dumping, fallout, shipping, and offshore oil production. Pollutants identified are salts from potash mines, phosphates from urban sewage, heavy metals (Cr, Mn, Fe, Ni, Cu, Zn, Cd, Hg, Pb, and As), pesticides, nitrates, ammonia, nitrites, PCBs, phenols, mineral oil, titanium dioxide wastes, ash, synthetic fiber waste, enzyme waste, resin waste, acids, sewage sludge, oil, wood and plastic packing material, bottles, kitchen waste, and ship wash water. Although limited data are available, it is concluded that the North Sea is one of the most polluted areas of the world.

INDEX TERMS: Water quality, Industrial wastes, Sewage sludge, Domestic wastes, Sewage disposal, North Sea.

AMIC-9166
"MULTIELEMENT INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL TISSUE USING A SINGLE COMPARATOR STANDARD AND DATA PROCESSING BY COMPUTER", Linekin, D. M., International Journal of Applied Radiation and Isotopes, Vol. 24, No. 6, June 1973, pp 343-351.

Equations were derived which show that multielement analysis can be carried out with a single comparator standard, cobalt, and thereby eliminate multiple runs. A computer technique employing a Fourier transform is employed for data smoothing. Biological samples, human blood, lung, liver, heart, kidney, and mouse tumors were analyzed for Au, Br, Na, Se, Cr, Cs, Ag, Pb, Sn, Zn, Hg, Sb, Sc, Co, and Fe. The samples were prepared by lyophilizing in polyethylene vials, sealing, wrapping the vials with cobalt-aluminum wire, and irradiating at 2 times 10 to the 13th power thermal neutrons/sq cm/sec for 9 hours. Five or six days after irradiation, samples were transferred to counting vials and counted for 100 min in a reproducible geometry 30 cm from a Ge(Li) detector. Concentrations of Au, Br, and Na were determined from these results. The remaining elements were analyzed by making counts for 1000 min at 5 cm from the detector six weeks after irradiation. Two weeks after irradiation, the cobalt wires were cleansed, weighed, and counted in the integral mode in a NaI well counter. The method should be useful for other kinds of samples.

INDEX TERMS: Neutron activation analysis, Heavy metals, Irradiation, Biological samples, Sample preparation.

AMIC-9577
"COLORIMETRIC DETERMINATION OF BORON IN AQUEOUS SOLUTIONS AND IN BOROSILICATE GLASS BY SOLVENT EXTRACTION", Tenney, A. S., Journal of the Electrochemical Society, Vol. 120, No. 9, September 1973, pp 1284-1285.

Boron in aqueous solutions can be determined by adding dilute HF and methylene blue solution to the sample in a polyethylene dropping bottle, shaking, allowing to stand for one hour, adding 1,2-dichloroethane, shaking, allowing to stand overnight, and reading the absorbance in the range 4000-7000 Angstroms with a double-beam recording spectrophotometer. Standards are prepared from boric acid solution. Absorbance curves show three peaks at 4900, 6050-6300, and 6750 Angstroms. Calibration curves show that boron can be determined in the range 0-5 micrograms/ml with an uncertainty of plus or minus 0.05-0.1 microgram/ml using results from the two major peaks. The detection limit is about 0.1 microgram in a 2.0 ml sample. The procedure is simpler than other methods because the double-beam spectrometer subtracts absorbance of the blank and because no procedure is employed to remove interfering ions such as NO3(-), As(5-), and Cr(6-).

INDEX TERMS: Colorimetry, Aqueous solutions, Boron, Sample preparation, Detection limits.

AMIC-9599
"DETERMINATION OF FLUORINE IN PETROLEUM AND PETROLEUM PROCESS CATALYSTS WITH A FLUORIDE ELECTRODE", Wilson, J. N., Marczewski, C. Z., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2409-2412.

Procedures are described which have been developed for the preparation of analytical solutions from crude oils, residues, products, and process catalysts, suitable for the direct measurement of fluoride ion concentration with a fluoride electrode. Finely ground catalyst samples are mixed with the fusion flux, heated, dissolved in water, buffer, and the EMF measured. For crude oil or residues or petroleum products, a quantity is weighed, dried, reweighed, and twice extracted in a separatory funnel. The aqueous phase was further extracted, diluted with water, and neutralized for the measurement of the EMF. Under the conditions described for the analysis of catalysts, the electrode response was Nernstian down to concentrations of 0.4 ppm fluoride, and deviated only very slightly between 0.4 and 0.1 ppm fluoride. The analysis of petroleum samples was completed entirely in the non-Nerstian region of electrode response. Fluorided catalysts were analyzed by the above method and by thorium nitrate titration following a standard Willard and Winter distillation. Generally good agreement was obtained for the 2 methods; the new method was about 5 times as quick and yielded much closer duplicates. Repeatable results were obtained with 10 crude oils using maximum sample sizes of 2.5 g. The limitation of sample size did not apply to distillate products, and determinations are possible at levels as low as 10 parts per billion. The series of light distillates presented show the excellent repeatability of the method over a wide range of fluoride concentrations.

INDEX TERMS: Fluorine, Pollutant identification, Methodology, Petroleum process catalysts, Petroleum products, Sample preparation, Fluoride electrodes.

AMIC-9601
"DIRECT DETERMINATION OF SULFIDE BY RAPID DIRECT CURRENT POLAROGRAPHY", Canterford, D. R., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2414-2417.

The rapid polarographic method for the direct determination of sulfide ion in aqueous solution has been investigated in detail. As well as comparing the sensitivity of the conventional and rapid methods, the possibility of interference from other anions and the effect of pH of the supporting electrolyte have been studied. The detection limit under rapid polarographic conditions was 4 microM sulfide, compared with 3 microM under conventional conditions. Interference studies involved the recording of polarograms of 0.0015 M sulfide in the presence and absence of 0.01 M potentially interfering anion. The rapid technique overcomes the auticipated anionic interferences. It was observed in this work that under both rapid and conventional conditions, the total limiting current is independent of pH, which is an advantage in analytical applications as it eliminates the need to buffer the supporting electrolyte prior to analysis. Supporting electrolytes of pH less than 8 or 9 are not recommended because of the possibility of loss of sulfide as hydrogen sulfide.

INDEX TERMS: Sulfides, Aqueous solutions, Pollutant identification, Chemical analysis, dc Polarography, Detection limits.

AMIC-9604
"SIMULTANEOUS DETERMINATION OF FERROCYANIDE AND FERRICYANIDE IN AQUEOUS SOLUTIONS USING INFRARED SPECTROMETRY", Drew, D. M., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2423-2424.

An infrared spectrophotometric procedure has been described for the simultaneous determination of ferricyanide and ferrocyanide in aqueous solutions. Photographic bleach and fixer samples were analyzed after dilution by a factor of five to bring the concentrations of ferricyanide and ferrocyanide into the analytical range. The spectrum was recorded in the region from 2200 to 2000/cm; the absorbance of ferricyanide was obtained at 2115/cm and ferrocyanide at 2040/cm. Absorbance readings taken from five determinations show standard deviations of plus or minus 0.02A for both species. For the interference work, the study was restricted to the effect of anions and cations most common to the photographic solutions in question. The determination of ferrocyanide was not affected by the presence of sodium thiosulfate and ammonium sulfate either separately or together. Ammonium sulfate had no effect on the determination of ferricyanide. Sodium thiosulfate was not added to the later solutions because of its reaction with ferricyanide.

INDEX TERMS: Aqueous solutions, Chemical analysis, Pollutant identification, Cations, Anions, Infrared spectrophotometry, Ferrocyanides, Ferricyanides, Absorbance, Chemical interference, Sodium thiosulfate, Ammonium sulfate, Molar absorptivity.

AMIC-9605
"COLUMN PARTITION CHROMATOGRAPHIC DETERMINATION OF SODIUM ALKANE MONOSULFONATES", Ali, W. R., Laurence, P. T., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2426-2428.

Alkane monosulfonic acids can be quantitatively separated from di- (and poly-) sulfonic acids over a wide range of carbon number (C9-C20) by a column partition chromatographic method using moist cellulose packing. After washing cellulose with water and drying, a slurry was prepared by blending cellulose with water and petroleum ether. This slurry was packed in the chromatographic columns to a depth of 30 cm. Acid samples from which sodium sulfate was removed were pipetted directly onto the column and the monosulfonic acids eluted with n-butanol in petroleum ether and the disulfonic acids with water. The two fractions were titrated with alkali using phenolphthalein indicator. 2-Propanol was used as cosolvent in titrating the monosulfonic acid fraction. Results of analysis of one sample at intervals over 9 months showed the repeatability of the method to be very good.

INDEX TERMS: Separation techniques, Sodium alkane monosulfonates, Column chromatography, Monosulfonic acids, Sample preparation.

AMIC-9606
"DETERMINATION OF SUBMICROGRAM LEVELS OF PHENOL IN WATER", Goulden, P. D., Brooksbank, P., Day, M. B., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2430-2433.

Continuous distillation equipment which permits the distillation of comparatively large sample flows in an automated system has been used in the determination of phenol in water. The sample flow is distilled and condensed, and after the color formation step utilizing color-developing reagents, the dye is concentrated by extraction into a small solvent flow. This technique has been used with both 4-aminoantiphrine (4AAP) and 3-methyl-2-benzothiazolinone hydrazone (MBTH), at a sample rate of 10 per hour. The limit of detection for the two methods is 0.2 microgram/l phenol. The coefficient of variation of the 4AAP method was 3.6 percent and that of the MBTH method, 2.4 percent. The step that separates the phenols from interfering substances is a single distillation, hence the method is applicable only to those relatively 'clean' waters for which this single distillation constitutes a satisfactory 'clean-up' procedure.

INDEX TERMS: Phenols, Pollutant identification, Methodology, Water analysis, Pollutants, Colorimetry, Solvent extractions, Chemical analysis, Distillation, Aqueous solutions, Separation techniques, Trace levels, Chromogenic reagents, Detection limits, 4-Aminoantipyrine, Chemical interference, 3-Methyl-2-benzothiazolinone hydrazone, Precision.

AMIC-9608
"IMPROVEMENTS IN THE WET OXIDATION-DITHIZONE METHOD FOR DETERMINING LOW MERCURY LEVELS IN FOOD", Nabrzyski, M., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2438-2440.

The wet oxidation-dithizone method for determining mercury was improved by successively combining the dithizonate extracts obtained from two or more digested samples to prepare one sample richer in mercury. The procedure was tested with samples of fish, milk powder, or rice grains which were oxidized in a flask with a mixture of sulfuric, perchloric, and nitric acids, the contents filtered, diluted with water, divided into two portions, and evaporated. Extraction was carried out by transferring samples into separatory funnels, shaking with acetic acid and chloroform, discarding the chloroform layer, and adding diluted dithizone in chloroform. Extracts were then combined, sulfuric acid and sodium nitrite added, the solutions heated to remove chloroform and nitrous acid, diluted with water and hydroxylamine chloride, cooled, acetic acid added, and the solution run into a separatory funnel. This solution was then analyzed by a visual or colorimetric procedure, both of which are described. Investigations with radioactively labeled samples showed that recovery of Hg was god. Analysis of fish digestate to which copper was added showed that copper did not interfere with Hg extraction at pH 0. Since Hg was selectively extracted at this pH, the procedure can be used for simultaneous determination of both elements in foods. The procedure can also be used to analyze natural waters.

INDEX TERMS: Separation techniques, Foods, Fish, Water analysis, Mercury, Biological samples, Sample preparation, Recovery, Chemical interference.

AMIC-9625
"STABILITY OF DILUTE STANDARD SOLUTIONS OF ANTIMONY, ARSENIC, IRON AND RHENIUM USED IN COLORIMETRY", Al-Sibaai, A. A., Fogg, A. G., Analyst, Vol. 98, No. 1171, October 1973, pp 732-738.

The stability of dilute standard solutions of Sb (4 micrograms/ml), As (20 micrograms/ml), Fe (50 micrograms/ml), and Re (5 micrograms/ml) used in colorimetry was studied by colorimetric procedures over a period of two months. The solutions were stored in soda-glass, borosilicate glass, and rigid polyethylene containers. The dilute standard antimony solutions, prepared either by dissolving antimony potassium tartrate in water, or by dissolving elemental antimony in sulphuric acid and diluting the solution with water, were found to be stable (i.e., to deteriorate by less than 3 percent) over a period of 50 days. Antimony solutions containing hydrochloric acid deteriorated rapidly, however. The dilute standard arsenic solutions prepared either by dissolving arsenic(III) oxide in sodium hydroxide solution and then neutralizing the solution with hydrochloric acid, or by dissolving disodium hydrogen arsenate heptahydrate in water, were found to be stable. Arsenic(III) in the former standard solution was oxidized slowly by dissolved oxygen, but the total arsenic present in the solution remained unchanged and could be determined by the molybdenum-blue method. An iron(III) standard solution, 0.06 M in hydrochloric acid and prepared from ammonium iron(III) sulphate, was stable for at least 2 months, as was a standard potassium perrhenate solution in a buffer solution of pH 6. Light in the laboratory and the material of the containers did not adversely affect the solutions reported to be stable.

INDEX TERMS: Stability, Colorimetry, Storage, Iron, Standard solutions, Antimony, Arsenic, Rhenium.

AMIC-9626
"GAS CHROMATOGRAPHIC DETERMINATION OF METAL MERCURY IN FISH, SEDIMENT, AND WATER", Longbottom, J. E., Dressman, R. C., Lichtenberg, J. J., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1297-1303.

Fish, sediment and water samples were analyzed for methyl mercury by a method selected previously by the AQCL, EPA, Cincinnati, Ohio, for analysis of similar type samples. Methyl mercury was extracted as the bromide salt from fish and sediment and as the chloride salt from water samples. All extracts are treated with a common cleanup procedure that resulted in the conversion of methyl mercury to the iodide salt for electron capture gas chromatographic analysis. Recoveries ranged from an average of 88.5 percent for water samples to averages of 95.5 and 96.3 percent for perch and sediments. Methods for controlling contaminants and interferences are discussed for all phases of the method. Particular problems encountered were column poisoning and detector poisoning. When the method was applied to sediment samples collected from a polluted river, a correlation could be established between total mercury and methyl mercury when the concentration of total mercury was in the 0-10 micrograms/g region. For samples of very high inorganic mercury, the correlation failed.

INDEX TERMS: Fish, Sediments, Chemical analysis, Pollutant identification, Water, Methylmercury, Electron capture gas chromatography, Organometallics, Chemical recovery, Chemical interference, Sample preparation, Sample preservation, Accuracy, Precision.

AMIC-9628
"INSTRUMENTAL PARAMETERS FOR DETERMINATION OF MERCURY BY FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY", Hoggins, F. E., Brooks, R. R., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1306-1312.

Studies have been made on the instrumental parameters affecting the performance of the solution-reduction and the thermal-volatilization techniques of flameless atomic absorption for mercury. Optimum conditions established for the solution-reduction technique were: gas flow 5 L/min, stirring time 100 sec, and stirring rate at least 1250 rpm. Optimum conditions for the thermal-volatilization technique were: flow rate 1.5 L/min, heating time 20 sec. The reproducibility and time requirements of the two methods are compared, and guidelines are given on the application of the methods to various kinds of samples such as fish, rocks, sediments, and soils.

INDEX TERMS: Water analysis, Soil analysis, Mercury, Fish, Sediments, Atomic absorption spectrophotometry, Instrumental parameters.

AMIC-9636
"NITRATE DETERMINATION BY A MODIFIED CONWAY MICRODIFFUSION METHOD", Stanford, G., Carter, J. N., Simpson, E. C., Jr., et al., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1365-1368.

The proposed modified Conway microdiffusion method provides for consecutive determinations of NH_4- and NO_3-N in a given aliquot of soil extract. Analysis is performed by pipetting soil extract into the peripheral chamber of an Obrink-Conway microdiffusion dish, pipetting boric acid solution into the center well, adding K_2CO_3 to the outer moat and the sample chamber of the dish, and sealing the dish with the cover. After 16 hrs or more the diffused NH_4N is titrated. Devarda's alloy is then added to the sample chamber, and NO_3-N is titrated after 16 hrs or more. To measure (NH_4(plus)NO_3)-N, Devarda's alloy is added to the sample chamber first. Analyses of primary nitrate standards showed essentially complete recovery in the range of 1 to 20 ppm NO_3-N (4 to 80 micrograms N/aliquot). Results for (NH_4(plus)NO_3)-N and NO_3-N in soil extracts are comparable to those obtained, respectively, by macrodistillation with Devarda's alloy and by the phenoldisulfonic acid colorimetric method. The method is rapid and suitable for routine analyses of soil extracts, the equipment is inexpensive, and no interferences are apparent.

INDEX TERMS: Nitrates, Soil analysis, Ammonium, Conway microdiffusion method.

AMIC-9642
"FORMATION OF PENTAFLUOROBENZYL DERIVATIVES FOR THE IDENTIFICATION AND QUANTITATION OF ACID AND PHENOL PESTICIDE RESIDUES", Johnson, L. G., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1503-1505.

A procedure is described for the preparation and electron capture GLC determination of pentafluorobenzyl ester and ether derivatives of 2,4-D, p,p'-DDA, 1-naphthol, p-nitrophenol, and sec.-amyl phenols. A column cleanup procedure quantitatively isolates the derivatives from excess reagents and other interferences. The method can be used as an aid in the confirmation of the identity of pesticide residues and for the quantitative determination of extracted residues.

INDEX TERMS: Pollutant identification, Pesticide residues, Phenolic pesticides, Chlorinated hydrocarbon pesticides, Pentafluorobenzyl esters, Ethers, Derivatives, Trace elements, Electron capture gas chromatography, Cleanup, Sample preparation.

AMIC-9646
"CONSOLIDATION CHARACTERISTICS OF DREDGING SLURRIES", Salem, A. B., Krizek, R. J., Journal of the Waterways Harbors and Coastal Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 99, No. WW4, November 1973, pp 439-457.

As part of a study of the consolidation characteristics of dredging slurries, dredgings from various sites around Toledo, Ohio, were chemically analyzed. Compositions were as follows: clay, 30-53 percent; total solids, 12.0-43.4 percent; volatile solids, 7.0-14.6 percent; COD, 80-185 mg/gm; organic N, 0.4-5.3 mg/g; ammonia-N, 0.4-1.7 mg/g; phosphates, 0.14.2 mg/g; oil and grease, 0-11.9 mg/g; hydrocarbons, 0-6.8 mg/g; iron, 0.3-31.8 mg/g; cyanide, 0-11.8 micrograms/g; lead, 50-181 micrograms/g; mercury, 0-0.4 micrograms/g; and organic C, 0-7.6 percent. The dredging water contained 0-0.25 ppm Pb, 0-0.85 ppm Cu, 14-32 ppm K, 0-30 ppm Na, 0-132 ppm Ca, and 0-80 ppm Fe.

INDEX TERMS: Heavy metals, Suspended solids, Chemical oxygen demand, Oil, Nutrients, Dredge spoils, Characterization, Grease.

AMIC-9647
"TRACE ORGANICS IN WATER: THEIR ISOLATION AND IDENTIFICATION", Burnham, A. K., Calder, G. V., Fritz, J. S., et al., Journal American Water Works Association, Vol. 65, No. 11, November 1973, pp 722-725.

The new method for isolating and concentrating organic compounds in potable water involves passing the water through a column packed with XAD-2 polystyrene macroreticular resin, and eluting the mostly neutral, sorbed organic compounds with an appropriate solvent (e.g., ethyl ether). After sorption and elution, the solvent is evaporated, the neutral organics separated by gas chromatography, and the individual compounds identified with a mass spectrometer coupled to the column. Gas chromatography is used in quantitative determinations. Except for the MS identification, the method is simple and relatively rapid; the concentration and elution steps are both quantitative, and when tested, all the organic compounds were recovered in their original form. The method has been used for concentrating and identifying neutral organic impurities in the water of two Iowa cities and of the Delaware River. Data on water from Ames, Iowa, show the distribution of hydrocarbons with respect to geographical proximity to a source of pollution.

INDEX TERMS: Organic compounds, Water pollution, Pollutant identification, Isolation, Methodology, Water analysis, Gas chromatography, Trace levels, Data interpretation.

AMIC-9648
"PROBLEMS IN PHENOLICS-MODELING METHODS IN THE OHIO RIVER AT WHEELING, W. VA.", McMichael, F. C., Vigani, F. C., Journal American Water Works Association, Vol. 65, No. 11, November 1973, pp 725-731.

An attempt was made to develop a forecasting function for phenolics in Ohio River water at Wheeling, W. Va., by fitting a time-series model to phenolic data obtained during 1963-1968. The analysis of the data revealed unexpected information on the effect of operator bias on the reported data. Although the historical data are unsuitable for modeling what is occurring in the river, they do reveal information about the activities of the operators in the treatment plant. When the operator bias is removed from the data, there is essentially no structure to the residuals, which indicates no apparent physical or assignable cause relationship in the phenolics-concentration data. The problem that very high concentrations of phenolics affect water quality remains. All available evidence indicates that these rare events follow no deterministic pattern. The extreme values of phenolics concentration may be caused by at least three factors: analytical problems, slugs of nonindustrial origin, and extraordinary industrial discharges.

INDEX TERMS: Forecasting, Mathematical models, Ohio River, Data interpretation, Phenolics.

AMIC-9649
"EVALUATION OF A LOW-COST ARSENIC AND SELENIUM DETERMINATION AT MICROGRAM-PER-LITER LEVELS", Caldwell, J. S., Lishka, R. J., McFarren, E. F., Journal American Water Works Association, Vol. 65, No. 11, November 1973, pp 731-735.

New methods and modifications of known methods of detecting arsenic and selenium in water are described. The modifications are concerned with converting inorganic arsenic and selenium into gaseous hydrides that can be swept into an argon-hydrogen flame of an atomic absorption spectrophotometer. Organic arsenic compounds can be determined like the inorganic compounds after a preliminary digestion with a mixture of nitric, sulfuric, and perchloric acids. Such a procedure does not appreciably interfere with inorganic As determinations. Organic Se was not investigated. Gas-flow rate, Zn concentration, burner head position in relation to light path, and the use of a single-slot burner head were investigated in relation to the decrease of sensitivity and/or extension of the determination range. The previous procedures for these elements are extremely tedious and time consuming, but these new procedures can be performed in a few minutes - thereby permitting routine monitoring of water supplies for As and Se.

INDEX TERMS: Water analysis, Pollutant identification, Methodology, Evaluation, Selenium, Arsenic, Trace levels, Chemical recovery, Chemical interference, Atomic absorption spectrophotometry.

AMIC-9650
"TREATMENT OF OILY AND METAL-CONTAINING WASTEWATER", Lin, Y. H., Lawson, J. R., Pollution Engineering, Vol. 5, No. 11, November 1973, pp 45-48.

Data are presented in a tabular form which cover the major sources of oily and metal-containing wastes, characteristics of selected industrial wastewaters, and effluent concentrations after various methods of waste treatment.

INDEX TERMS: Waste water (pollution), Properties, Oil wastes, Industrial wastes, Water pollution sources, Liquid wastes, Effluents, Chemical wastes, Oily water, Metal wastes.

AMIC-9654
"BRAVE NEW WORLD OF TOC AND TOD", Industrial Water Engineering, Vol. 10, No. 5, September-October 1973, pp 13-17.

Because of the shortcomings of BOD and COD tests and time required to obtain results, they are unsatisfactory for real-time control of treatment plant effluents. As a result total organic carbon (TOC) and total oxygen demand (TOD) are being used for this purpose. Although there is no rigorous correlation between TOC and BOD or COD, because of the general consistency of effluent compositions, they all show the same trends. TOC is based on the automatic measurement of the oxygen required to combust the impurities of a water sample. TOD correlates well with COD when interferences are not present. The correlation between TOD and BOD depends on the specific sample. Typical examples of applications of TOC and TOD are discussed and several commercially available instruments are described.

INDEX TERMS: Biochemical oxygen demand, Chemical oxygen demand, Monitoring, Sewage effluents, Total organic carbon, Total oxygen demand.

AMIC-9661
"IDENTIFYING SOURCE OF PETROLEUM BY INFRARED SPECTROSCOPY", Lynch, P. F., Brown, C. W., Environmental Science and Technology, Vol. 7, No. 13, December 1973, pp 1123-1127.

The infrared spectra of over 50 samples of crude oils, fuel oils, and other petroleum products have been measured using a Perkin-Elmer Model 521 infrared spectrometer. Bands in the 650-1200/cm spectral region were characteristic of each sample and can be used to identify the source of the sample. Computer analysis of absorptivities of 21 selected bands was used to match unknowns with the correct knowns by taking the ratios of known to unknown absorptivities. The method was demonstrated on laboratory samples and on a sample taken from an actual oil spill. The method of analysis is rapid and it provides unambiguous identification for petroleum products, eliminating the need for adding tracer materials to petroleum products or for other methods of analysis.

INDEX TERMS: Water pollution sources, Oil pollution, Oil spills, Pollutant identification, Water pollution, Chemical analysis, Computers, Data processing, Methodology, Infrared spectrophotometry, Data interpretation, Crude oil, Fuel oil, Petroleum products, Oil characterization, Kerosene, Petroleum distillates, No. 2 fuel oil, Absorptivity.

AMIC-9663
"TEST FOR ANTICHOLINESTERASE MATERIALS IN WATER", Gamson, R. M., Robinson, D. W., Goodman, A., Environmental Science and Technology, Vol. 7, No. 13, December 1973, pp 1137-1140.

A simple device containing paper impregnated with cholinesterase is reported for detection of organophosphorus inhibitors in the ppb to ppm range in water. The device is a polypropylene 'ticket', 1 in. wide, 2 in. long, and 1/16 in. thick, round at one end, and square at the other. The round end is wetted with buffer (pH 8) and the substrate (2,6 dichloroindophenyl acetate in ligroine) is added from a dispenser. After a short waiting period, the round end is observed for blue color development which serves as a control for the presence or absence of enzyme activity. The appearance of the blue color indicates that the system is operating properly; it also means that a cholinesterase inhibitor is not present. No change in color is indicative of the presence of a hazard. Optimum performance is obtained at 20 C and pH 8. Under these conditions, the enzyme is completely inhibited in 20 min or less by 10 ppb up to 1 ppm depending on the inhibitor. Comparison of inhibition data with rate constants indicates that the sensitivity of the device to any given inhibitor can be estimated if the rate constant value is known for that inhibitor with horse serum cholinesterase. Experimental data are presented on studies with the organophosphorus esters isopropyl methylphosphonofluoridate (Sarin), O-ethyl S(2-diisopropylamino)ethyl methylphosphonothioate, and O,O-diethyl O-p-nitrophenyl phosphorothioate (parathion).

INDEX TERMS: Pollutant identification, Methodology, Organophosphorus compounds, Water pollution, Water analysis, Enzymatic inhibitors, Anticholinesterases, Horse serum cholinesterase, Detection limits, Sensitivity, Trace levels, Chemical indicators.

AMIC-9667
"A SYRINGE GAS-STRIPPING PROCEDURE FOR GAS-CHROMATOGRAPHIC DETERMINATION OF DISSOLVED INORGANIC AND ORGANIC CARBON IN FRESH WATER AND CARBONATES IN SEDIMENTS", Stainton, M. P., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1441-1445.

A simple, rapid method is described for determining dissolved inorganic carbon in water. A 20-cu cm sample of water is drawn into a 50-cu cm polypropylene syringe and acidified by injection of 1-cu cm of dilute sulphuric acid. Twenty-nine cubic centimeters of helium at atmospheric pressure is injected into the syringe followed by 10 sec of manual agitation to partition CO2 between gas and liquid phase. The gas phase containing 60 percent of CO2 from the sample is then analyzed by gas chromatography. This method has been used to determine dissolved inorganic and organic carbon in Canadian Shield waters and to determine total carbonates in sediments.

INDEX TERMS: Gas chromatography, Freshwater, Sediments, Water analysis, Soil analysis, Dissolved inorganic carbon, Dissolved organic carbon, Syringe gas-stripping method, Sample preparation, Sensitivity, Chemical recovery, Precision.

AMIC-9671
"DISTRIBUTION AND UPTAKE OF ARTIFICIALLY INTRODUCED RADIUM-226 IN A SMALL LAKE", Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1485-1490.

Radium-226 was added to lake 227 of the Experimental Lakes Area in August, 1970, so that gas-exchange rates between the atmosphere and the lake could be traced by its gaseous daughter product radon-222. Although the radium was expected to remain in solution it did so for only about 1 month. An investigation was made to locate the radium after it left solution. Water and deep water surface sediment samples and algal (epilithophyton) and detrital material were analyzed in order to determine radium distribution. Since Ra was found to be highly concentrated in rock scrapings, an attempt was made to correlate Ra uptake with epilithophyton carbon fixation. Algal-detrital material from nonlabelled lakes (lakes 239 and 240) with natural radium activities (0.1 dpm/liter) was analyzed for Ra by liquid scintillation counting in a dioxane fluor. In lake 227 radon activity decreased toward the center, thus confirming that the radon source was the littoral zone. Radium activity of rock scrapings and surface sediment further indicated that radium was concentrated on the littoral bottom surface. Results of two successive scrapings of the same rocks from lake 227 showed that the radium analyzed in these scrapings was concentrated in the algal or detrital coating of the rock and not from the rock itself. Two years after labelling lake 227, activities in the surface sediments below 8 m were as high as 660 dpm/g of dried sediment. Radium uptake had no relation to the carbon fixation rate. Laboratory tests determining radium removal rate indicated no significant difference between removal by unaltered algal-detrital material and boiled algal-detrital material.

AMIC-9671 (Continued) Card 2/2

INDEX TERMS: Lake sediments, Absorption, Ecological distribution, Detritus, Chemical analysis, Path of pollutants, Ra-226, Epilithophyton, Gas exchange rates, Algal counts, Pollutant removal.

AMIC-9675
"MOVEMENTS OF PHOSPHORUS BETWEEN ITS BIOLOGICALLY IMPORTANT FORMS IN LAKE WATER", Lean, D. R. S., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1525-1536.

A model consistent with the kinetics of phosphorus in epilimnetic lake water was developed. Adding P-3204 to lake water and separating the major forms of dissolved phosphorus by Sephadex gel filtration showed that the exchange mechanism between inorganic phosphate and the particulate fraction predominates. At the same time, a low-molecular-weight phosphorus compound is excreted which combines with colloids in lake water, releasing phosphate from the colloid and making the phosphate available for 'transfer' again. This rapid cycling of phosphorus between the four principal forms - the particulate fraction, the low-molecular-weight P compound, colloidal P, and phosphate - appears to contribute to formation of colloids in lake water. No direct complexing of phosphate to the colloid was observed. Only in the presence of algae, bacteria, and other particulate matter did the radioactive phosphorus move to the low-molecular weight and the colloidal forms. The low-molecular-weight compound is negatively charged, as is the colloidal P, but to a lesser degree. Both are removed by anion exchange materials along with phosphate, but the rate that they move into the fraction removed by membrane filtration is different from that for phosphate. This complicates measurements of transfer and makes previous studies on utilization of dissolved organic phosphorus of doubtful value since corrections for filter retention were rarely, if ever, made.

INDEX TERMS: Phosphorus, Path of pollutants, Lakes, Epilimnion, Kinetics, Cycling nutrients, Movement, Model studies.

AMIC-9682
"USE OF A SILVER-SULFIDE ELECTRODE FOR STANDARDIZING AQUEOUS SULFIDE SOLUTION IN DETERMINING SULFIDE IN WATER", Barica, J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1589-1591.

A simplified method is described for standardizing aqueous sulfide solution in determining sulfide in water. A silver-sulfide electrode is used to detect the endpoint in titration of standard solution of sodium sulfide by silver nitrate. The method makes it possible to perform potentiometric titration within 60 sec by adding the titrant until the potential reading is between -150 and 0 mv, without plotting the data on a graph. The concentrations of sulfide solutions determined by this method were within plus or minus 0.24 mg S (SD), or 3 percent, of the values obtained by the conventional iodometric standardization.

INDEX TERMS: Sulfides, Aqueous solutions, Water analysis, Pollutant identification, Silver/sulfide electrodes, Standardization.

AMIC-9685
"LABORATORY STUDIES OF THE ACCOMMODATION OF SOME CRUDE AND RESIDUAL FUEL OILS IN SEA WATER", Gordon, D. C., Jr., Keizer, P. D., Prouse, N. J., Journal of the Fisheries Research Board of Canada

To understand more fully the potential availability of petroleum hydrocarbons to marine organisms inhabiting the water column (both in the natural environment and in experimental situations devised to test the effects of hydrocarbons), a series of laboratory experiments were undertaken to study the accommodation of three different types of oil in seawater under different experimental conditions. Concentrations of oil accommodated in seawater under laboratory conditions are directly related to the amount added and the degree of turbulence, but inversely related to temperature. The major fraction (87-98 percent) of this oil is in particulate form ranging in size from about 1 to 30 microns, presumably small droplets. The exact ratio of the particulate to subparticulate fractions is directly related to the apparent viscosity of each individual oil. Of the total amount of oil initially added, 9-15 percent appeared in seawater at the end of the 7-days experiments. Except in the proximity of recent oil slicks, the oil concentrations observed in these experiments are one to two orders of magnitude greater than the concentrations generally observed in the marine environment off eastern Canada.

INDEX TERMS: Laboratory tests, Sea water, Oil pollution, Turbulence, Water temperature, Crude oil, Residual fuel oil, Accomodation, Fate of pollutants, Particulate oil, Subparticulate oil, Aliphatic hydrocarbons, Petroleum hydrocarbons.

AMIC-9686
"FACTORS AFFECTING THE BEHAVIOR OF FIVE CHLORINATED HYDROCARBONS IN TWO NATURAL WATERS AND THEIR SEDIMENTS", Oloffs, P. C., Albright, L. J., Szeto, S. Y., et al., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1619-1623.

Water samples from the Fraser River and Georgia Strait, British Columbia, were treated with different chlorinated hydrocarbons and incubated for up to 12 weeks at 13 C. (1) In the presence of bottom sediments from the same locations as the waters, no residues were found to escape into the atmosphere. (2) With the exception of lindane in ocean water, all detectable residues had moved into the sediments after 6 weeks. (3) Most of the lindane was metabolized. (4) Sterilization of the waters and sediments prevented the metabolism of lindane but had little effect on DDT and DDD. (5) Agitation of water samples containing gamma-chlordane, incubated without sediment, had no effect on its disappearance, but the presence of 0.01 percent of a nonionic surfactant retarded this almost completely.

INDEX TERMS: Bottom sediments, Pesticide kinetics, Environmental effects, Water pollution, Fraser River, Georgia Strait, Chlorinated hydrocarbons.

AMIC-9688
"OCCURRENCE OF DDT RESIDUES IN BELUGA WHALES (DELPHINAPTERUS LEUCAS) FROM THE MACKENZIE DELTA, N.W.T", Addison, R. F., Brodie, P. F., Journal of the Fisheries Research Board of Canada, Vol. 130, No. 11, November 1973, pp 1733-1736.

Tissue samples from 14 Beluga whales were analyzed for the presence of pesticide residues as a possible reflection of the level of pesticide contamination of the marine environment in the Mackenzie Delta area. Blubber, middorsal muscle, and liver samples were taken and preserved in formalin or frozen. Ten grams were dissected from the interior of each sample, extracted by homogenizing with an acetonitrile-based system, evaporated to dryness for gravimetric lipid determination. Additional aliquots were cleaned up by chromatography on Florisil and analyzed by gas-liquid chromatography. Only residues of the DDT group were detected with certainty. Muscle and liver contained p,p'-DDE and p,p'-DDT; total residue concentrations in these tissues were approximately 0.01 and 0.02 ppm fresh weight, respectively. Blubber contained p,p'-DDE, p,p'-DDT, and o,p'-DDT; total residue content was approximately 2-4 ppm fresh weight.

INDEX TERMS: Marine animals, Pesticide residues, Pollutant identification, DDT, Chlorinated hydrocarbon pesticides, Beluga whales, Animal tissues.

AMIC-9700
"ACCUMULATION AND MOVEMENT OF MIREX IN SELECTED ESTUARIES OF SOUTH CAROLINA, 1969-71", Borthwick, P. W., Duke, T. W., Wilson, A. J., Jr., et al., Pesticides Monitoring Journal, Vol. 7, No. 1, June 1973, pp 6-26.

In In conjunction with a fire ant eradication program during which mirex was aerially applied to coastal areas near Charleston, S. C., field studies were conducted to monitor the movement and accumulation of mirex in the estuarine system. Collections of background and periodic posttreatment samples of water, bottom sediments, shrimp, crabs, fish, and estuary-dependent birds and mammals were analyzed for mirex using electron-capture gas chromatography. The data revealed that (1) mirex was translocated from treated lands and high marsh to estuarine biota - all animal classes sampled contained mirex; and (2) biological concentration of mirex occurred - especially in predators such as racoons and birds. Mirex residue ranges for respective sample categories were: water (less than 10.01 ppb); sediment (0-0.07 ppm); crabs (0-0.60 ppm); fishes (0-0.82 ppm); shrimps (0-1.3 ppm); mammals (0-4.4 ppm); and birds (0-17.0 ppm). No mass mortalities were observed during the study.

INDEX TERMS: Pesticide kinetics, Pesticide residues, Bottom sediments, Estuaries, Path of pollutants, Biota, Chlorinated hydrocarbon pesticides, Fish, Water birds, Shellfish, Bird eggs, Mammals, Mirex, Bioaccumulation, Animal tissues, Data interpretation, Chemical recovery, Sample preparation.

AMIC-9702
"INTERNATIONAL COOPERATIVE STUDY OF ORGANOCHLORINE AND MERCURY RESIDUES IN WILDLIFE, 1969-71", Holden, A. V., Pesticides Monitoring Journal, Vol. 7, No. 1, June 1973, pp 37-52.

A two-part collaborative study of organochlorine pesticides, polychlorinated biphenyls (PCB's), and mercury residues was carried out by 26 laboratories in 12 countries. The first part involved the analysis of three test samples containing organochlorine residues and one group of test samples containing mercury. One organochlorine sample contained seven pesticides or derivatives added to corn oil; a second was a standard solution of a PCB formulation in hexane; and the third a homogenate of cormorant (Phalacrocorax carbo) muscle containing mainly PCB's. With few exceptions, agreement among the analysts involved was reasonably good and acceptable for monitoring wildlife residues. Coefficients of variation for the various organochlorines were from plus or minus 10 percent to plus or minus 17 percent. The test samples containing mercury included a group of freeze-dried homogenates of the muscle tissue of pike (Esox lucius) and an ampoule of methylmercury dicyandiamide in water; the samples were analyzed for total and methylmercury. Again, agreement was reasonably good, although only four laboratories reported total mercury values and eight, methylmercury values. The second part of the program required the sampling and analysis of several species of wildlife from both terrestrial and aquatic environments, including fish, shellfish, and the eggs of birds. Samples were taken in specified numbers and at specified times, from both areas considered to be free of any pesticide usage and areas known or believed to be seriously polluted. Eggshell thickness indices were also determined. The results of the wildlife analyses demonstrated the difficulties in selecting species appropriate for international monitoring programs, in identifying (before analysis) areas of high

AMIC-9702 (Continued) Card 2/2

contamination, and in relating concentrations to measurable biological effects. Samples of any one species from areas regarded as unpolluted in different countries contained a wide range of organochlorine concentrations. The PCB levels in mussels from such areas contained 0.01 to 0.67 mg/kg, and DDE levels in herring ranged from less than 0.01 to 0.03 mg/kg. The differences between residue results for samples in this second part of the study were much greater than the analytical variations estimated from the first part of the study.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Pesticide residues, Mercury, Heavy metals, Polychlorinated biphenyls, Wildlife, Shellfish, Freshwater fish, Water birds, Pollutants, Pollutant identification, Bird eggs, Bioaccumulation, Animal tissues, Interlaboratory studies, Collaborative studies.

AMIC-9703
"PESTICIDE RESIDUES IN NATURAL FISH POPULATIONS OF THE SMOKY HILL RIVER OF WESTERN KANSAS", Klaassen, H. E., Kadoum, A. M., Pesticides Monitoring Journal, Vol. 7, No. 1, June 1973, pp 53-61.

Fish populations from five locations in an area of low pesticide use are described and their pesticide residue levels are given for the 3-year period, 1967-69. The study was carried out in a dry-land farming area with developing irrigation on the Smoky Hill River of west central Kansas. Fish samples were collected by electro-shocking at five stations along an 80-km section of the river. A total of 393 samples of the commonly occurring species (whole body, flesh, gonads) were analyzed for organochlorine residues by electron capture gas chromatography. During the 3 years, 24 species of fishes were collected; 15 of these species were common in the study area. The number of species, number of individuals collected, and species diversity are presented for each station with respect to time. No endrin, aldrin, or heptachlor residues were detected in any sample. Heptachlor epoxide was found in trace amounts in three samples. Dieldrin was present in 15 percent of the samples, usually in amounts less than 0.01 ppm. DDT and its metabolites were detected in 75 percent of the samples, usually at only several hundredths of a part per million. The fish populations collected were considered 'clean' from pesticides when compared with fishes from other surveys. These data form a baseline for future comparison as the agriculture changes in this area.

INDEX TERMS: Fish populations, Pesticide residues, Chlorinated hydrocarbon pesticides, Freshwater fish, Smoky Hill River, Metabolites, Background levels, Animal tissues, Sample preservation, Sample preparation.

AMIC-9705
"PESTICIDES IN SELECTED WESTERN STREAMS - 1968-71", Schulze, J. A., Manigold, D. B., Andrews, F. L., Pesticides Monitoring Journal, Vol. 7, No. 1, June 1973, pp 73-84.

This paper presents data from the U. S. Geological Survey program for monitoring pesticides in the streams of the Western United States for the period October, 1968 to September, 1971. Samples were collected in 1-quart glass bottles sealed with a Teflon-lined screw cap. Two bottles were collected at each of 20 sampling stations, one for insecticide analysis and the other for herbicide analysis. All analyses were performed by gas chromatography. Compounds determined include the common chlorinated insecticides and herbicides. Heptachlor and its epoxide were not detected during the 3-year period, and aldrin was found only once. DDT was the most frequently occurring insecticide, and 2,4,5-T the most common herbicide. The amounts observed were small; the maximum concentration of an insecticide was 0.46 microgram/liter for DDT, and of an herbicide 0.99 microgram/liter for 2,4-D. Concentrations were highest in water samples containing appreciable amounts of suspended sediments. Graphs are included to show insecticide and herbicide occurrences for the 4-year period (October, 1967-September, 1971) during which all 20 monitoring stations have been in operation. Beginning in July, 1970, the phosphorothioate insecticides - parathion, methyl parathion, malathion, and diazinon - were determined monthly on all samples. Malathion was not found during this period. Polychlorinated biphenyl (PCB's) compounds which were monitored for beginning in October, 1969 were also detected at two stations.

INDEX TERMS: Natural streams, Chlorinated hydrocarbon pesticides, Phosphothioate pesticides, Polychlorinated biphenyls, Pollutant identification, Insecticides, Herbicides, Water analysis, Gas chromatography, Sample preparation.

AMIC-9721
"SYSTEM SIMULATION TO IDENTIFY ENVIRONMENTAL RESEARCH NEEDS: MERCURY CONTAMINATION", Anderson, A. A., Anderson, J. M., Mayer, L. E., OIKOS, Vol. 24, No. 2, 1973, pp 231-238.

Data on the distribution and translocation of mercury in the environment are summarized to determine whether the mercury balance has been disturbed by man's activities and whether additional research is required. A model based on System Dynamics methodology was developed to identify research needs, assess the persistence of mercury as a pollutant, and analyze policies for controlling mercury pollution. This model traces the path of mercury from its natural sources to its natural sinks. By superimposing the effect of man's activities on the natural flow of mercury, the effect of industrial and agricultural consumption on mercury contamination in the world system can be examined. Although the model is not complete several conclusions result from the available data: Mercury pollution of soils and streams is primarily a local problem; mercury levels in marine fish may rise above acceptable levels if the consumption of resources with one ppm mercury or more continues. Further experimental research is needed to obtain data on the mercury content of fossil fuels, on possible natural mechanisms for the release of mercury into the air, and on conversion mechanisms for methylation of mercury in the soil, ocean, and fish sectors.

INDEX TERMS: Model studies, Mercury, Path of pollutants, Environmental effects, Water pollution effects, Soils, Fish, Mud, Air, Air pollution, Heavy metals, Cycles, Data interpretation.

AMIC-9723
"TRACE METALS IN SEDIMENTS OF NEW YORK BIGHT", Carmody, D. J., Pearce, J. B., Yasso, W. E., Marine Pollution Bulletin, Vol. 4, No. 9, September 1973, pp 132-135.

Sediment samples from seventy-five stations around the waste disposal sites in the New York Bight were analyzed for the presence of Cr, Cu, Pb, Ni, and Zn. Twenty-five other sites in the Hudson Shelf Valley and in Delaware Bay were sampled for comparative purposes. A Smith-McIntyre bottom grab was used for sampling. Aliquots were removed, frozen, oven-dried at 105 C, extracted in 8 N HNO_3 for 30 min, and filtered to a constant volume. The resulting solutions were analyzed by atomic absorption. There was a greater variation in heavy metal concentrations in and near the dumping areas than in the uncontaminated regions. In severely polluted areas, metal concentrations occasionally varied as much as 50 percent between subsamples taken from the same grab sample. On comparing metal concentrations at different depths to a depth of 15 cm, no consistent trend was discernible.

INDEX TERMS: Trace elements, Bottom sediments, Chromium, Copper, Lead, Nickel, Zinc, Waste disposal, Heavy metals, Pollutant identification, Sewage sludge, New York Bight, Dredge spoils.

AMIC-9724
"TRACE METALS IN THE NORTH SEA", Dutton, J. W. R., Jefferies, D. F., Folkard, A. R., et al., Marine Pollution Bulletin, Vol. 4, No. 9, September 1973, pp 135-138.

The distribution of zinc, manganese, nickel, copper and cadmium in water and biological material has been measured in the southern North Sea and Straits of Dover, and off the north-east coast of England. Analyses were conducted by means of an atomic absorption technique. Zn, Mn, Cu, Ni, and Cd were measured in all samples. Fe was additionally analyzed in shoreline and biological samples; Pb and Ag were measured in the biological material only. With the exception of cadmium, the metals measured showed onshore-offshore gradients to varying degrees, the highest values generally occurring in the vicinity of estuaries. The concentration of cadmium varied between less than 0.1 and 1.4 micrograms/l but its distribution could not be contoured with any degree of confidence. These investigations provide baseline values against which future pollution changes can be measured.

INDEX TERMS: Baseline studies, Heavy metals, Surface waters, Chemical analysis, Marine algae, Biological materials, North Sea, Background levels.

AMIC-9725
"TRACE METALS IN CARBONATE AND ORGANIC RICH SEDIMENTS", Segar, D. A., Pellenbarg, R. E., Marine Pollution Bulletin, Vol. 4, No. 9, September 1973, pp 138-142.

During an investigation of the trace transition metal distributions within carbonate and organic rich near-shore and estuarine sediments, three separate geographical locations, Card Sound and Turkey Point, Florida and Mangrove Lake, Bermuda, have been studied. The sediment samples were collected with hand coring tubes and homogenized. A subsample was freeze-dried to a constant weight and analyzed by flameless atom reservoir atomic absorption spectrophotometry after acid dissolution and solvent extraction of the metal pyrrolidine dithiocarbamates. The results obtained from the three areas show that the accumulations could be ascribed to local human activities, though their nature varied widely from one site to another.

INDEX TERMS: Bottom sediments, Heavy metals, Pollutant identification, Chemical analysis, Trace elements, Carbonates, Estuarine environment, Organic soils, Clays, Water pollution sources, Marine environment.

AMIC-9727
"POLLUTION STUDIES IN THE CLYDE SEA AREA", Steele, J. H., McIntyre, A. D., Johnston, R., et al., Marine Pollution Bulletin, Vol. 4, No. 10, October 1973, pp 153-157.

The water quality and the effects of pollution on the Firth of Clyde are being monitored by the Department of Agriculture and Fisheries for Scotland. Surveys were made of the plankton, benthic and fish populations of the area. Pollutants identified were sewage sludge; heavy metals such as Cu, Pb, Zn, Cd, and Hg; trace organics; PCB's; pesticides such as dieldrin and DDT; crude fuel and lubricating oils; and heated water. Levels of metals in fish, shellfish, sediments, zooplankton, and water and the levels of dieldrin, DDE, TDE, DDT, and PCB in fish are listed. Bioassays with flatfish, plaice, the bivalve Tellina tenuis, and herring eggs and larvae show that copper concentrations of 10 micrograms/l have adverse effects on the food chain leading to young flatfish and at levels above this, herring eggs are affected. Excess nutrients apparently lower grazing rates which may be the reason for the occurrence of higher chlorophyll concentrations in the Firth. There are three main conclusions from this study. (1) There is evidence of enhanced levels of contaminants in the Clyde. (2) This evidence is found most obviously at intermediate trophic levels (Tellina and zooplankton), rather than in the water or the fish. (3) Experiments show direct effects on organisms from this area which are comparable to effects found by contaminated additions to unpolluted waters, but the exact cause or causes remain to be determined.

INDEX TERMS: Water pollution effects, Water quality, Heavy metals, Polychlorinated biphenyls, Oil, Bioassay, Sewage sludge, Fish, Zooplankton, Benthic fauna, Pesticides, Thermal pollution, Firth of Clyde.

AMIC-9745
"INTERNATIONAL CONFERENCE ON HEAVY METALS IN THE AQUATIC ENVIRONMENT, DECEMBER 4-7, 1973, NASHVILLE, TENNESSEE, VANDERBILT UNIVERSITY", Vanderbilt University, Nashville, Tennessee, Conference Papers, 1973, 529 pp.

Among the papers presented at the International Conference on Heavy Metals in the Aquatic Environment, held at Vanderbilt University, December 4-7, 1973, were the following: 'The Effects of Heavy Metals on Fish and Aquatic Organisms', Katz, M., Seattle Marine Laboratories; 'Methyl Mercury Analysis (A Review and Some Data)', Sumino, K., Kobe University School of Medicine; 'A Review of the Status of Total Mercury Analysis', Burrows, W. D.; 'Analytical Techniques for Heavy Metals Other Than Mercury', Laitinen, H. A., University of Illinois; 'Field Observations on the Transport of Heavy Metals in Sediments', de Groot, A. J., Allersma, E., Institute for Soil Fertility and Delft Hydraulics Laboratory; 'Metabolic Cycles for Toxic Elements in the Environment - A Study of Kinetics and Mechanism', Wood, J. M., University of Minnesota; 'Sorption Phenomenon in the Organics of Bottom Sediments', Reimers, R. S., Krenkel, P. A., Eagle, M., Tragett, G., Battelle's Columbus Laboratories and Vanderbilt University; 'The Accumulation and Excretion of Heavy Metals in Organisms', Miettinen, J. K., University of Helsinki; 'Transport and Biological Effects of Molybdenum in the Environment', Chappell, W. R., University of Colorado; 'The Distribution of Mercury in Fish and Its Form of Occurrence', Doi, R., Ui, J., Tokyo Metropolitan Research Institute of Environment Protection and University of Tokyo; 'Environmental Lead Distribution in Relation to Automobile and Mine and Smelter Sources', Rolfe, G. L., Jennett, J. C., University of Illinois; 'Experience with Heavy Metals in the Tennessee Valley Authority System', Nicholas, W. R., Brye, B. A., Water Quality Branch; 'The Use of Synthetic Scavengers for the Binding of Heavy Metals', Feick, G., Johanson, E. E., Yeaple, D. S., JBF Scientific

AMIC-9745 (Continued) Card 2/2

Corporation; 'Physical-Chemical Methods of Heavy Metals Removal', Patterson, J. W., Minear, R. A., Illinois Institute of Technology and University of Tennessee; 'The Effects Effects and Removal of Heavy Metals in Biological Treatment', Adams, C. E., Jr., Eckenfelder, W. W., Jr., Goodman, B. L., Associated Water and Air Resources Engineers, Inc.

INDEX TERMS: Heavy metals, Chemical analysis, Public health, Water pollution effects, Fish, Sediments, Bioassay, Absorption, Transport, Methylation, Bioaccumulation, Biotransformation.

AMIC-9762
"ARSENIC AND ANTIMONY IN LAUNDRY AIDS BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS", Tanner, J. T., Friedman, M. H., Holloway, G. E., Analytica Chimica Acta, Vol. 66, No. 3, October 1973, pp 456-459.

Samples of laundry aids (3 enzyme presoaks, 1 detergent, 2 heavy-duty enzyme detergents and 1 heavy-duty detergent) and standards of As(III) oxide and metallic antimony were sealed in quartz and irradiated for 20 min and allowed to undergo radioactive decay for 3-5 days for determinations of As and Sb concentrations by neutron activation analysis. The analyses were made with a high-resolution Nuclear Diodes Ge(Li) detector and a Nuclear Data 4096 channel analyzer. The concentrations in the laundry aids tested ranged from 5 to 51 ppm of As and from 1 to 8 ppm of Sb. In comparison, values for arsenic as determined by X-ray fluorescence and colorimetry were, respectively, 6-47 ppm and 5.57 ppm.

INDEX TERMS: Neutron activation analysis, Chemical analysis, Detergents, Pollutant identification, Water pollution sources, Domestic wastes, Arsenic, Antimony.

AMIC-9752
"THIN-LAYER CHROMATOGRAPHIC ANALYSIS OF HMX IN WATER", Glover, D. J., Hoffsommer, J. C., Bulletin of Environmental Contamination and TOXICOLOGY , Vol. 10, No. 5, November 1973, pp 302-304.

HMX (1,3,5,7,-tetranitro-1,3,5,7-tetrazacyclooctane) may be determined in concentrations down to 0.05 ppm in water by a combination of extraction, concentration, and thin-layer chromatography. The solubility of HMX in water was determined to be 5.0 ppm at 22 degrees plus over minus 2 C.

INDEX TERMS: Pollutant identification, Water analysis, Aqueous solutions, Thin layer chromatography, HMX, Trace levels.

AMIC-9780
"A SOLVENT-EXTRACTION METHOD FOR THE DETERMINATION OF MANGANESE-54 IN SEA WATER", Flynn, W. W., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 129-134.

A solvent-extraction procedure is described for the determination of manganese-54 in seawater. The water (1 liter) is buffered to pH 3.8, and extracted with di(2-ethylhexyl) phosphoric acid in n-heptane. The manganese-54 with carrier is stripped from the organic phase, and eventually precipitated as the dioxide; the precipitate is dissolved in hydrochloric acid and counted in a scintillation counter. Chemical recovery is determined colorimetrically. Samples spiked with manganese-54 showed quantitative recovery from 1 liter of seawater with a typical recovery of 70-75 percent of carrier. The method is applicable to seawater containing many other ions, and decontamination factors for a wide range of radionuclides are reported. The limit of detection is ca. 0.00000001 microCi/ml.

INDEX TERMS: Solvent extractions, Pollutant identification, Methodology, Sea water, Chemical analysis, Cations, Heavy metals, Alkaline earth metals, Mn-54, Chemical recovery, Detection limits, Ionic interference, Rare earth elements.

AMIC-9786
"PHOSPHORIMETRIC DETERMINATION OF TRACES OF BORON", Marcantonatos, M., Gamba, G., Monnier, D., Analytical Chimica Acta, Vol. 67, No. 1, November 1973, pp 220-224.

Micro-amounts of boron in seawater and in solutions containing an interfering metal can be determined using the phosphorescent emissions which occur with the complexation of boric acid by dibenzoylmethane or benzoylacetone. Calibration curves were constructed using standard solutions prepared by heating nanogram quantities of boron as boric acid in sulfuric acid, cooling, and adding ether. Limits of detection were about 0.4 ng B/ml with dibenzoylmethane when emission was measured at 508 nm with a 2-mm dia. phosphorimetric cell and an excitation wavelength of 402 nm. The presence of Cr, Ce, Ni, Cu, Mg, Mn, Pb, Cd, Zn, Sn, Li, Na, K, Al, V, Fe, Co, Ag, Te, Hg, In, Tl, NH_4, F, Br, Cl, I, NO_3, SCN, PO_4, S_2O_3, and CH_3COO ions gave errors of less than 10 percent. Mo and W caused significant interference. Seawater samples were prepared for analysis according to the same procedure used for standard solutions substituting seawater for boric acid. The solutions for analysis should contain no more than 3 percent seawater.

INDEX TERMS: Water analysis, Sea water, Boron, Phosphorimetry, Detection limits, Sample preparation, Chemical interference.

AMIC-9787
"ENHANCEMENT OF SENSITIVITY FOR THE DETERMINATION OF MERCURY IN WATERS", Harsanyi, E., Polos, L., Pungor, E., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 229-233.

A study of the parameters common to the Topping and Pirie (1972) preconcentration method for mercury in seawater has been undertaken in order to establish if the sensitivity and speed of the method could be improved. The method involves aerating the seawater sample into a quantity of permanganate-sulfuric acid solution after treating the sample with tin (II). This solution is then treated with tin (II), and the mercury is further aerated into the measuring cell. The value of the detection limit was determined from the deviation of reagent blank results; with the proposed enrichment technique, it was found to be 0.008 ng Hg/ml, which could be further reduced by decreasing the blank value. In a study of the efficiency of the enrichment, a 7 percent average decrease in the signal compared to direct aeration from a 50-ml volume was observed, i.e. the efficiency of the transference of mercury into the smaller volume was 93 percent. The relative standard deviation of the enriching operation was 4 percent for 7 parallel determinations. The proposed enriching method was compared in the examination of waters with an enriching method based on extraction with dithizone; the efficiency of the latter method was 85 percent after a single extraction, but greater amounts of reagents were required, so that the blank values were larger. The reproducibility was the same in both cases. The enrichment method, owing to its simplicity and rapidity, is very suitable for the determination of mercury in waters. Independently from the atomic absorption measurements, the enriching operation can be done on several samples simultaneously.

INDEX TERMS: Mercury, Methodology, Sea water, Sensitivity.

AMIC-9788
"COMPLEXIMETRIC DETERMINATION OF PHOSPHATE", De Sousa, A., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 234-235.

The complexiметric method esdescribed for the determination of phosphate ion is based on the rapid quantitative precipitation of silver orthophosphate from a neutral or slightly alkaline phosphate solution. The freshly precipitated silver phosphate is dissolved in an ammoniacal solution of potassium tetracyanonickelate and titrated with EDTA to a visual endpoint with murexide as indicator. The time required for phosphate determination is about 30 min. The method described gave satisfactory results for the determination of phosphate in the range 10.0-150.0 mg; the accuracy varied from 1.0 percent to 0.5 percent over this range. There was no interference from moderate amounts of Al, Ni, Co, Mn, Zn, Cd, Cu, Pb, Ca, Sr, Ba, and Mg, but vanadate, chromate, molybdate, tungstate and halide ions interfered.

INDEX TERMS: Phosphates, Methodology, Aqueous solutions, Pollutant identification, Complexiметric titration, Accuracy, Ionic interference.

AMIC-9797
"DETECTION OF POLLUTANTS IN WATER BY RAMAN SPECTROSCOPY", Braunlich, G., Gamer, G., Petty, M. S., Water Research, Vol. 7, No. 11, November 1973, pp 1643-1647.

A system for detecting pollutants in water by Raman spectroscopy consists of a cell containing the sample which is irradiated by laser light which passes through the sample several times by the use of mirrors. Scattered light, shifted and unshifted, is collected by a lens, passed through an edge filter which absorbs unshifted components and an interference filter which transmits the selected Raman spectra, and read by a photomultiplier. The region chosen for investigation was that corresponding to stretching of the CH bond. Investigations were carried out with solutions or suspensions of detergent, algae, and motor oil and with pond water, river water, and purified sewage, with ethanol chosen as the standard. Fluorescence from contaminants and the Raman spectrum of water interfered with detection of the desired spectra. Consideration of methods for eliminating these problems produced several guidelines for the system: edge filters with a discrimination of better than 10 billion are required; high power lasers and sensitive detection equipment are necessary; fluorescence effects should be removed; the exciting source should probably be red; and the Raman signal from water should be eliminated possibly by comparing signals from samples and pure water. Detection limits of a system using HeCd or HeNe lasers is calculated to be in the range of 1-10 ppm.

INDEX TERMS: Water analysis, Design criteria, Instrumentation, Raman spectroscopy, Detection limits.

AMIC-9809
"CHEMICAL RELATIONSHIPS BETWEEN SURFACE WATER AND THE GROUND IN SOUTH FLORIDA", Greenfield, L. J., Hare, C. R., Water Resources Bulletin, Vol. 9, No. 5, October 1973, pp 923-931.

Water and soil from a stretch of shallow ground north of a cypress head in south Florida were analyzed for chlorides, Mg, Ca, Na, K, pH, alkalinity, SO_4, Si, Fe, PO_4, NO_3, NO_2. The area is covered with water part of the year, and the soil consists primarily of peat formed from decaying vegetation. The top layer consists of a blue-green algal mat whose decay products contribute to the peat. Collections of soil were made layer by layer and analyzed for cations, anions, and ion exchange capacity and examined microscopically. The main features found fr the area were that soil compaction increases with depth and that there is a large fraction of solid silica present. The ion exchange capacity is high enough to account for the ion content within the soil and surrounding waters and is probably a very important buffer system that retards limestone erosion. CEC values ranged from 20-190 meq/100 gm dry soil from bedrock to surface.

INDEX TERMS: Water analysis, Soil analysis, Peat, Wetlands, Ion exchange capacity.

AMIC-9827
"CHANGES IN CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF A HEAVY RESIDUAL OIL WEATHERING UNDER NATURAL CONDITIONS", Betancourt, O. J., McLean, A. Y., Journal of the Institute of Petroleum, Vol. 59, No. 569, September 1973, pp 223-230.

An oil spill from the tanker Arrow in Chedabucto Bay, Nova Scotia, in 1970 provided an opportunity to study changes in properties of oil over a 2-year period subsequent to the spill. The indicators of weathering used were viscosity, density, asphaltene content, and the concentration of nickel, vanadium, and sulfur. The main conclusions from the study were: (1) The ratio of the concentrations of vanadium and nickel in an oil sample appear to be unaffected by the age of the sample. (2) Compounds containing vanadium and nickel in the fuel oil studied do not appear to be affected by weathering to any significant extent. (3) The composition of residual fuel oil is altered on weathering by evaporation and other processes, possibly biodegradation and solution. (4) The effect of the weathering processes is not great in terms of total loss of material and was less than 20 per cent after 18 months. (5) The rate of weathering is rapid, although erratic, in the early months after a spill. After approximately one year the rate of change is much reduced suggesting that the oil on the shore will remain for several years unless removed by mechanical means. (6) Asphaltene concentration rises as the result of weathering processes. This is associated with a corresponding rise in viscosity which suggests that if asphaltene concentration could be increased artificially, the movement of shore bound oil could be restricted.

INDEX TERMS: Oil pollution, Weathering, Oil spills, Degradation (decomposition), Chedabucto Bay, Asphaltenes, Vanadium, Bunker C oil.

AMIC-9829
"MOLECULAR WEIGHT DISTRIBUTIONS OF KUWAIT ASPHALTENES AS DETERMINED BY ULTRACENTRIFUGATION. RELATION WITH VISCOSITY OF SOLUTIONS", Reerink, H., Lijzenga, J., Journal of the Institute of Petroleum, Vol. 59, No. 569, September 1973, pp 211-222.

Molecular weight distributions of various Kuwait asphaltenes were determined by means of ultracentrifugation. In comparison with most synthetic polymers the asphaltene distributions are very wide. Some of them are approximately log-normal. Asphaltene samples are poorly characterized by their number average molecular weight. Blowing of bitumens can lead to a marked widening of the molecular weight distribution of the asphaltenes. The viscosity of solutions of these asphaltenes is related to the width of the distribution.

INDEX TERMS: Oil, Centrifugation, Viscosity, Dialysis, Separation techniques, Asphaltenes, Ultracentrifugation, Bitumens, Molecular weight, Sedimentation coefficients, Blowing.

AMIC-9830
"NUCLEONIC SEDIMENT CONCENTRATION GAUGE - COMPARISON OF TRANSMISSION AND SCATTERING MODES", Krishnamurthy, K., Rao, S. M., Rajagopalan, R., International Journal of Applied Radiation and Isotopes, Vol. 24, No. 11, October 1973, pp 579-583.

Recent interest in the development of nucleonic gauges for measuring the concentration of suspended sediments in streams prompted this comparison of the transmission and scattering modes of operation for such instruments. It was found that there is hardly any difference in the performance of the gauge in either mode of operation. This could be predicted by the theory as well. The standard deviation under the experimental conditions corresponds to about 700-750 ppm. Besides the fact that there is little or no difference in both types of gauges, since scattering of low energy gamma radiation of 60 keV does not appreciably alter the photon energy even under multiple scattering (mean free path:5 cm), the dependence on the chemical nature of the sediment will be similar to that with the original energy gamma rays. It was also concluded that the nucleonic sediment concentration gauge with Am-241 may not be good for measurement of concentrations below 3000 ppm.

INDEX TERMS: Suspended solids, Nucleonic gauge, Counting, Scattering mode, Transmission mode.

AMIC-9835
"HYDROCARBON AND CHLOROPHYLL: A CORRELATION IN THE UPWELLING REGION OFF WEST AFRICA", Zsolnay, A., Deep-Sea Research, Vol. 20, No. 11, October 1973, pp 923-925.

Seawater samples were taken from 17 stations off West Africa for analysis of hydrocarbon and chlorophyll a content to investigate their possible relationship. Samples were taken in the euphotic zone, usually at 4, 10, 17 and 35 m. The hydrocarbons were extracted from the sea water by shaking each of two 1-litre aliquots of the sample with 10 ml hexane. The extracts were combined and concentrated under vacuum until their volume was 300 microliters. Fifty microliters were then injected on a 10 cm column with a 1.8 mm i.d. containing 0.05-0.2 mm silica gel that had been 5 percent (w/w) deactivated with distilled water. The heat of adsorption detector consisted of two thermistors, one surrounded by an inert material while the other was packed in a material capable of adsorbing hydrocarbons. The resulting heat of adsorption was then a measure of the amount of hydrocarbons present and resulted in one sharp peak within two minutes after injection. Amounts as small as 1 microgram hydrocarbon could be determined with fresh graphite as the adsorbent. A significant linear correlation between the non-aromatic hydrocarbons and the chlorophyll-a content in the euphotic zone of the water off West Africa existed between 4 March and 10 March 1972. This showed that the hydrocarbons present were the result of phytoplankton activity. The line of the estimating equation tended to go through the origin, indicating that the hydrocarbons in the euphotic zone were not due to a pollution source.

INDEX TERMS: Organic compounds, Chlorophyll, Phytoplankton, Sea water, Separation techniques, Upwelling, Analytical techniques, Data interpretation.

AMIC-9837
"ANALYSIS OF TRACE ELEMENTS, PHOSPHORUS AND SULPHUR, IN THE LIPID AND THE NON-LIPID PHASE OF HALIBUT (HIPPOGLOSSUS HIPPOGLOSSUS) AND TUNNY (THUNNUS THYNNUS)", Lunde, G., Journal of the Science of Food and Agriculture, Vol. 24, No. 9, September 1973, pp 1029-1038.

To study the effect which some natural conditions have upon the level of trace elements, halibut was chosen as representative for a relatively stationary species of fish and old individuals of tunny were selected as examples of non-stationary fish. Samples were homogenized in a blender and extracted with hexane. The insoluble phase (meal) and the aqueous phase were dried, weighed, ashed, the ash dissolved in HCl, and diluted with water. The determination of zinc, iron, selenium, copper, lead, and cadmium in the meal and in the dehydrated aqueous phase was carried out using atomic absorption spectrophotometry and X-ray fluorescence techniques for zinc, cadmium, lead, copper, arsenic, and iron and neutron activation for the analysis of selenium. Mercury was determined together with the selenium in the meal by non-destructive activation analysis. In the aqueous phase the mercury was analyzed in some samples by flameless atomic absorption spectrophotometry. The results show that the tunny which cover a great area and occupy positions near the top of the marine food chain show large variations in the content of the different trace elements analyzed. The halibut samples taken from the various localities did not show such a great difference in the content of trace elements analyzed for. Nor could any particular difference between young and old individuals be observed. The content of the heavy metals lead, copper, zinc and cadmium seems on average to be within the same range as formerly reported. The values for iron found in halibut, are, however, remarkable low.

INDEX TERMS: Phosphorus, Sulfur, Fish, Lipids, Cadmium, Lead, Copper, Zinc, Iron, X-ray fluorescence, Mercury, Separation techniques, Neutron activation analysis, Bromine.

AMIC-9838
"SPECTROPHOTOMETRIC ESTIMATION OF ARSENIC IN NITRIC ACID EXTRACTS OF SOIL AND SOIL ADDITIVES", Collier, G. F., Journal of the Science of Food and Agriculture, Vol. 24, No. 9, September 1973, pp 1115-1117.

The spectrophotometric determination of arsenic in solutions containing nitric acid necessitates the removal of nitrate ions without loss of arsenic. A convenient and effective method for its removal was achieved by treatment with formic acid. The recoveries of arsenic over the working range, 0.4 to 4.0 ppm gave a standard error of 0.039 and 0.052 ppm, respectively. The recoveries obtained by the proposed method of nitrate removal compare favourably with those of the more tedious evaporation procedures where recoveries of 87 percent are reported. It is also a simple and rapid method and permits the detection of arsenic over the normal working range with the minimum of error.

INDEX TERMS: Spectrophotometry, Soil analysis, Separation techniques, Nitrites, Arsenic, Detection limits, Chemical interference.

AMIC-9841
"COMPOSITION AND WASTE LOAD OF UNIT EFFLUENTS FROM A COMMERCIAL LEAFY GREENS CANNING OPERATION", Bough, W. A., Journal of Milk and Food Technology, Vol. 36, No. 11, November 1973, pp 547-553.

Analysis of data on composite waste loads from canning of collard, turnip, mustard, spinach, and kale greens revealed no significant differences among the five types of greens. For unit effluents from the dunker washers, reel washers, and blancher, significant differences were found for solids load and total acidity. The most concentrated effluent was from the tumbler fillers. The average composite waste load for all leafy greens was 20.2 plus or minus 5.7 lb/ton COD, 8.5 plus or minus 2.8 lb/ton BOD, 2.8 plus or minus 1.2 lb/ton suspended solids, and 2,666 plus or minus 427 gal/ton waste water. These values are less than one-half of those previously reported for wastes from spinach greens. These results suggest possibly improvement for inplant control of waste from leafy greens, and may also be relevant to the setting of effluent standards for the fruit and vegetable industry.

INDEX TERMS: Effluents, Canneries, Waste identification, Acidity, Chemical oxygen demand, Biochemical oxygen demand, Suspended solids, Dissolved solids, Hydrogen ion concentration, Vegetables, Characterization.

AMIC-9853
"DETERMINATION OF TRACE ORGANICS IN AIR AND WATER", Mieure, J. P., Dietrich, M. W., Journal of Chromatographic Science, Vol. 11, No. 11, November 1973, pp 559-570.

Several procedures have been developed for measuring trace organics in air and water matrices. These methods use only the equipment and apparatus normally found in an analytical laboratory, and require a minimum of operator training. The scheme used for analyzing both air and water consists of the following operations: (1) The organics are concentrated and isolated from the matrix. (2) The components of interest are identified. (3) The identified compounds are measured. The second two operations are based primarily on gas chromatography (GC) and utilize relatively standard techniques. These are basically the same for air or water. Three specific procedures for determining trace organics in water, particularly waste water are described. The identification and quantitation steps are basically the same for the three procedures and use standard GC techniques. The procedures differ in their method of sample concentration. One is based on liquid-liquid extraction, another on head space sampling and the third on concentration with a packed column. Analysis of tap water, waste water, and river water revealed the presence of a number of organic compounds.

INDEX TERMS: Potable water, Waste water (pollution), Organic compounds, Gas chromatography, Separation techniques.

AMIC-9854
"ANALYSIS OF TRACE ORGANIC COMPOUNDS IN NEW ENGLAND RIVERS", Hites, R. A., Journal of Chromatographic Science, Vol. 11, No. 11, November 1973, pp 570-574.

Water from the Monatiquot and Merrimack Rivers has been examined for the presence of anomalous lipophilic organic compounds using computerized gas chromatography-mass spectrometry and high resolution mass spectrometry. Several plasticizers (di-n-butyl phthalate, dibutoxyethoxyethoxymethane, di-2-ethylhexyl adipate, various isomers of dioctyl phthalate, and diisodecyl phthalate) were found at levels of 1 to 30 ppb in the Monatiquot River. A factory on the river dealing with plastic products is the probable source of these compounds. Biphenyl, trichlorobenzene, and butyl benzoate were found in the water of the Merrimack River at a concentration of 0.1 to 0.5 ppb. Since all of these compounds are commonly used in the dyeing industry as additives to the dye bath, this would seem to be their source.

INDEX TERMS: Organic wastes, Industrial wastes, Computer programs, Plastics, Separation techniques, Dyes, GC-mass spectrometry, Methylene chloride, Phthalates, Plasticizers.

AMIC-9855
"COMPLEXING CAPACITY OF NATURAL WATER - ITS SIGNIFICANCE AND MEASUREMENT", Chau, Y. K., Journal of Chromatographic Science, Vol. 11, No. 11, November 1973, p 579.

The abundance of complexing ligands in a body of water determined the complexing capacity of the water and hence its regulating capability. The measurement of complexing capacity of a water sample is based on the amount of copper ion being complexed by the organic ligands through direct complexation and/or displacement reaction. It is done by spiking several aliquots of a sample with increasing amounts of a copper solution. Then the uncomplexed copper is measured by a differential pulse anodic stripping voltammetric technique. After the complexing ligands in the sample have been saturated with copper, the peak current of free copper will increase linearly with the amount of the copper spikes. By extrapolating this linear curve back to zero peak current, the intercept of the X-axis represents the complexing capacity of the water expressed as equivalents of micro mole Cu/l. As the differential pulse anodic stripping voltammetry measurement of 'free' copper is carried out in a system containing excess of copper ions, the peak current thus obtained represents the concentration of 'free' copper. The amount of copper plated out from the labile complexes, if any, becomes insignificant. The significance of complexing capacity of water on the effect and toxicity of copper ion on algal photosynthesis has also been investigated elsewhere using the C-14 uptake technique with lake waters of different complexing capacity and with the original plankton species.

INDEX TERMS: Trace elements, Copper, Ions, Chelation, Photosynthesis, Absorption, Lake Ontario, Lake Erie, Complexing capacity, Anodic stripping voltammetry, Ligands, Chelating agents.

AMIC-9857
"A METHOD FOR THE HIGH TEMPERATURE GAS CHROMATOGRAPHIC ANALYSES OF PETROLEUM RESIDUES", Levy, E. M., Webber, L. R., Moffatt, J. D., Journal of Chromatographic Science, Vol. 11, No. 11, November 1973, pp 591-593.

An analytical procedure is described by which crude oils, residual fuel oils and pollution samples can be analyzed by high temperature gas chromatography without pretreatment of the sample. Problems, which would otherwise arise from contamination of the system by the high boiling residues in the oils, are avoided by placing the sample in a aluminum boat in which the involatile residues are retained. The technique is as follows: with the carrier gas flowing through the system, the detector at the operating temperature (400 C), are both the column and injection port at room temperature, the septum nut and aluminum disc are removed from the instrument and the boat containing the weighed sample is placed into the injection port. The injection port is reclosed and its temperature increased to a few (about 10 C) degrees below 400 C. Substances with an appreciable vapor pressure at this temperature are swept onto the comparatively cold column where presumably they condense. After the injection port has been maintained at this temperature for approximately five minutes, the sample boat containing the involatile residue is removed from the injection port. The temperature of the column is then increased at 6 C/min to 400 C. This temperature program proved to be appropriate for the analysis of the higher boiling constituents in a wide variety of crude oil, residual fuel oils, and pollution samples.

INDEX TERMS: Oil, Gas chromatography, Hydrocarbons, Separation techniques, Oil pollution, Oil spills, Fingerprinting.

AMIC-9859
"A MULTIPLE SPECIFIC ION DETECTOR AND ANALOG DATA PROCESSOR FOR A GAS CHROMATOGRAPH QUADRUPOLE MASS SPECTROMETER SYSTEM", Jenden, D. J., Silverman, R. W., Journal of Chromatographic Science, Vol. 11, No. 11, November 1973, pp 601-606.

A system is described which allows a quadrupole mass spectrometer to be used as an 8-channel multiple specific ion detector for a gas chromatograph. Eight separate outputs are provided, each of which may be tuned to any mass peak within the range of the mass spectrometer. Scaling and zero bucking controls are provided on each channel. An analog data processor allows up to four sets of linear combinations to be calculated from the outputs, which may thus be made specific for isotopic variants rather than nominal masses. A set of semi-automatic peak integrators allows ion currents for eight masses to be separately integrated over a chromatographic peak, using only a single channel recorder to monitor the peak. A usable mass spectrum may be obtained in this way from 1 ng of a compound when a reference spectrum is available for comparison.

INDEX TERMS: Mass spectrometry, Gas chromatography, Computer programs, Analog computers, Ion detectors, Recorders, GC-Mass spectrometry.

AMIC-9867
"PHOTOCHEMISTRY OF BIOACTIVE COMPOUNDS. KINETICS OF SELECTED s-TRIAZINES IN SOLUTION", Ruzo, L. O., Zabik, M. J., Schuetz, R. D., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1047-1049.

The purpose of the present investigation was to extend the knowledge of the photochemistry of symmetrical substituted triazines. The rate variations caused by solvent and substituent effects indicate certain characteristics of the excited state which will be useful in the understanding of their photoreactions. The rate constants (k) for several 2-methylthio and 2-halo-4,6-bias(alkylamino)-s-triazines were calculated in methanol, n-butyl alcohol, and water solutions. The rate of disappearance of the starting material (I-XII) was found to be dependent on the nature of the halogen and alkyl substituents and the solvent employed. A decrease in k was observed in the order I-Br-Cl-F and -C2H5 greater than -C3H7. All photoreactions showed zero-order rate constants. The rate constant in methanol was found to be considerable greater than that calculated in n-butyl alcohol.

INDEX TERMS: Triazine pesticides, Pesticide kinetics, Pollutant identification, Aqueous solutions, Chromatography, Photochemistry, Methanol, n-Butyl alcohol, Photolysis, Thin layer chromatography.

AMIC-9868
"PHOTODECOMPOSITION OF P-CHLOROPHENOXYACETIC ACID", Crosby, D. G., Wong, A. S., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1049-1052.

The purpose of this investigation was to examine the effect of natural and simulated sunlight (300-450 nm) on dilute aqueous 4-CPA solutions and establish a general mechanism for the environmental photolysis of phenoxy acids. Solutions of 4-CPA (p-chlorophenoxyacetic acid) decomposed readily under sunlight or laboratory ultraviolet light to provide principally p-chlorophenol, phenol, hydroquinone, p-chlorophenyl formate, phenoxyacetic acid, p-hydroxyphenoxyacetic acid, and humic acids. These products represent oxidative removal of the side chain, replacement of the chlorine by hydroxyl or by hydrogen, and polymerization of unstable intermediates. Formation of p-chlorobenzonitrile by irradiation of 4-CPA in the presence of cyanide ions substantiated that the corresponding replacement of the ring chlorine by hydroxyl was a photonucleophilic reaction.

INDEX TERMS: Ultraviolet radiation, Aqueous solutions, Chemical degradation, Light, Sodium compounds, Pesticides, Photodecomposition, Chlorophenoxyacetic acid, Sunlight, Polymerization, Sodium salt, Chlorinated phenoxyacetic acids, Photolysis.

AMIC-9869
"PHOTODECOMPOSITION OF 2,4,5-TRICHLOROPHENOXYACETIC ACID (2,4,5-T) IN WATER", Crosby, D. G., Wong, A. S., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1052-1054.

Photodecomposition of the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in aqueous solution principally involved cleavage of the ether bond and replacement of the ring chlorines by hydroxyl and by hydrogen. The major products were 2,4,5-trichlorophenol and 2-hydroxy-4,5-dichlorophenoxyacetic acid; 4,6-dichlororesorcinol, 4-chlororesorcinol, 2,5-dichlorophenol, and a dark polymeric product also were isolated. The toxic 2,3,7,8-tetrachlorodibenzo-p-dioxin was not detected among the photodecomposition products. 2,4,5-T photolyzed very slowly compared to its 4-chloro and 2,4-dichloro analogs, but the 11-fold increase in photolysis rate caused by sensitization with acetone or riboflavin suggests that sunlight can be an important factor in the environmental degradation of 2,4,5-T.

INDEX TERMS: 2 4 5-T, Degradation (decomposition), Pollutant identification, Water pollution effects, Aqueous solutions, Ultraviolet radiation, Irradiation, Chromatography, 2 4-D, Photodecomposition, Acetone, Riboflavin, Sunlight.

MIC-9870
'CHARACTERIZATION AND MICRODETERMINATION OF A WATER-SOLUBLE METABOLITE FROM BLADEX HERBICIDE BY CONVERSION TO 5,5-DIMETHYLHYDANTOIN", Lau, S. C., Katague, D. B., Stoutamire, D. W., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1091-1094.

A gas chromatographic method has been designed for the characterization and measurement of Bladex herbicide (propionitrile, 2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methyl-) and its various metabolites. It involves the simultaneous cleavage of the Bladex triazine ring and the cyclization of the characteristic Bladex fragment to 5,5-dimethylhydantoin. Measurement of the 5,5-dimethylhydantoin provides a quantitative assessment of the amount of Bladex and/or its metabolites present. This is readily accomplished by gas-liquid chromatography or by thin-layer chromatography. As an example, a procedure for the electron-capture gas chromatographic determination of a water-soluble metabolite derived from Bladex herbicide by conversion to 5,5-dimethylhydantoin is described. Following the procedure, 1 ng of the metabolite gives 25 percent full-scale response on the gc recorder chart. Recovery data from experiments run on crops and soil were generally in the 75 to 110 percent range when equal amounts of sample and reference solution in the same concentration range were analyzed. A sensitivity of 0.1 ppm is achieved in crops and 0.02 ppm is achieved in soil and water.

INDEX TERMS: Herbicides, Gas chromatography, Pollutant identification, Cation exchange, Aqueous solutions, Separation techniques, Crops, Bladex, Gas liquid chromatography, Thin layer chromatography, Cleanup, Metabolites, Electron capture gas chromatography.

AMIC-9871
"DETERMINATION OF TRICHLORFON (O,O-DIMETHYL (2,2,2-TRICHLORO-1-HYDROXYETHYL)PHOSPHONATE) IN FOREST ENVIRONMENTAL SAMPLES", Devine, J. M., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1095-1098.

A gas chromatographic method is described for the determination of trichlorfon (O,O-dimethyl (2,2,2-trichloro-1-hydroxyethyl)phosphonate) in various forest environmental samples such as leaves, twigs, forest litter, soil, mud, water, aquatic vegetation, and animal tissues. Trichlorfon residues were removed with chloroform. Animal extracts were processed through hexane-water and water-chloroform partition steps to remove lipid materials. Forest extracts were cleaned up with Nuchar C-190N activated carbon. Determination of trichlorfon was made with a gas chromatograph equipped with a flame photometric detector in the phosphorus mode. Recovery from the various types of samples averaged 96 percent. The method is sensitive to 0.002 ppm for water and 0.05 ppm for all other sample types.

INDEX TERMS: Gas chromatography, Pesticides, Pollutant identification, Vegetation, Soils, Mud, Separation techniques, Water analysis, Soil analysis, Aqueous solutions, Pesticide residues, Flame photometry, Activated carbon, *Trichlorfon, Environmental samples, Tissue, Cleanup, Storage.

AMIC-9872
"ELEMENT SPECIFIC GAS CHROMATOGRAPHIC ANALYSES OF ORGANOCHLORINE PESTICIDES IN THE PRESENCE OF PCB'S BY SELECTIVE CANCELLATION OF INTERFERING PEAKS", Su, G. C. C., Price, H. A., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1099-1102.

Polychlorinated biphenyl interference-free qualitative and quantitative gas chromatographic (gc) analyses of beta-BHC, oxychlordane, heptachlor epoxide, p,p'-DDE, o,p'-DDT, p,p'-DDD, p,p'-DDT, and Mirex in the 10-25 ng range have been carried out in the presence of approximately 10 to 20 times their concentrations of Aroclors 1232, 1248, 1254, and 1260 by the use of the Coulson electrolytic conductivity detector in the noncatalytic reductive mode. No modification of the detector system was necessary except to set the detector's reactor temperature at 660 degrees. The results of individual analyses in most instances were within plus or minus 20 percent of the actual value. The operating parameters of the Coulson conductivity detector for gc in the noncatalytic reductive mode are as follows: conductivity bridge voltage, 30 V; conductivity bridge attenuation, 1; furnace (reactor) temperature, 660-840 degrees; transfer block temperature, 250 degrees; hydrogen flow rate through reactor, 40 ml/min; nitrogen flow rate through reactor, 100 ml/min; gas chromatograph column temperature, 200 degrees; sample size, 5 microliters.

INDEX TERMS: Aroclors, Gas chromatography, Chlorinated hydrocarbon pesticides, Electrolytic conductivity detector,

AMIC-9875
"DIBUTYL-AND DI-(2-ETHYLHEXYL)PHTHALATE IN FISH", Williams, D. T., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1128-1129.

Twenty-one samples of canned seafoods and fish from Canadian lakes and rivers were analyzed by GLC and GLC-mass spectrometry for dibutylphthalate (DBP) and di-(2-ethylhexyl)phthalate (DEHP). Samples were chopped, macerated manually, and extracted three times by heating with hexane. The hexane solutions were concentrated, extracted with acetonitrile saturated with hexane, and concentrated again. m-Chloroperbenzoic acid and sulfuric acid were added and the solution let stand overnight. After adding water, the solution was extracted with petroleum ether, the extract dried, concentrated, transferred to a silica gel column made up with ethyl ether in petroleum ether, eluted, and the eluate examined by GLC. GLC-mass spectrometry was used for confirmation of phthalate esters at concentrations five times greater than background levels. Recoveries were 60-65 percent for DBP and 65-70 percent for DEHP. Concentrations found were 0-78 ppb DBP and 0-160 ppb DEHP in the 21 samples.

INDEX TERMS: Freshwater fish, Marine fish, Crabs, Clams, Oysters, Shrimp, Biological samples, Sample preparation, Dibutylphthalate, Di-(2-ethylhexyl)phthalate, *Gas liquid chromatography.

AMIC-9888
"ANALYSIS OF ORGANIC MATERIALS IN WASTEWATER EFFLUENTS AFTER CHLORINATION", Glaze, W. H., Henderson, J. E., IV, Bell, J. E., et al., Journal of Chromatographic Science, Vol. 11, No. 11, November 1973, pp 580-584.

Sewage wastewater effluent from the Denton, Texas, municipal treatment plant has been examined before and after laboratory chlorination. Neutral organic materials were concentrated by adsorption on Amberlite XAD-2 macroreticular resin followed by elution with diethyl ether. Gas chromatographic analysis of the extracts after concentration was carried out using flame ionization, electron capture, and Coulson electrolytic conductivity detectors. New chlorine-containing organics were observed by the Coulson detector in the chlorinated effluent using as little as 10 mg/l of total available chlorine. These results confirm the conclusion that chlorination as practiced in municipal waste treatment plants may produce new chlorinated organic compounds. Further studies must be carried out on the toxicological properties of these substances once their molecular structures are known.

INDEX TERMS: Sewage effluents, Gas chromatography, Separation techniques, Electrolytic conductivity detector, Chlorinated hydrocarbons.

AMIC-9892
"DETERGENT AND NON-DETERGENT PHOSPHORUS IN SEWAGE", Porcella, D. B., Cowan, P. A., Middlebrooks, E. J., Public Works, Vol. 104, No. 9, September 1973, pp 126-128.

Sewage samples were collected from a suburban community of the City of Logan, Utah, and analyzed to develop basic data on the changes in phosphorus content that might occur as a result of restricting the use of heavy-duty detergents. A baseline sample was collected first, and three weeks later the residents were requested not to use dishwashers and clotheswashers for a period of 48 hours to permit collection of test samples. Flow rates, C, N, P, Fe, BOD, pH, alkalinity, conductivity, suspended solids, and volatile solids were measured for the samples collected during the two periods. During the test period, total phosphorus decreased by 57 percent. The concentration of organic carbon and BOD almost doubled in the test sample while nitrogen remained approximately constant. Iron was relatively low in the raw sewage. Alkalinity, pH, and conductivity were in the range considered normal for raw sewage. The difference in solids concentration corresponds to the increase in organic carbon and BOD indicating that the lack of dilution water from the washers caused a significant increase in concentration in the test sample. It is concluded that additional research is necessary before decisions are made to restrict detergent usage or to remove phosphorus at treatment plants.

INDEX TERMS: Domestic wastes, Detergents, Phosphates, Water quality control, Nutrient removal, Characterization.

AMIC-9893
"EFFECTS OF HIGHWAYS ON SURFACE AND SUBSURFACE WATERS", Khanna, S. D., Public Works, Vol. 104, No. 11, November 1973, pp 123-124.

The construction of highways can create serious environmental problems in surface and subsurface waters. Such problems need to be identified and solutions considered during the design and location stage of highway construction. This paper identifies several general problem areas, discusses them briefly and offers solutions to either minimize detrimental effects or maximize beneficial effects. The general problem areas considered are: (1) quantity of water, (2) water resources projects, (3) storm drainage systems, (4) channel relocations, (5) flood controls and flood plains, (6) groundwater, (7) water recreation, (8) community utilities, and (9) water quality.

INDEX TERMS: Highway effects, Subsurface waters, Surface waters, Runoff, Storm drains, Water resources, Channels, Flood control, Flood plains, Groundwater, Water quality, Recreation, Erosion, Sedimentation, Channel relocation.

AMIC-9896
"MODIFIED ATOMIC ABSORPTION SPECTROSCOPIC METHODS IN ANALYSES OF TRACE METALS", Buttgereit, G., Zeitschrift fur Analytische Chemie, Vol. 267, No. 2, November 1, 1973, pp 81-88.

The basis of this experience report about atomic absorption spectroscopy with and without flame is the recognition and elimination of interferences. Interferences which are caused by the bonding state of the atoms, background absorption, viscosity and surface tension changes are discussed with the aid of examples for flame AAS including sample boat technique. A laboratory-made device with background compensator for the flameless mercury analysis, and a laboratory-made tantalum furnace for the flameless high temperature method are presented. The interferences by absorption superimpositions and optimizations in the direct analysis of heavy trace metals in urine, blood or serum are discussed in detail for commercial graphite furnaces. (In German)

INDEX TERMS: Spectroscopy, Trace elements, Urine, Absorption, Viscosity, Surface tension, Atomic absorption spectrophotometry, Blood, Biological samples, Serum.

AMIC-9899
"METHYLMERCURY IN ESTUARINE SEDIMENTS", Andren, A. W., Harriss, R. C., Nature, Vol. 245, No. 5423, October 5, 1973, pp 256-257.

A study was conducted to determine the concentration and distribution of methylmercury compounds in natural sediments from polluted and unpolluted coastal environments. Surface sediments were collected and analyzed from the Mississippi Delta, Mobile Bay, and the Florida Everglades. All the sediment samples were frozen immediately after collection and returned to the laboratory for the determination of total mercury, methylated mercury and total organic content. The methylmercury concentration varied from less than 0.02 ng/g to 0.19 ng/g, the high value being in the estuarine sediments from Mobile Bay. The most interesting aspect of the data is the fact that the methylmercury content never represents more than 0.07 percent of the total mercury present; the average is 0.03 percent. Measurements of methylmercury with depth in two cores from Mobile Bay were also made. Both cores were reducing except for the upper 4 to 5 cm. It is shown that the methylmercury values decrease with depth to minima of approximately 0.02 ng/g and that the methylmercury concentrations vary from 0.04 percent to 0.006 percent of the total mercury. The results suggest that future toxicological studies should emphasize biochemical mechanisms for synthesis of methylmercury from inorganic mercury species.

INDEX TERMS: Mercury, Sediments, Estuaries, Water pollution effects, Gulf of Mexico, Gas chromatography, Distribution patterns, Methylmercury, Mississippi Delta, Mobile Bay, Everglades, Sample preservation.

AMIC-9900
"MERCURY-SELENIUM CORRELATIONS IN MARINE MAMMALS", Koeman, J. H., Peeters, W. H. M., Koudstaal-Hol, C. H. M., et al., Nature, Vol. 245, No. 5425, October 19, 1973, pp 385-386.

Data on Hg and Se concentrations in the livers of dolphins, porpoises, and common seals showed a strong correlation of these two elements (correlation coefficient of 0.932). Work in progress indicates a similar correlation for the brain. This result suggests that the correlation reflects a causal relationship between mercury and selenium in marine animals. Se may have a protective effect against the toxic action of Hg in these animals as has been found in rats and Japanese quails. Additional observations that Hg in seal liver and brain is tightly bound and could not be recovered in the form of methylmercury may support the suggestion that Hg and Se occur together in animal tissues and are associated to proteins by means of S.

INDEX TERMS: Mercury, Toxicity, Correlation analysis, Methylmercury, Selenium, Dolphins, Porpoises, Seals (animals).

AMIC-9902
"NEW SPOT TESTS FOR NITRATES AND NITRITES", Hassan, S. S. M., Microchemical Journal, Vol. 18, No. 5, October 1973, pp 486-490.

Nitrates can be determined by placing a drop of the test solution in a microtest tube with aqueous hydroquinone solution and HCl, covering the mouth of the tube with filter paper treated with Griess reagent, and heating. Development of a pink or red spot indicates nitrates. An alternative test involves cooling the aforementioned solution, shaking with ether, and placing one or two drops of this solution on filter paper spotted with tetra base. A blue stain indicates nitrates. The lower detection limit for both procedures is 50 micrograms of KNO_3. Nitrites are determined by mixing a drop of test solution on a spot plate with one drop of Griess reagent. Nitrites produce a red color. The detection limit is 5 micrograms of KNO_2. Nitrates are identified in the presence of nitrites by adding sodium azide to the test solution before applying one of the previously described procedures. The detection limit is 60 micrograms of KNO_3. Nitrites can be detected in the presence of nitrates by the method described. The detection limit is 10 micrograms of KNO_2. Further tests were conducted to detect interfering ions.

INDEX TERMS: Nitrates, Nitrites, Aqueous solutions, Chemical analysis, Pollutant identification, Detection limits, Chemical interference.

AMIC-9903
"SEMIMICRODETERMINATION OF MERCURY(II) AND ZINC(II) BY PRECIPITATION FROM HOMOGENEOUS SOLUTION, USING CATION GENERATION TECHNIQUE", Johri, K. N., Kaushik, N. K., Bakshi, K., Microchemical Journal, Vol. 18, No. 5, October 1973, pp 497-501.

A gravimetric procedure for the evaluation of milligram quantities of mercury(II) and zinc(II) when present along with adverse ions is based on the technique of masking one or more constituents while precipitating the others. Besides potassium thiocarbonate (PTC), EDTA and ammonium tartrate have been employed as masking agents, thereby affording selective precipitation. In alkaline medium, PTC causes the precipitation of basic thiocarbonates of mercury and zinc. However, by the masking action of EDTA or ammonium tartrate, not only the hydroxide precipitation is prevented but the thiocarbonate precipitate obtained is clean and dense, having better filterable properties. The procedure for the determination of mercury is not applicable in the presence of Bi(III), Pb(II), and Cd(II) ions as the latter ions are also precipitated out with Hg(II). EDTA and ammonium tartrate, when added, prevent the precipitation of Zn(II), Cu(III), Al(III), Mo(VI), As(III), Sb(III), and Sn(II) against mercury(II). Cu(II), Ni(II), and Co(II) remain in the solution as their soluble thiocarbonate complexes with an excess of PTC. Since EDTA masks zinc completely against PCT, it could not be used in the case of zinc. Separations of zinc(II) have been carried out by adjusting the required pH of the solution. In acidic solution, Mo(VI), Sn(II), Sb(III), As(III), Cd(II), Hg(II) ions are separated from alkaline solution by adding an excess of PTC.

INDEX TERMS: Chemical precipitation, Mercury, Zinc, Gravimetric analysis, Ions, Pollutant identification, EDTA, Potassium thiocarbonate, Masking, Ammonium tartrate.

AMIC-9906
"ON THE REACTION BETWEEN IODIDE AND MERCURY(II)", Khalifa, H., Microchemical Journal, Vol. 18, No. 5, October 1973, pp 529-535.

A survey on the iodide-mercury(II) reaction and its analytical uses is given. Titrations of iodide with mercury(II) in various acidities, using nitrate, acetate, and chloride as titrants and silver or platinum amalgam as the indicator electrode, showed that mercury(II) nitrate is the best titrant giving 0.46 V/0.1 ml potential break in comparison with 0.14 V/0.1 ml of mercury(II) chloride and 0.35 V/0.1 ml of mercury(II) acetate, all titrants being 0.05 M in mercury(II).

INDEX TERMS: Mercury, Ions, Volumetric analysis, Electrodes, Iodides, Pollutant identification, Acidity, Chlorides, Nitrates, Ion selective electrodes, Acetates, Platinum electrodes, Silver electrodes, Amalgam.

AMIC-9910
"ELECTRON-DONOR-ACCEPTOR COMPLEXING REAGENTS IN THE ANALYSIS OF PESTICIDES. VI. INFLUENCE OF STRUCTURE IN DETECTION AND IDENTIFICATION", MacNeil, J. D., Frei, R. W., Hutzinger, O., Mikrochimica Acta, No. 5, 1973, pp 641-650.

Pesticides may be detected following thin-layer chromatography by spraying the chromatogram with a reagent which forms a pi complex with the pesticide. The effect of various pesticide structures and substituents in choosing a suitable pi complexing reagent is discussed, as well as the effect of these factors in influencing the color of the complex formed. Quantitative analyses may be performed in situ on the thin-layer chromatogram and positive identification of the pi complexed compounds may be made by mass spectrometry. The procedure should be applicable for formulation analysis or studies of pesticide decomposition. The sensitivity of these reagents (1-10 micrograms) is not sufficient, however, for them to be regarded as having a useful potential in residue analysis. Their principal use will be in cases where a non-destructive colorimetric method of detection offers an advantage.

INDEX TERMS: Pesticides, Pollutant identification, Mass spectrometry, Degradation (decomposition), Colorimetry, Thin layer chromatography, Spray reagents.

AMIC-9920
"ORGANIC FUNCTIONAL GROUP ANALYSIS VIA GAS CHROMATOGRAPHY. III. DETERMINATION OF CARBAMATES BY REACTION WITH ALKALI", Ladas, A. S., Ma, T. S., Mikrochimica Acta, No. 5, 1973, pp 853-862.

A gas chromatographic procedure for the analysis of carbamates employs a specially prepared reaction tube, packed with a 10 percent mixture of potassium hydroxide in glass beads, placed inside the injection port of a Perkin-Elmer 900 Gas Chromatograph in front of the chromatographic column packed with Porapak Q.S. A solution of the carbamates (0.01-0.1 micromole) is injected directly into the gas chromatograph. The carbamates are reacted with the alkali present in the reaction tube and the alcohols produced are separated, detected and recorded. Standard calibration graphs of the alcohols are prepared in the same manner and the quantities of carbamates are determined. The procedure is fast and quantitative.

INDEX TERMS: Carbamate pesticides, Gas chromatography, Alkalis (bases), Alcohol, Pollutant identification, Methyl carbamate, Ethyl carbamate, Iso-propyl carbanilate.

AMIC-9922
"CANCELLATION OF SPECTROPHOTOMETER SYSTEM CHARACTERISTICS USING AN ANALOG COMPUTER", Brach, E. J., Montour, M., St. Amour, G., Laboratory Practice, Vol. 22, No. 10, October 1973, pp 631-632.

A method to cancel the effect of spectral and environmental characteristics of the components of a spectrophotometer on spectral response curves of the absorption characteristics of materials are discussed. The method uses analog computer techniques. The spectral range covered is from 450 to 1050 nm. The position of the wavelength drive is interfaced to the analog computer by a potentiometric voltage divider, acting as a linear wavelength to analog voltage converter.

INDEX TERMS: Spectrophotometry, Analog computers, Potentiometers, Instrumentation, Transmittance, Spectral response, Cancellation, Monochromators.

See also: Category 2, AMIC-9657
Category 3, AMIC-9815
Category 5, AMIC-9790.

AMIC-9619
"EFFECT OF pH ON TOXICITY OF COPPER TO SCYTALIDIUM SP., A COPPER-TOLERANT FUNGUS, AND SOME OTHER FUNGI", Starkey, R. L., Journal of General Microbiology, Vol. 78, No. 2, October 1973, pp 217-225.

The effect of the chelating agents, oxine (8-hydroxy-quinoline) and EDTA (ethylenediaminetetra-acetic acid) on toxicity of copper to Scytalidium sp., and the influence of salts of iron, cobalt and chromium on development of the fungus, have been determined. Scytalidium sp. grew in acidic media (pH 2.0 to 0.3) saturated with copper sulphate (approx. 1 M) but was sensitive to low concentrations of copper (0.0004 M) near neutrality. Eleven other fungi (Aspergillus, Penicillium, Trichoderma, Fusarium, Monilinia, Stemphylium, and Rhizopus) differed in that they tolerated relatively high concentrations of copper near neutrality; nine tolerated high concentrations from pH 3.0 to 7.0, and six tolerated 0.004 M-copper sulphate at pH 2.0 to 7.0. Oxine was more toxic to Scytalidium sp. at neutrality than it was at an acid pH and in the presence of relatively large amounts of copper. EDTA had no appreciable effect on toxicity of copper. The fungus was relatively tolerant to chlorides of iron, cobalt and chromium at both neutral and acid pH.

INDEX TERMS: Copper, Toxicity, Hydrogen ion concentration, Fungi, Iron, Chromium, Cobalt, Chlorides, Cultures, Nitrogen, Scytalidium, Oxine, EDTA, Chelating agents.

AMIC-9652
"BIOLOGICAL EFFECTS OF OCEAN DISPOSAL OF SOLID WASTES", Pratt, S. D., Saila, S. B., Gaines, A. G., Jr., Krout, J. E., University of Rhode Island, Graduate School of Oceanography, Kingston, Rhode Island, Marine Technical Report Series Number 9, 1973, 53 pp.

The possible biological effects of disposal of compressed solid waste was studied by conducting literature research and laboratory tests with scaled down waste samples. Tests were conducted in tanks (16 ft X 1 ft X 1 ft) floored with test waste consisting of paper, food, tin cans, aluminum, plastic, and glass. A control tank was floored with sand. Oxygen uptake was studied in a 4 ft X 4 in. X 4 in. tank, and waste degradation was monitored in 20-gal tanks in a temperature controlled bath. A variety of dissolved substances were monitored in water overlying the waste and in interstitial water. Interstitial water was monitored in tanks containing high organic waste in salt water and in fresh water, high organic waste in salt water poisoned with mercuric chloride, and low organic waste in salt water. Analysis of gas production from the model systems and from slurries suspended in seawater showed that H_2, O_2, N_2, CH_4, CO_2, and H_2S were produced. Rate of oxygen uptake in the test tank was several times higher than that of the control tank, but never exceeded 100 ml/sw m/hr. Slides in the waste tank were fouled by filaments of sulfide bacteria which also contained nematodes, oligochaetes, and harpacticoid copepods. Only two large infaunal species colonized the waste deposits: Capitella capitata and Nereis succinea. Marine fish and shrimp died in 72-hr bioassays in which they were exposed to water flowing over the waste. No mortality occurred with barnacles, hermit crabs, rock crabs, mussels, surf clams, or ocean quahogs. The major toxicant was H_2S. It is concluded that degradation of solid

AMIC-9652 (Continued) Card 2/2

waste will be slow in the ocean. However, more research is needed before the long-term effects and consequent safety of ocean disposal can be adequately assessed.

INDEX TERMS: Model studies, Water pollution effects, Degradation (decomposition), Waste disposal, Oceans, Solid wastes, Laboratory tests, Oxygen demand, Gases, Marine fish, Benthic fauna, Connate water, Sea water, Fate of pollutants, Gas production.

AMIC-9656
"IN-PLANT BIOLOGICAL MONITORING", Cairns, J., Jr., Sparks, R. E., Industrial Water Engineering, Vol. 10, No. 5, September/October 1973, pp 22-24.

The quality of plant effluents can be monitored by recording the breathing rate, swimming rate or other physiological activities of fish and other organisms subjected to the effluent in tanks. After baseline values have been established with unpolluted water, the presence of toxic substances can be detected by the occurrence of abnormal activity. The sensor signals can be sent to a computer which automatically compares the values with baseline values and sounds an alarm in the event of significant changes. If the alert were sounded, the effluent would be analyzed to detect the toxic pollutant and its sources. The method is also potentially useful for river management.

INDEX TERMS: Industrial wastes, Water quality, Bioassay, Monitoring, Animal physiology.

AMIC-9657
"BIOLOGICAL RESPONSE TO DETERGENT AND NONDETERGENT PHOSPHORUS IN SEWAGE - PART I", Porcella, D. B., Cowan, P. A., Middlebrooks, E. J., Water and Sewage Works, Vol. 120, No. 11, November 1973, pp 50-67.

Sewage effluent from a suburban community of the City of Logan, Utah, was collected during times when detergents were and were not used to ascertain whether the elimination of phosphate detergents would affect algal growth. Algal bioassays were conducted with Selenastrum capricornutum and Anabaena flos-aquae using nutrient spikes to determine which nutrients were limiting. Bioassays were also performed using secondary treated, detergent-free sewage samples spiked with detergent to observe whether any increase in biostimulation resulted. The nutrient spikes were NH_4Cl, KH_2PO_4, Fe and trace elements, and NAAM solution for control. Chemical analysis of the sewage samples showed that restricted use of detergent resulted in a 57 percent decrease in phosphorus content; alum treatment also reduced phosphorus content. However, calculated phosphorus concentrations in the bioassay flasks for different dilutions of the secondary and tertiary effluents of the two sewage samples indicated the P content was high as a result of the high level of P in the reservoir water used for dilution. It is concluded that if the P content of the water is naturally high, the addition of more P will not affect algal growth. The results of the algal bioassays are not included in this part of the report.

INDEX TERMS: Algae, Detergents, Growth rates, Limiting factors, Phosphorus, Waste treatment.

AMIC-9662
"STUDIES ON UPTAKE AND LOSS OF METHYLMERCURY-203 BY BLUEGILLS (LEPOMIS MACROCHIRUS RAF.)", Burrows, W. D., Krenkel, P. A., Environmental Science and Technology, Vol. 7, No. 13, December 1973, pp 1127-1130.

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

INDEX TERMS: Bioassay, Sunfishes, Bioaccumulation, Biotransformation, Methylmercury.

AMIC-9666
"EUTROPHICATION OF LAKE 227 BY ADDITION OF PHOSPHATE AND NITRATE: THE SECOND, THIRD, AND FOURTH YEARS OF ENRICHMENT, 1970, 1971, AND 1972", Schindler, D. W., Kling, H., Schmidt, R. V., et al., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1415-1440.

Lake 227, a small lake with extremely low concentrations of dissolved inorganic carbon, was fertilized with PO_4 and NO_3 for 4 years, beginning in 1969. The additions increased natural inputs of phosphorus and nitrogen about five times. Phytoplankton standing crop increased nearly two orders of magnitude, and the Cryptophyceae and Chrysophyceae present in natural lakes of the area were replaced by Chlorophyta and Cyanophyta. The standing crop of phytoplankton per square meter was near the maximum which could theoretically be maintained by surface light, in spite of the low carbon concentrations. Added phosphate and nitrate were rapidly removed by phytoplankton, so that concentrations in the lake remained low. Almost all of the added nutrient was retained by the lake, in spite of relatively fast water renewal times. An average of 80 percent of the phosphorus income of the lake was sedimented. There was no return of phosphorus from sediments in spite of anoxic conditions in the hypolimnion. Photosynthesizing plankton reduced dissolved inorganic carbon concentrations severely, causing a flux of atmospheric CO_2 into the lake. From 69 to 95 percent of the inorganic plus particulate carbon supplied to the lale was from the atmosphere. Results demonstrate that low carbon concentrations do not hinder eutrophication if phosphorus and nitrogen supplies are adequate.

INDEX TERMS: Limiting factors, Phosphates, Nitrates, Eutrophication, Carbon, Growth rates, Dominant organisms, Phytoplankton, Primary productivity.

AMIC-9668
"A NUMERICAL MODEL FOR DETERMINING INTEGRAL PRIMARY PRODUCTION AND ITS APPLICATION TO LAKE MICHIGAN", Fee, E. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1447-1468.

A computer-based model for determining production by phytoplankton, integrated over depth and over an arbitrary time interval, is described. The solution incorporates light inhibition and uses the actual distribution of surface irradiance for the time interval of interest, since it is not possible to predict the detailed nature of cloudiness. Statistical procedures for estimating the model parameters from experimental data relating the rate of carbon uptake to irradiance are described. The model is applied to data collected from May 27, 1970 through February 3, 1971, from Lake Michigan. Integral primary production was bimodal at inshore and offshore stations with minimum production in midsummer and winter. There was great daily variability of integral production, due solely to variation of light. From this it is inferred that occasional in situ measurements would give a very poor knowledge of true seasonal trends. The model output was verified by performing two in situ experiments. The agreement was better than 95 percent on both dates. The model makes it possible to estimate integral primary production on a routine basis in large water bodies with well-mixed photic zones.

INDEX TERMS: Primary productivity, Lake Michigan, Phytoplankton, Light, Mathematical models, Carbon, Computer programs.

AMIC-9673
"DIURNAL VARIATION OF DISSOLVED INORGANIC CARBON AND ITS USE IN ESTIMATING PRIMARY PRODUCTION AND CO2 INVASION IN LAKE 227", Schindler, D. W., Fee, E. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1501-1509.

In the course of studying phytoplankton response to low carbon levels and fertilization with phosphate and nitrate in lake 227 a eutrophic softwater lake in the Canadian Shield, several paradoxes were observed. Although standing crop increased after fertilization, primary productivity as measured by C-14 uptake at midday remained the same as for unfertilized lakes. Furthermore, although carbon was shown not to limit phytoplankton standing crop, certain observations pointed to carbon limitation of photosynthesis. To attempt to resolve these inconsistences, a new method was employed based on the diurnal variation of dissolved inorganic carbon (DIC), community respiration, and invasion of CO2 as measured by gas chromatography. Errors were found to result from diurnal variations in the degree of carbon limitation of phytoplankton and from invasion of CO2 from the atmosphere and hypolimnion. Production by phytoplankton in lakes fertilized with nitrogen and phosphorus was found to be several times higher than in natural lakes of the area. Net production during summer stratification was found to be equal invasion of CO2 from the atmosphere. The new technique should have application in other eutrophic low carbon lakes, where C-14 tracer techniques are encumbered by serious technical complications.

INDEX TERMS: Photosynthesis, Limiting factors, Carbon, Primary productivity, Diurnal, Gas chromatography, Standing crops.

AMIC-9674
"PRODUCTION OF EPILITHIPHYTON IN TWO LAKES OF THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO", Schindler, D. W., Frost, V. E., Schmidt, R. V., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1511-1524.

Two new techniques for measuring photosynthesis by benthic algal flora in waters low in dissolved inorganic carbon are described. The first uses gas chromatography to measure changes in DIC in incubation chambers directly. The second is a variation of the usual C-14 procedure, in which disappearance of C-14 from the water is measured by liquid scintillation instead of uptake of C-14 by the algae. This procedure is simpler than measuring the uptake of C-14, because digestion and/or combustion of samples is not necessary. Results are compared with the commonly employed C-14 uptake and O2 release techniques. Tests showed that heterogeneity of substrate was the major source of variation in in situ results, being large enough to make interpretation of seasonal effects and other causal factors extremely difficult. Annual production by epilithiphyton in two natural lakes in the Experimental Lakes Area (ELA) was 5.19 g C and 5.18 g C/sq m of substrate annually for lakes 239 and 240, respectively. These are the lowest values recorded for freshwater lakes at temperate latitudes. Because DIC and O2 concentrations could be measured simultaneously, it was possible to calculate photosynthetic quotients on several dates. These were extremely high, averaging 2.6 for the summer of 1971.

INDEX TERMS: Gas chromatography, Benthic flora, Primary productivity, Absorption, Photosynthesis, Carbon, Scintillation counting, Substrates, Incubation chambers.

AMIC-9676
"MEASUREMENT OF ADENOSINE TRIPHOSPHATE (ATP) IN TWO PRECAMBRIAN SHIELD LAKES OF NORTHWESTERN ONTARIO", Rudd, J. W. M., Hamilton, R. D., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1537-1564.

Water samples were collected in Van Dorn bottles from lakes 227 and 302 in the Precambrian shield area of northwestern Ontario for analysis of ATP over several months. Samples were filtered through a 250-micron net and three subsamples prepared for extraction by passing through a 0.22-micron, 47-mm GS Millipore filter and 10-micron and 56-micron nylon mesh filters. ATP analyses were performed under diffuse incandescent light in modified glass scintillation vials. Large seasonal changes were evident, as were specific sites of high biological activity due either to natural stratification or to deliberate manipulation. Chlorophyll a, particulate carbon, and direct count data were found to be misleading in specifying the changes or the sites of biological activity. Analysis of the ATP data on the basis of the relative abundance of different size fractions was found to be useful. An ATP filtration error could not be demonstrated, indicating that cell breakage is not a source of the filtration error inherent in some C-14 primary and secondary productivity studies.

INDEX TERMS: Primary productivity, Secondary productivity, Lakes, Adenosine triphosphate.

AMIC-9677
"HETEROTROPHIC UTILIZATION OF SUCROSE IN AN ARTIFICIALLY ENRICHED LAKE", Thompson, B. M., Hamilton, R. D., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1547-1552.

Lake 304 in the Canadian Shield area was enriched with C, N, and P as sucrose, ammonium chloride, and orthophosphoric acid to investigate the role of organic carbon in eutrophication. The investigation included study of the kinetics of sucrose transformation, comparison of particulate carbon produced by heterotrophic processes with that produced by algal photosynthesis and supplied by other sources, disappearance of sucrose immediately after enrichment using a laboratory experiment, and comparison of the uptake of glucose and sucrose in lakes 304 and 227. The lake was enriched with C-14-labeled sucrose at a rate of 5.54 g C/sq m/yr. Heterotrophic activity exhibited fluctuations representing the damped oscillations of a disturbed steady state system, stabilizing 3 months after the commencement of enrichment. By late summer, reduction of the weekly addition of sucrose to a few micrograms per liter was accomplished within a day by the increased microbial activity resulting from rapid growth of heterotrophic microorganisms. Heterotrophic conversion (preenrichment) of sucrose to particulate carbon in the epilimnion between July and October 1971 was 2-17 percent of primary production. 25-35 percent of total sucrose utilized was converted to carbon dioxide, the remainder being incorporated into particulate material or released as nonvolatile products of metabolism.

INDEX TERMS: Eutrophication, Kinetics, Bioassay, Metabolism, Substrate utilization, Biotransformation, Sucrose, Fate of pollutants, Organic carbon, Heterotrophic bacteria, Particulate matter.

AMIC-9678
"EFFECTS OF CADMIUM AND COPPER ON THE OXIDATION OF LACTATE BY RAINBOW TROUT (SALMO GAIRDNERI) GILLS", Bilinski, E., Jonas, R. E. E., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1553-1558.

The purpose of this study was to determine whether or not the exposure of rainbow trout to copper and cadmium salt solutions results in a significant inhibition of lactate oxidation in gills. Fish were exposed to 11.2-0.0112 mg/l CdCl2 for 4-96 hr in fiberglass tanks. After exposure, fish were decapitated, the gill arches cut out, and gill filaments removed and weighed. The oxidative activity in gill filaments was determined by measuring the liberation of C-14-labeled CO2 from C-14-labeled Na-lactate-3-C. Gills were also analyzed for Cd and Cu content and examined histologically. At the highest Cd concentration (11.2 mg/l), fish died in 7 hr. At 1.12 mg Cd/l, fish mortality was 50 percent; of the fish surviving, oxidative activity was inhibited by 50 percent. All fish died in 24 hr when exposed to the highest level of copper (0.636 mg/l). At a concentration of 0.064 mg Cu/l, 50 percent of the fish died; of those surviving, oxidative activity was inhibited by 53 percent. Comparatively high levels of cadmium (20 micrograms) or copper (50 micrograms) were needed to produce in vitro inhibition of lactate oxidation by gill filament. The histological studies suggest that impairment of oxidative activity might be due to disruption of cellular organization or to inhibition of enzyme activity. The lactate oxidation test appears to be useful only at high levels of Cd and Cu, however it could be useful in detecting gill damage with other toxicants.

INDEX TERMS: Bioassay, Cadmium, Copper, Rainbow trout, Oxidation, Animal physiology, Lactates, Sample preparation, Histology, Gills.

AMIC-9680
"BIOASSAY PROCEDURES TO EVALUATE ACUTE TOXICITY OF NEUTRALIZED BLEACHED KRAFT PULP MILL EFFLUENT TO PACIFIC SALMON", Davis, J. C., Mason, B. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1565-1573.

A series of bioassays was carried out to assess the acute toxicity of neutralized, filtered, bleached kraft pulp mill effluent (BKME) from a single mill to underyearling Pacific salmon in fresh soft water, at 10-13 C. Toxicity expressed in terms of the 96-hr LC50 varied from 22 percent of full strength BKME to nontoxic in different collections. A procedure is described for estimating the 4-day LC50 from geometric mean survival time data. Toxicity of effluents changed unpredictably with storage (even at 2 C), and declined with air stripping. Comparison of continuous flow and static test procedures indicated that continuous flow procedures yield somewhat higher toxicity results than static tests. Experiments with varying fish densities indicate that measurable toxicity is less in static tests with heavy figsh loading. Use of loading densities of 2.5 liters/g fish or better is recommended. Young sockeye salmon (Oncorhynchus nerka) appeared most sensitive, and pink (O. gorbuscha) and coho (O. kisutch) salmon somewhat more resistant to toxic BKME solutions. No correlation was found between time to death and condition factor in the size range of underyearling coho tested (3.0-7.3 cm). Recommendations are made for routine and regulatory bioassay procedures.

INDEX TERMS: Bioassay, Toxicity, Sockeye salmon, Pink salmon, Bleached kraft pulp mill wastes, Coho salmon.

AMIC-9681
"MERCURY UPTAKE AND ION DISTRIBUTION IN GILLS OF RAINBOW TROUT (SALMO GAIRDNERI): TISSUE SCANS WITH AN ELECTRON MICROPROBE", Olson, K. R., Fromm, P. O., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1575-1577.

Rainbow trout were exposed to 0.25 ppm HgCl2 and 0.05 ppm methylmercury for 23 hr and the gills removed and examined by electron microprobe for the purpose of identifying the pathway of Hg uptake. Gills were prepared by quick freezing, cutting into 4-10-micron sections, mounting on quartz slides or carbon discs, and freeze drying. Mercury was found in gills of rainbow trout which had been exposed to inorganic mercury but not in those exposed to methylmercury. No specific site for mercury uptake was identified and it is suggested that inorganic mercury enters the gill across the general lamellar surface. High concentrations were found associated with the gill cartilage. Since little ion diffusion occurs during tissue preparation, localization and/or identification of tissues can be accomplished by scans for various elements: sodium (Na), potassium (K), chlorine (Cl), and sulfur (S). The technique is not suitable for identification of highly volatile compounds such as methylmercury due to the necessity of subjecting tissues to high vacuum conditions, however, electron probe analyses should be useful in studies of active ion transport systems in gill tissue and in investigations of the effects of heavy metal pollutants on fishes.

INDEX TERMS: Rainbow trout, Mercury, Distribution patterns, Gills, Methylmercury, Bioaccumulation, Sample preparation.

AMIC-9683
"APPARATUS FOR RECORDING AVOIDANCE MOVEMENTS OF FISH", Scherer, E., Nowak, S., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1594-1496.

An apparatus for continuously recording movements of fish exposed to chemical substances in a tank consists of an open sight viewer connected to the shaft of a power-supplied potentiometer and mounted so that an observer can track a specimen in the test chamber. The tank is designed with inlets at each end and an outlet in the middle so that a test solution can be precisely added to one end and untreated water at the other end of the tank. The tank is observed through a one-way mirror to reduce visual disturbance of the fish. Varying the position of the viewer changes the output voltage from the potentiometer to a strip chart recorder. The viewer also actuates a voltage sensitive switch which activates a timer when the fish enters one half of the tank and gives a cumulative time of exposure to the conditions in that section. A second timer records overall elapsed test time. Sample recordings show the avoidance response of goldfish when exposed to HgCl2. Total cost of materials to build the system is 1350 dollars, and construction time is about 50 manhours.

INDEX TERMS: Toxicity, Bioassay, Laboratory equipment, Fish, Movement, Design criteria, Costs.

AMIC-9689
"INFLUENCE OF ENVIRONMENTAL EXPERIENCE ON RESPONSE OF YEARLING RAINBOW TROUT (SALMO GAIRDNERI) TO A BLACK AND WHITE SUBSTRATE", Ritter, J. A., MacCrimmon, H. R., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1740-1742.

Yearling rainbow trout (Salmo gairdneri) selected black substrate regardless of size or rearing experience when first introduced into an experimental tank offering a choice of black or white. Differences in the degree of black selection among the various lots of the same strain during the initial 120 min of exposure, under an illumination of .01 lx, were correlated only with the level of swimming activity. By 24 hr, only pond-reared fish continued to select black while laboratory-reared fish were randomly distributed over black and white. The continuing wariness of only the pond-reared fish reveals the long-term effect of prior experience of juvenile trout behavior. This finding indicates the possible feasibility of environmental conditioning for wariness in the artificial propagation of hatchery-reared fis for live release.

INDEX TERMS: Rainbow trout, Color, Distribution patterns, Sediments, Substrates.

AMIC-9690
"ENDRIN UPTAKE AND RELEASE BY FINGERLING CHANNEL CATFISH (ICTALURUS PUNCTATUS)", Argyle, R. L., Williams, G. C., Dupree, H. K., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1743-1744.

Fingerling channel catfish (Ictalurus punctatus) offered diets containing 0.04-4.0 micrograms endrin/g food (dry weight) rapidly accumulated the pesticide. Amounts in the tissues as determined by gas chromatography were directly proportional to amounts in the food. Dietary endrin had no measurable effect on growth or mortality. After endrin was withdrawn from the diet, it rapidly disappeared and could not be detected after 41 days. In fish exposed to 0.5 microgram endrin/liter of water, mortalities began at tissue levels of 0.7 microgram endrin/g of wet whole fish and total mortality occurred at levels near 1.0 microgram/g.

INDEX TERMS: Bioassay, Channel catfish, Mortality, Growth rates, Endrin, Elimination, Bioaccumulation.

AMIC-9691
"A PORTABLE WIDE-SPEED INDICATOR FOR USE WITH PLANKTON NETS", Lusz, L. D., Waldron, K. D., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1749-1751.

A wire-speed indicator for monitoring the rate of wire payout or retrieval during plankton tows consists of a metering wheel, a tachometer-generator, and a readout meter. The tachometer-generator is driven by the metering wheel and produces output which is fed to the readout meter. The unit is self-contained, provides remote readout, and measures wire travel up to 50 m/min. It has been used satisfactorily during about 100 tows.

INDEX TERMS: Plankton nets, Design criteria, Wire speed indicators.

AMIC-9694
"DIVERSITY IN FRESH-WATER PHYTOPLANKTON", Moss, B., The American Midland Naturalist, Vol. 90, No. 2, October 1973, pp 341-355.

Phytoplankton samples were collected from three water bodies, Gull Lake (Kalamazoo, Mich.), Priddy Pool, and Abbot's Pond (Somerset, U. K.), for as long as 2 years, the species counted, and diversity calculated using a derivative of the Shannon formula. In the more eutrophic bodies, diversity increased in summer but was low in winter. Diversity decreased with increased fertillity of the water. The data confirm predictions made in the literature, but existing explanations of the phenomena are considered unnecessarily complex. An explanation based on the balance of cell numbers between overlapping populations of several species is given, supported by a simple mathematical model. The pigment diversity index and the nature of succession (periodicity) in freshwater phytoplankton are discussed.

INDEX TERMS: Phytoplankton, Seasonal, Nutrients, Mathematical models, Water quality, Eutrophication, Succession, Dominant organisms, Species diversity, Data interpretation.

AMIC-9696
"DIVERSITY AND LONGITUDINAL ZONATION IN FISH POPULATIONS OF TWO STREAMS ENTERING A METROPOLITAN AREA", Tramer, E. J., Rogers, P. M., The American Midland Naturalist, Vol. 90, No. 2, October 1973, pp 366-374.

The distribution and relative abundance of fishes were surveyed in Swan and Tenmile creeks, Lucas Co., Ohio, from their headwaters in a rural agricultural area to points near the center of the city of Toledo, Ohio. Twenty-one species were found in each creek. Of the total of 27 species collected only two, Semotilus atromaculatus and Notropis stramineus, occurred at each sample station. Species diversity along both streams followed no definite pattern, even when the creeks became grossly polluted, since declines in the number of species present were often offset by shifts toward relative abundances which were more evenly distributed. Fish species diversity was not correlated with an index of habitat diversity. Furthermore, unlike other longitudinal zonations, diversity was not correlated with mean depth of the stream or with distance from the headwaters, and species composition changes took the form of replacements rather than additions to the headwaters assemblage. We conclude that pollution stress cancelled out the effects of factors such as substrate diversity and mean depth, thereby obliterating the normal patterns of diversity and longitudinal zonation.

INDEX TERMS: Systematics, Distribution patterns, Freshwater fish, Water pollution effects, Depth, Streams, Sampling, Habitats, Data interpretation.

AMIC-9698
"CAMBARUS BUNTINGI, A NEW SPECIES OF PUNCTICAMBARUS (DECAPODA, ASTACIDAE) FROM KENTUCKY AND TENNESSEE, Bouchard, R. W., The American Midland Naturalist, Vol. 90, No. 2, October 1973, pp 406-412.

Cambarus buntingi, a new species of crayfish from the Cumberland Plateau and Great Valley in Tennessee and the Cumberland Plateau in Kentucky, is described. Color notes, relationships, distribution, life history notes and ecological data are given.

INDEX TERMS: Crayfish, Distribution patterns, Habitats, Tennessee, Kentucky, Color, Ecological distribution, Cambarus buntingi, Puncticambarus, Decapods.

AMIC-9707
"THE DISTRIBUTION OF ASELLUS AQUATICUS (L.) AND PROASELLUS MERIDIANUS (RAC.) IN THE SOUTHWESTERN PART OF THE NETHERLANDS", Wolff, W. J., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 381-392.

The freshwater isopods Asellus aquaticus and Proasellus meridianus are common in the Netherlands. The distribution of both species in the southwestern part of the Netherlands seems to indicate that small ecological differences between both species exist. This paper reports on these differences and discusses them in relation to the results of previous authors. The ecological similarity of the two species apparently may be extended to their tolerance to raised salinities. On the other hand it was possible to confirm that these species react differently to water pollution. The main conclusion of this study is, however, that A. aquaticus and P. meridianus form an extremely interesting couple of species. A study of the way they colonize the future fresh Delta lakes therefore may result in valuable data on interaction of closely related species, and also has considerable theoretical interest. Such a study is planned.

INDEX TERMS: Distribution patterns, Salinity, Systematics, Water pollution effects, Habitats, Water quality, Brackih water, Asellus aquaticus, Proasellus meridianus, Netherlands.

AMIC-9708
"SELF- PURIFICATION AND CILIATE COLONIZATION IN ACID ENVIRONMENT (MODEL EXPERIMENT)", Bick, H., Drews, E. F., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 393-402.

Because acid precipitation originating from air pollution may increase the acidity of lakes and rivers, a study was conducted of the effects of acidification on the population dynamics of bacteria and protozoa associated with the decomposition of peptone. Increasing acidification with sulfuric acid caused reduced rate of decomposition and nitrification. Below pH 5 no oxidation of ammonia took place. Total counts of bacteria and ciliates as well as number of species of ciliated Protozoa decreased slowly within the pH-range 7 to 5, but rapidly at pH-values 5 to 3. The limits of tolerance to high hydrogen ion concentration are summarized for 29 species of freshwater ciliates. (In German)

INDEX TERMS: Acidity, Bacteria, Protozoa, Freshwater, Lakes, Rivers, Air pollution effects, Peptides, Degradation (decomposition), Hydrogen ion concentration, Nitrification, Ammonia.

AMIC-9714
"THE OXYGEN CONSUMPTION OF MAYFLY (EPHEMEROPTERA) AND STONEFLY (PLECOPTERA) LARVAE AT DIFFERENT OXYGEN CONCENTRATION", Nagell, B., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 461-489.

The aim of this investigation was to elucidate how four aquatic insect larvae, from different habitats and having different respiratory organs or types of respiratory regulation, react to a lowered oxygen concentration, and how their oxygen consumption is affected. The species investigated where the stoneflies Taeniopteryx nebulosa, Diura nanseni and Nemoura cinerea and the mayfly Cloeon dipterum. Water of known oxygen concentration was allowed to flow past the experimental larvae. The oxygen consumption of the larvae was calculated from the lowering of the oxygen concentration which ensued. The critical point on the curve representing mean oxygen consumption as a function of oxygen concentration was found to be a 4-5 mg O2/l for Nemoura. The values refer to 8 C. No influence on the oxygen consumption of starvation for 4 to 5 days was found. No difference between the oxygen consumption values obtained in the presence or in the absence of calcium ions could be observed during the experiments. The basic picture obtained in this investigation is a set of oxygen consumption values scattered between a curve connecting highest values obtained and a curve of the standard metabolism together with a zone in which the larvae are activated by reduced oxygen concentrations.

INDEX TERMS: Respiration, Stoneflies, Mayflies, Larvae, Metabolism, Water pollution effects, Behavior, Calcium, Temperature, Osmotic pressure, Oxygen consumption, Motor activity.

AMIC-9715
"POPULATION DYNAMICS OF POND ZOOPLANKTON. II. DAPHNIA AMBIGUA SCOURFIELD", Angino, E. E., Armitage, K. B., Saxena, B., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 491-507.

Statistical relationships of 27 environmental components with population units of D. ambigua were determined for fifty weeks in a pond in northeastern Kansas. Simultaneous analyses accounted for more variability in total number/l and in the number of ovigerous females/l than did any of the lag analyses; 1-week lag accounted for the greatest amount of variability in clutch size. Calcium was the most important variable determining density of Daphnia. Temperature and chlorophyll a (as a measure of food) were relatively unimportant in affecting total number. Other environmental components accounting for at least 2 percent of the variation in no lag were nitrite, ammonia, iron, chloride, phosphate, magnesium, sulfate and manganese. Temperature and boron were the most important variables affecting the number of egg-bearing females/l. Boron, nitrate, chloride, and strontium were the most important variables affecting clutch size. Food apparently affected clutch size in a minor way. The environmental components affect Daphnia ambigua and Diaptomus pallidus in quite different ways. These differences may prevent either species from maintaining dominance and excluding the other and could account for the widespread pattern of co-occurrence of diaptomid and daphnid species.

INDEX TERMS: Zooplankton, Environmental effects, Population, Density, Statistical methods, Calcium, Nitrites, Ammonia, Iron, Chlorides, Phosphates, Magnesium, Sulfates, Reproduction, Manganese, Ovigerous females.

AMIC-9716
"NITROGEN AND PHOSPHORUS RELEASE FROM DECAYING WATER MILFOIL", Nichols, D. S., Keeney, D. R., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 509-525.

To evaluate the net N and P contribution to water from herbicide-killed aquatic weeds, water milfoil containing 1.5 percent N and 0.30 percent P was killed with endothal and allowed to decompose, in the dark, in water only or sediment-water systems. Changes with time in dry weight, total N and P, and organic C in the plant material, and organic and inorganic forms of N and P in the water were determined. Plant decomposition was limited by N. Inorganic N was released by the sediment, and decomposition was more rapid when sediment was present. A smaller N requirement for decomposition under conditions of low O2 was postulated as a possible explanation of the more rapid decomposition observed in the absence of aeration. The presence of plant P in excess of decomposition requirements resulted in rapid accumulation of organic P, followed by inorganic P, in the water. Organic N appeared in the water early in the experiments, but was depleted rapidly, and inorganic N was apparently immobilized as soon as it was formed. In the presence of sediment, organic N and inorganic P levels were much lower. On treating of water milfoil with herbicide, rapid P release can be expected. It would appear that N release from decaying weeds is much slower than P.

INDEX TERMS: Nitrogen, Phosphorus, Herbicides, Carbon, Hydrogen ion concentration, Analytical techniques, Aquatic weeds, Degradation (decomposition), Sediments, Aeration, Biomass, Oxygen, Water milfoil, Endothal, Organic carbon.

AMIC-9717
"THE BIOLOGY OF MYSIDS ACCLIMATIZED IN THE RESERVOIRS OF THE VOLGA RIVER", Borodich, N. D., Havlena, F. K., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 527-539.

Mysids were successfully introduced and acclimatized in the artificial reservoirs of the Volga River. They live there in the shallow sandy areas and their numbers amount to 300-500 ind./sq m. They avoid direct sunlight, make slight vertical migrations according to the light intensity; during the morning hours their maximum is at the depth 0.2 m, at noon in 0.1-1.5 m. It has been proved that their biological features in the new localities do not differ from those in the original localities.

INDEX TERMS: Systematics, Habitats, Environment, Reservoirs, Light intensity, Migration, Reproduction, Behavior, Adaptation, Mysids.

AMIC-9719
"RELATIONSHIPS BETWEEN LEVELS OF RADIOCESIUM IN DOMINANT PLANTS AND ARTHROPODS IN A CONTAMINATED STREAMBED COMMUNITY", Anderson, G. E., Gentry, J. B., Smith, M. H., OIKOS, Vol. 24, No. 2, 1973, pp 165-170.

For several years Steel Creek (South Carolina) received reactor cooling water and disassembly basin effluents from two nuclear production reactors located near the stream's headwaters. When the stream no longer received reactor effluent in 1968, water flow was reduced and portions of the old streambed became exposed. Contaminated vegetation then became available to animals as food. Thus, a unique opportunity was created to study the fate of radionuclides in a natural system. Preliminary study of the Steel Creek system was an investigation into the radiocesium levels and concentration ratios of a plant - herbivore - predator food web. Emphasis has been to develop predictive models for radiocesium concentrations in the system. Samples of vegetation and arthropods were collected, analyzed for radiocesium by scintillation counting, and the results statistically analyzed to determine whether any relationship existed between radioisotope concentrations. Mean cesium concentrations were significantly higher on the islands than on floodplain areas. There were no consistent trends for increasing or decreasing concentration across trophic levels. However, the degree of linear correlation between radiocesium concentrations in different types of plants and arthropods was significant and makes possible a model to predict radiocesium levels in other components of the system. Predictability was highest between the various arthropod groups and lowest among the different plant types. Between the two possible producer-herbivore-predator associations (broomsedge-grasshopper-spider, and broomsedge-leafhopper-spider) radiocesium concentrations ratios differed significantly.

AMIC-9719 (Continued) Card 2/2

INDEX TERMS: Cesium, Radioactive wastes, Food webs, Flood plains, Vegetation, Path of pollutants, Nuclear reactors, Radioisotopes, Streams, Insects, Statistical methods, Ecosystems, Arthropods.

AMIC-9720
"ALGAL ASSAYS OF ARCHIPELAGO WATERS. QUANTITATIVE ASPECTS", Lindahl, P. E. B., Melin, K. E. R., OIKOS, Vol. 24, No. 2, 1973, pp 171-178.

Eighteen surface water samples were collected during 1970 from Lake Malaren (freshwater) and to the outer part of the Stockholm Archipelago (brackish water). After filtration most samples were enriched with phosphate (P), nitrate (N) and chelated trace elements (TE), alone or in combination, and inoculated with blue-green algae, Oscillatoria agardhii or Aphanizomenon flos-aquae, isolated from the investigated area. The algae (not free from bacteria) were cultivated under standard conditions. The dry weight at harvesting was used to evaluate the growth-stimulating effect (in comparison with unenriched controls) of the additions. The yields of O. agardhii (the controls and those with all three additions) were largest 17-26 km to the east of Slussen, the Stockholm lock. During the year the smallest growth occurred during summer. The results with A. flos-aquae followed a similar distribution pattern. Regression analysis of the results with O. agardhii showed that enrichment with TE or P, along or together, did not stimulate growth. The addition of N, alone and in combinations with TE or P, stimulated the growth, in proportion to the growth in the unenriched water samples. The enrichment with P plus N plus TE gave the largest stimulation.

INDEX TERMS: Freshwater, Brackish water, Sewage treatment, Cyanophyta, Phosphates, Nitrates, Chelation, Trace elements, Growth rates, Water pollution effects, Sewage.

AMIC-9722
"SUCCESSION IN BENTHIC MACROFAUNA IN A SWEDISH FJORD SUBSEQUENT TO THE CLOSURE OF A SULPHITE PULP MILL", Rosenberg, R., OIKOS, Vol. 24, No. 2, 1973, pp 244-258.

Quantitative sampling of the fauna in a Swedish fjord was made in 1971 and 1972 to complement previous data about the faunal recovery after the cessation of the sulphite pulp mill in 1966. In 1972 the succession had approached a final phase in which the fauna had regained a composition similar to that found forty years earlier. The benthic faunal increment, expressed as dry weight, in Saltkallefjord over the period 1968-71 was roughly estimated to 20 percent and the yearly production to 70-80 tons on this 4.4 sq km area. Different indices have been used to describe the communities and the diversity. The succession showed a logistic pattern similar to population growth curves.

INDEX TERMS: Pulp wastes, Sulfites, Biological communities, Succession, Statistical methods, Growth rates, Population, Fjords, Benthic fauna, Water pollution effects, Species diversity, Repopulation.

AMIC-9728
"EFFECT OF CHELATION ON TOXICITY OF COPPER", Morris, O. P., Russell, G., Marine Pollution Bulletin, Vol. 4, No. 10, October 1973, pp 159-160.

The effect of chelation on copper toxicity to algae was studied in the laboratory using EDTA as a chelating agent and Ectocarpus siliculosus as the algae. Three growth media were used. The basic medium was a formulation with Na2 EDTA excluded to make the medium as inorganic as possible. The second consisted of the basic formulation plus 3.7 mg EDTA per liter. The third was 'Erd Schreiber' medium, which contains soil extract. A series of copper concentrations was prepared in each medium giving from 0.00 to 1.00 mg Cu (2 plus)/liter. The plant material was inoculated into the media and cultures were grown at 11 C and a continuous light intensity of 2,700 lux. Volumetric analysis of growth was made after 35 days. The growth rate of Ectocarpus in the basic medium dropped very rapidly with increasing copper, and there was no increase in plant volume over 35 days, at a concentration of 0.45 mg Cu (2 plus)/l. The presence of EDTA increased this critical concentration, the Ectocarpus continuing to show some growth up to a level of over 0.85 mg Cu (2 plus)/l. It was concluded that the effect of chelation on the toxicity of copper to Ectocarpus siliculosus in culture is very marked.

INDEX TERMS: Chelation, Toxicity, Copper, Marine algae, Organic compounds, Cultures, Aqueous solutions, Chlorides, Growth rates, Volumetric analysis, EDTA, Erd Schreiber medium.

AMIC-9731
"MULTIVARIATE APPROACHES TO ALGAL STRATAGEMS AND TACTICS IN SYSTEMS ANALYSIS OF PHYTOPLANKTON", Allen, T. F. H., Koonce, J. F., Ecology, Vol. 54, No. 6, Autumn 1973, pp 1234-1246.

Numerical classifications and principal components ordinations were performed on species from 57 weekly samples of phytoplankton from Lake Wingra. The data were considered in absolute and relative terms before and after transformation to presence/absence and logarithmic quantities. The data were also analyzed, taking into account growth rates in the samples, by means of a transformation that replaced the scores of species present by the productivity of the sample as determined by C-14 uptake/biomass. It is shown that different transformations can reveal different but biologically meaningful aspects of the data. These different biological aspects are species similarities based on either short-term survival expedients in particular environmental circumstances, species tactics, or long-range growth patterns, involving breadth of tolerance and place in the community, that is, species stratagems. Most phytoplankton species in Lake Wingra adopt one of three stratagems: either ungrazed, slow-growing and very persistent, or ungrazed, fast-growing and of intermediate duration, or grazed fast-growing and ephemeral. Tactical information is relevant to particular systems, while strategic information is needed in ecosystem comparison and for models applicable to several systems.

INDEX TERMS: Phytoplankton, Statistical methods, Productivity, Growth rates, Absorption, Biomass, Biological communities, Ecosystems, Model studies, Grazing, Seasonal, Standing crops, Data interpretation, Multivariate analysis, Lake Wingra.

AMIC-9732
"EFFECTS OF THERMAL ADDITIONS FROM THE YELLOWSTONE GEYSER BASINS ON THE BENTHIC ALGAE OF THE FIREHOLE RIVER", Boylen, C. W., Brock, T. D., Ecology, Vol. 54, No. 6, Autumn 1973, pp 1282-1291.

During the spring and summer of 1971 and 1972 quantitative measurements of temperature, water chemistry, and standing crop of benthic algal mats were made at a series of stations along the Firehole River as it flows through the main geyser basins of Yellowstone National Park. As the river flowed through the thermal areas, the temperature gradually increased to a maximum daily midsummer temperature 12 degrees higher than the unheated upper portion of the river (15 to 27 C), and the river began cooling when the thermal additions to the river ceased. The river was coldest in early June, when maximum input from melting snow occurred, and remained relatively warm in the heated areas throughout the winter. Alkalinity, pH, conductivity, phosphate, and chloride also increased markedly; nitrate and ammonium concentrations appeared not to be influenced by the additions of hot spring water. The quantity of chlorophyll per unit area extracted from epilithic algal mats also increased with the amount of thermal water input to 20 times that in the unheated control areas. The apparent growth rates of benthic algae calculated from periodic quantitative sampling of cleaned rocks were over fivefold greater in the warmer than in the cooler portion of the river. The temperature optimum for CO2 fixation paralleled the midsummer temperature of the habitat although it averaged about 3 degrees higher at each station. The results suggest that higher temperatures from the additions of thermal water increase the algal standing crop through increase in growth rate of the algae, and that the algae in the heated portion of the river are optimally adapted to the temperatures of their habitats.

AMIC-9732 (Continued) Card 2/2

INDEX TERMS: Thermal pollution, Benthic flora, Geysers, Water temperature, Alkalinity, Hydrogen ion concentration, Conductivity, Phosphates, Chlorides, Nitrates, Ammonia, Chlorophyll, Growth rates, Photosynthesis, Radioactivity techniques.

AMIC-9736
"INDICATIONS OF DISTURBANCES IN THE NITRIFICATION PROCESS IN A HEAVILY NITROGEN-POLLUTED WATER BODY", Landner, L., Larsson, T., AMBIO, Vol. 2, No. 5, 1973, pp 154-157.

When high concentrations of nitrite were repeatedly detected in the Bay of Koping, Lake Malaren (Sweden), a study was initiated to analyze the autotrophic oxidation of ammonium to nitrate. The number of denitrifiers and of heterotrophs was also determined. Water and sediment samples were taken with sterilized NIVA and Jenkins samplers on four occasions, and the numbers of autotrophically nitrifying bacteria were determined by indirect most probable number procedures. It was found that Nitrosomonas were 100 to 10,000 times more abundant than Nitrobacter in the bottom water as well as in the sediment surface of the bay. The activity of Nitrobacter in the bay was also reduced, clearly indicating a disturbance of the oxidation of nitrite to nitrate.

INDEX TERMS: Nitrification, Water pollution effects, Nitrogen fixing bacteria, Nitrogen, Nitrites, Oxygen, Ammonium compounds, Nitrates, Benthos, Metabolism, Respiration, Sampling, Oxidation, Nitrobacter, Nitrosomonas.

AMIC-9738
"METHYL MERCURY ACCUMULATION IN AN AQUATIC FOOD CHAIN. A MODEL AND SOME IMPLICATIONS FOR RESEARCH PLANNING", Fagerstrom, T., Asell, B., AMBIO, Vol. 2, No. 5, 1973, pp 164-171.

This paper utilizes a mathematical model to study the mechanisms of methyl mercury accumulation in aquatic food chains. The three step food-chain model has pike feeding on roach and roach feeding on chironomids. Functions in the model include environmental variables and equations describing some ecological and ethological processes that determine the flow of energy. The discussion is limited to three specific problems. (1) Is the model at all able to mimic, in a qualitative sense, the static picture that is common in nature, ie MM concentrations in fish increasing with age, and concentrations in predatory species exceeding those in prey species by a factor of two-five? (2) What is the relative importance of the accuracy of the numerical values for the calculated MM concentrations in the fish? (3) What are the dynamics of the reaction of the system to perturbations in the same simulations as were used for the sensitivity analysis?

INDEX TERMS: Mercury, Food chains, Mathematical models, Industrial wastes, Water pollution effects, Pikes, Diptera, Ecosystems, Absorption, Respiration, Metabolism, Methylmercury, Roach.

AMIC-9737
"BENTHIC FAUNA AND ZOOPLANKTON IN SOME POLLUTED SWEDISH ESTUARIES", Olsson, I., Rosenberg, R., Olundh, E., AMBIO, Vol. 2, No. 5, 1973, pp 158-163.

Four more-or-less polluted estuaries on the Swedish west coast are compared regarding bottom fauna of different sizes, and zooplankton. The salinity in these almost non-tidal waters varies from estuary to estuary and decreases from north to south. As it was expected that the physical and chemical environment in the estuarine systems might be reflected in the faunal communities, the purpose was to classify the systems in respect to each other on a faunal basis, especially with regard to the pollution aspects. The meiofauna of the bottom (size 0.1-1 mm), represented by foraminifers (one-celled animals) and annelids (segmented worms), seemed more to reflect differences in pollution than differences in salinity. A reduced ostracod fauna (crustaceans) was an outstanding feature. Few species appeared in all estuaries. Even the macrofauna of the bottom (size greater than or equal to 1 mm) showed that the effects of pollution in Byfjorden were restricted to the inner areas. In a comparison with another estuary, Saltkallefjorden, nowadays almost non-polluted and recovered, there was a remarkably uniform fauna at certain localities in the two estuaries. If distance to river-mouth is taken into consideration, both meio- and macrofaunal composition seemed to be more similar between the various estuaries than within individual estuaries, reflecting the short-distance changes of the environment. Compared to the bottom fauna, the zooplankton (greater than or equal to 0.16 mm) showed the least differences between the various estuaries. The composition seemed to be much the same, with copepods (crustaceans) as the dominating group.

INDEX TERMS: Benthic fauna, Zooplankton, Estuaries, Salinity.

AMIC-9740
"EFFECTS OF ARTIFICIAL HYPOLIMNION AERATION AND RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON) DEPTH DISTRIBUTION", Fast, A. W., Transactions of the American Fisheries Society, Vol. 102, No. 4, October 1973, pp 715-722.

Hemlock Lake, an eutrophic and meromictic Michigan lake, was artificially aerated by hypolimnetic aeration. This aeration system involved a special aeration tower and compressed air injection. Hypolimnetic oxygen concentrations increased from zero to saturation during aeration. Thermal stratification was gradually reduced by the aeration, but the lake remained thermally stratified for 10 weeks during aeration. Before aeration, rainbow trout (Salmo gairdneri Richardson) were limited to shallow depths by the anaerobic hypolimnion. They distributed to the deepest depths soon after aeration began and occupied the entire lake during artificial aeration.

INDEX TERMS: Rainbow trout, Distribution patterns, Aeration, Depth, Hypolimnion, Oxygen, Thermal stratification, Water temperature.

AMIC-9741
"THE EFFECTS OF DIBROM ON RESPIRATORY ACTIVITY OF THE STONEFLY, HYDROPERLA CROSBYI, HELLGRAMMITE, CORYDALUS CORNUTUS AND THE GOLDEN SHINER, NOTEMIGONUS CRYSOLEUCAS", Marki, A. W., Stewart, K. W., Silvey, J. K. G., Transactions of the American Fisheries Society, Vol. 102, No. 4, October 1973, pp 806-815.

The respiratory activity of three aquatic animals, selected from different pollution index classifications, was examined in the presence of sublethal concentrations of Dibrom, a commonly used, broad spectrum, organophosphate insecticide. The oxygen consumption of Hydroperla crosbyi (Needham and Classen), Corydalus cornutus L. and Notemigonus crysoleucas was measured in a specially designed following-water respirometer, housed in an environmental chamber. The acute toxicity of Dibrom, measured as 24-hr LC50's for these animals, was compared in both static and flowing-water bioassays and found to be significantly more toxic to both the hellgrammites and stoneflies in the flowing system (LC50: 6.8 ppm and 11.4 ppb, respectively) than in the static bioassay (LC50: 9.5 ppm and 16.0 ppb, respectively). There was a marked difference in the toxicity of Dibrom to golden shiners between flowing and static systems but this was not statistically significant at the 95 percent confidence level. Sublethal Dibrom concentrations significantly affected oxygen consumption (Q02) in all test animals, and reduced their tolerance to low oxygen tensions. The ability of the golden shiner to tolerate low oxygen tensions was reduced by 50 percent by exposure to 5 ppm Dibrom concentrations. Stonefly body undulations and hellgrammite gill beats were increased by exposure to sublethal toxicant levels in the flowing system. The flowing-water respirometer offers an approach to simulate the lotic environment in bioassays and laboratory assessments of the effects of pollutants on respiration and other organism responses.

AMIC-9741 (Continued) Card 2/2

INDEX TERMS: Stoneflies, Shiners, Respiration, Insecticides, Oxygen, Water pollution effects, Bioassay, Lethality, Hellgrammites, Dibrom.

AMIC-9742
"ACUTE TOXICITIES OF ANTIMYCIN A, BAYER 73, AND TFM TO THE OSTRACOD CYPRETTA KAWATAI", Kawatski, J. A., Transactions of the American Fisheries Society, Vol. 102, No. 4, October 1973, pp 829-831.

Static bioassays were conducted at 24 C with the ostracod Cypretta kawatai in 1500-ml glass beakers to investigate the toxicity of antimycin A, TFM (95.7 percent 3-trifluoromethyl-4-nitrophenol), Bayer 73 (70 percent 2-aminoethanol salt of 2',5-dichloro-4'-nitrosalicylanilide), and mixtures of TFM and Bayer 73. Mortality observations were made at 24-hr intervals up to 96 hr. The 96-hr LC50 values were: antimycin A, 7.40 micrograms/l; TFM 7.10 mg/l; Bayer 73, 1.16 mg/l. The toxicity of a 50:50 mixture of TFM and Bayer 73 was simply additive (96-hr LC50, 3.03 mg/l), whereas a 98:2 combination of TFM and Bayer 73 was slightly synergistic (96-hr LC50, 5.00 mg/l). The three toxicants tested would have no significant immediate effect on C. kawatai when employed at normal field concentrations for short periods of time, however, if the toxicants were to persist in the ostracod's environment at application concentrations for more than 48 hours, material loss of ostracods could occur.

INDEX TERMS: Invertebrates, Pesticide toxicity, Bioassay, Lethal limit, Ostracods, Antimycin A, Bayer 73, TFM, Synergistic effects.

AMIC-9743
"THE INFLUENCE OF DISSOLVED OXYGEN ON THE GROWTH OF CHANNEL CATFISH", Andrews, J. W., Murai, T., Gibbons, G., Transactions of the American Fisheries Society, Vol. 102, No. 4, October 1973, pp 835-838.

The long-term effects of three levels of dissolved oxygen (100,60 and 36 percent of air saturation) on channel catfish, Ictalurus punctatus, were evaluated under two feeding regimes - a constant rate of 3 percent of biomass daily and ad libitum. At ad libitum rates (6-week duration) average gains of 159, 124, and 65 g per fish were obtained in tanks containing oxygen at 100, 60, and 36 percent of saturation, respectively. In both experiments food consumption and efficiency were drastically reduced at 36 percent oxygen saturation. Survival rates were 100 percent in all groups, thus suggesting that disease and parasite problems were not enhanced by a hypoxic environment. In these studies catfish did not demonstrate a polycythemic response to hypoxic conditions.

INDEX TERMS: Dissolved oxygen, Channal catfish, Growth rates, Biomass, Feeding rates, Water quality, Carbon dioxide, ammonia, Blood samples, Hemoglobin, Hematocrit.

AMIC-9744
"NOTES ON THE UPPER LETHAL TEMPERATURE OF THE DUSKYSTRIPE SHINER, NOTROPIS PILSBRYI, AND THE BLUEGILL, LEPOMIS MACROCHIRUS", Hickman, G. D., Dewey, M. R., Transactions of the American Fisheries Society, Vol. 102, No. 4, October 1973, pp 838-840.

Sublethal, incipient upper lethal, and total lethal temperatures were obtained for the duskystripe shiner, Notropis pilsbryi, and the bluegill, Lepomis macrochirus. Both species were exposed to a gradual temperature increase of 2 C per day and to sudden temperature increases after being acclimated to a temperature of 21.5 C. Results indicate that the incipient upper lethal temperature of the bluegill, with a 2 C rise in temperature per day, is 35.5 C and that of the duskystripe shiner is approximately 32.0 C. Resistance times of both species to a sudden temperature increase were also determined.

INDEX TERMS: Water temperature, Lethal limit, Shiners, Sunfishes, Thermal pollution.

AMIC-9747
"PREDICTION OF INCIPIENT LETHAL LEVELS OF COPPER TO JUVENILE ATLANTIC SALMON IN THE PRESENCE OF HUMIC ACID BY CUPRIC ELECTRODE", Zitko, P., Carson, W. V., Carson, W. G., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 6, November 1973, pp 265-271.

This paper deals with the toxicity of copper and zinc to juvenile Atlantic salmon in the presence of humic acid, and with predictions of incipient lethal levels (ILL) of copper from the potential of a cupric ion selective electrode. The ILL of copper increases with increasing concentration of humic acid. The potential of the cupric ion selective electrode is a linear function of the total copper concentration in semilogarithmic coordinates. The ratio of predicted to calculated ILL's decreases with increasing hardness due to decreased binding of copper by humic acid at higher hardness. Humic acid at concentrations of 5 and 10 mg/l has no effect on the ILL of zinc to juvenile Atlantic salmon, possibly due to lower stability of humic acid - zinc complexes. The zinc - fulvic acid complex is approximately 10 times less stable than the corresponding copper - fulvic acid complex. The presented data indicate that the cupric ion selective electrode is a useful tool for predicting ILL of copper to juvenile Atlantic salmon in the presence of humic acid. The technique may very likely be extended to other copper-complexing substances such as lignosulfonates, pulp mill effluents in general, and various organic compounds.

INDEX TERMS: Copper, Lethal limit, Atlantic salmon, Zinc, Humic acids, Toxicity, Electrodes, Bioassay, Hardness (water), Calcium sulfate, Fulvic acids, Ion selective electrodes.

AMIC-9750
"THE ACUTE TOXICITY OF SOME HEAVY METAL IONS TOWARD BENTHIC ORGANISMS", Rehwoldt, R., Lasko, L., Shaw, C., et al., Bulletin of Environmental Contamination and Toxicology, Vol. 50, No. 5, November 1973, pp 291-294.

A study was conducted to determine the toxicity of some heavy metal ions toward benthic fauna in a freshwater region of the Hudson River. Metal ions evaluated were copper, zinc, nickel, cadmium, mercury, and chromium. Water quality during the experiment was maintained at 17 C, 50 mg/l hardness, 7.6 pH, and 6.2 mg/l dissolved oxygen. Mercury was the most toxic ion toward the test organisms (bristle worms, scud, caddisflies, damselflies, midges, and snails) and was more toxic toward these organisms than toward fish studied earlier in the same area. However, with the exception of the scud and midge, benthic organisms tend to be more able to withstand heavy metal inputs than fish.

INDEX TERMS: Toxicity, Copper, Zinc, Nickel, Cadmium, Mercury, Chromium, Bioassay, Benthic fauna, Oligochaetes, Amphipoda, Caddisflies, Diptera, Gastropods.

AMIC-9751
"EFFECT OF WATER HARDNESS ON THE TOLERANCE OF THE GUPPY TO BERYLLIUM SULFATE", Solnim, C. B., Slonim, A. R., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 5, November 1973, pp 295-301.

Bioassays were conducted to investigate the effect of water hardness on the toxicity of $BeSO_4$ to guppies. Four static tests were conducted simultaneously with four levels of hardness (22, 150, 275, 400 mg/l) and Be concentrations ranging from 0.1 to 60 mg/l. In addition, two subsequent bioassays were conducted to assess the hypothetical relationship between the TL sub 50 and water hardness. Median tolerance limits for 96 hour tests were 20.0 mg Be/l at 400 mg/l hardness, 13.7 mg Be/l at 275 mg/l hardness, 6.1 mg Be/l at 150 mg/l hardness, and 0.16 mg Be/l at 22 mg/l hardness. Curves resulting from plots of percent survivors vs. Be concentrations show downturns as water hardness is lowered. In hard water, TL sub 50 values did not change significantly after 24-hr exposures, but in soft water they were significantly lower from 24-to 96-hr exposures. Equations are included which can be used to estimate the toxicity of $BeSO_4$ to guppies at any given water hardness.

INDEX TERMS: Hardness (water), Bioassay, Beryllium, Equations, Estimating, Toxicity, Resistance, Guppy.

AMIC-9753
"MIREX INCORPORATION IN THE ENVIRONMENT: TOXICITY IN SELECTED FRESHWATER ORGANISMS", Naqvi, S. M., de la Cruz, A. A., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 5, November 1973, pp 305-308.

A study was conducted to determine the toxicity of Mirex to the following pond invertebrates: amphipods (Hyallela azteca), dragonfly nymph (Macromia sp.), a gyrinid beetle (Dineutes americanus), a water strider (Gerris remigis), and a shrimp (Palaemonetes kadiakensis). The specimens were taken with nets from a garden pond and a managed lake in Mississippi. Bioassay solutions were prepared by serial dilution with tap water from a 1 percent stock solution of technical grade Mirex in acetone. LD sub 30, LD sub 50, LD sub 99 and upper and lower limits of lethal concentrations in parts per million for Gerris, Dineutes, and Palaemonetes were determined by probit analysis on an IBM 360-40 digital computer. Percent mortalities but not LD values were considered for Hyallela and Macromia nymph at 1 ppb and 1 ppm Mirex concentrations. Representative TL sub 50 values were: Gerris, 0.13 ppm at 24 hr; Dineutes, 0.04 at 72 hr; and Palaemonetes, 0.19 at 120 hr. Palaemonetes was most resistant, Dineutes next, and Gerris least resistant to Mirex. The results also show a delayed mortality effect of Mirex.

INDEX TERMS: Pesticides, Toxicity, Amphipoda, Dragonflies, Shrimp, Bioassay, Ponds, Lakes, Lethality limit, Mississippi, Computer programs, Mirex, Gyrinid beetles, Water striders, Hyallela azteca, Dineutes americanus, Gerris remigis, Palaemonetes kadiakensis.

AMIC-9754
"UPTAKE AND ACCUMULATION OF AN ORGANOCHLORINE INSECTICIDE (DIELDRIN) BY AN ESTUARINE MOLLUSC, RANGIA CUNEATA", Petrocelli, S. R., Hanks, A. R., Anderson, J., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 5, November 1973, pp 315-320.

Clams (Rangia cuneata) were collected from Trinity Bay in Texas to study uptake and accumulation of dieldrin from dilute solution. The clams were acclimated for 1 to 2 weeks in holding tanks at 25 C, 8.2 pH, and 15.6 percent salinity. They were than transferred to experiment tanks with water having like properties and a dieldrin concentration maintained at about 0.55 microgram/liter. Samples of clams and water were removed after 12, 24, 36, 48, 60, and 72 hours and after freezing and cleanup of the meat samples were analyzed for pesticide residue by gas-liquid chromatography. The results indicated that Rangia is capable of absorbing and concentrating dieldrin in its tissue to levels far above ambient. The smallest dieldrin residue in experimental calms was 38.2 micrograms/liter after 12 hours exposure and the largest 1226 micrograms/liter after 60 hours. Apparently the dieldrin is not noxious enough in the concentration used to affect siphoning and thus it is accumulated in quantities that may become a threat to the estuarine food web.

INDEX TERMS: Dieldrin, Mollusks, Bioassay, Absorption, Kinetics, Pesticide residues, Estuaries, Bioaccumulation, Biological magnification, Gas liquid chromatography, Rangia cuneata, Sample preservation, Sample preparation, Cleanup.

AMIC-9767
"OXYGEN CONSUMPTION OF LIMNOCALCANUS MACRURUS SARS (CALANOIDA, COPEPODA) IN RELATION TO ENVIRONMENTAL CONDITIONS", Roff, J. C., Canadian Journal of Zoology, Vol. 51, No. 8, August 1973, pp 877-885.

The oxygen consumption of Limnocalanus macrurusnand its relationship to a number of environmental parameters were determined on specimens from two arctic lakes, both in the laboratory and in situ. The Q10 from 0 to 10 C was 1.93 and from 5 to 15 C was 2.20. The respiration rate increased shortly after capture of the animals and then declined to steady levels within 6 hr after capture. Experimental population densities within the range of 0.1 to 2 animals/ml had no effect on the adult respiration rate nor did the volume of the respiratory container. Experiments carried out in situ showed no relationship between depth of incubation and respiration rate, and did not differ significantly from the laboratory respiration rates. The upper lethal temperature was about 18 C but animals could briefly withstand exposure to 21 C. Lethal oxygen concentration was dependent on temperature, being about 0.8 mg/liter at 0 C. The relationship of these lethal levels to the distribution of the species is discussed.

INDEX TERMS: Copepods, Oxygen, Respiration, Water temperature, Lakes, Arctic, Population, Density, Distribution patterns, Depth, Lethal limit.

AMIC-9774
"CYANOPHAGES - VIRUSES ATTACKING BLUE-GREEN ALGAE", Padan, E., Shilo, M., Bacteriological Reviews, Vol. 37, No. 3, September 1973, pp 343-370.

This paper reviews characteristics, genetics, and growth cycles of cyanophages, discusses the interaction of their development with metabolism of the cyanophycean host, and considers ecological effects. An extensive bibliography is included.

INDEX TERMS: Cyanophyta, Viruses, Reviews, Bibliographies, Physicochemical properties, Proteins, Growth stages, Metabolism, Photosynthesi, Genetics, Cytological studies, Distribution patterns, Cyanophages, Nucleic acids, Phages.

AMIC-9795
"CHEMICAL ASPECTS OF BIOASSAY TECHNIQUES FOR ESTABLISHING WATER QUALITY CRITERIA", Lee, G. R., Water Research, Vol. 7, No. 11, November 1973, pp 1525-1546.

Increasing emphasis is being placed on the use of bioassay techniques to evaluate potential water quality problems in the aquatic environment. Although the physical environment is carefully maintained, often less emphasis is placed on maintaining the proper chemical environment in bioassay tests. Considerations of oxidation state, solubility, complexation, ionic strength, type and amount of solids, salt ratios and concentrations and organic content are essential in extrapolating the results from the test conditions to the environment. The chemical history of the test organism must be controlled to insure meaningful results, and analytical measurements should be made to insure that the proper chemical species is maintained throughout the test period. If the environmental conditions are not duplicated, studies are needed to determine how the results are dependent on the test environment used. This paper discusses examples in which changes in the chemical environment of a bioassay test may affect the results of the test and recommends procedures for minimizing problems of this type.

INDEX TERMS: Water quality, Bioassay, Methodology, Reviews, Chemicals, Oxidation, Solubility, Solid wastes, Salt balance, Organic matter, Toxicity, Pesticides, Chelation, Trace elements, Hardness (water), Complexation, Ionic strength.

AMIC-9798
"EFFECTS OF OIL DISPERSANTS AND OIL EMULSIONS ON MARINE ANIMALS", Swedmark, M., Granmo, A., Kollberg, S., Water Research, Vol. 7, No. 11, November 1973, pp 1649-1672.

The toxicities to marine animals of nine oil dispersants, three oil emulsions with Corexit and of a dispersion of Oman crude oil, were studied in continuous flow aquarium systems at 96 hr exposures followed by a recovery period in clean seawater. New types of dispersants were found to be less toxic than older types and oil emulsions more toxic than dispersants alone or crude oil alone. Fishes and bivalves were found most sensitive. Crustaceans were the most resistant to dispersants but very susceptible to oil emulsions. The tolerance of different species was found to be related to their mode of life, more active species being more susceptible. Delayed mortality of bivalves increased their susceptibility if the recovery period was included. Effects on locomotory behavior of fishes and crustaceans, breathing rate of fish, valve-closure of bivalves and byssal thread formation of common mussels have been demonstrated for both dispersants and oil emulsions. The general sequence of such effects was: increased activity; successively impaired activity; immobilization; and death. Recovery is good for fish and crustaceans but poor for bivalves due to the delayed effects. Ecological consequences of dispersants and oil pollution in the marine environment are discussed.

INDEX TERMS: Oil pollution, Toxicity, Bioassay, Fish, Mussels, Crabs, Water temperature, Salinity, Lethal limit, Sea water, Water pollution effects, Oil dispersants, Oil emulsions, Crude oil.

AMIC-9799
"ALGAL GROWTH PREDICTION USING GROWTH KINETIC CONSTANTS", Toerien, D. F., Huang, C. H., Water Research, Vol. 7, No. 11, November 1973, pp 1673-1681.

The growth kinetics under conditions of phosphorus limitation of Selenastrum capicornutum Printz, a green alga specified for use in algal bioassays, were used to predict growth in batch cultures for varied specific conditions of time and phosphorus concentration. These predictions compared very well with actual batch culture growth studies. The predicted maximum cell concentration for two different levels of phosphorus lay within values obtained in different laboratories. The predicted maximum specific growth rates were either close to or just above actual laboratory data. The determination of growth kinetics thus allows accurate prediction of the growth of planktonic algae, a benefit in either algal bioassays or the solution of practical eutrophication problems. The growth kinetic constants of specific algae important in eutrophication problems need to be determined in order to utilize potentialities of prediction in the rational solution of these problems.

INDEX TERMS: Growth rates, Kinetics, Phosphorus, Bioassay, Cultures, Forecasting, Time, Eutrophication, Biomass, Nutrients, Suspended solids, Selenastrum capricornutum, Batch cultures.

AMIC-9801
"EFFECT OF PHENOL ON OXYGEN UPTAKE RATE OF A LABORATORY POPULATION OF CHIRONOMUS ATTENUATUS (WALK.)", Cole, S. L., Wilhm, J., Water Research, Vol. 7, No. 11, November 1973, pp 1691-1700.

A laboratory population of fourth-instar larval forms of Chironomus attenuatus Walker received a continuous life-long exposure of 0, 2.8, 11.2, 16.3, and 22.4 ppm phenol. Measurements were taken of water temperature, pH, and dissolved oxygen concentration. Larvae exposed to the different phenol concentrations were analyzed for oven-dry weight and ash-free weight. The oxygen uptake was determined. The regression of oxygen uptake (Y), adjusted for phenol level, pH, and oxygen concentration, on ash-free weight (X) was log Y equals 0.173 minus 0.478 log X. The regression of adjusted oxygen uptake (Y) on phenol concentration (X) was Y minus 1.632 plus 0.299 log X. Calories lost through respiration (Y) were related to phenol level (X)0 by the equation, Y equals (0.0021) plus (0.000386) log X. The ash-free weight per individual (Y) decreased with increasing phenol concentration (X) as explained by the equation, Y equals 0.114 log X.

INDEX TERMS: Diptera, Oxygen, Absorption, Phenols, Toxicity, Bioassay, Respiration, Larvae, Water temperature, Hydrogen ion concentration, Dissolved oxygen, Weight, Regression analysis, Chironomus attenuatus.

AMIC-9802
"CHRONIC TOXICITY OF A COPPER, CADMIUM AND ZINC MIXTURE TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS RAFINESQUE)", Eaton, J. G., Water Research, Vol. 7, No. 11, Nobember 1973, pp 1723-1736.

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

INDEX TERMS: Copper, Cadmium, Zinc, Toxicity, Bioassay, Lethal limit, Spectrophotometry, Water temperature, Growth stages, Spawning, Larvae, Fathead minnow, Embryos.

AMIC-9823
"THERMOPHILIC FUNGI IN A MUNICIPAL WASTE COMPOST SYSTEM", Kane, B. E., Mullins, J. T., Mycologia, Vol. 65, No. 5, September/October 1973, pp 1087-1100.

A high-rate municipal compost system was systematically sampled during the digestion period for the presence of thermophilic fungi. The objectives were to (1) monitor environmental conditions during composting, (2) develop sampling and culturing techniques for isolating thermophilic fungi from compost, and (c) examine environmental requirements for growth of the isolated fungi. The compost consisted of sorted municipal refuse which was shredded, moistened with water or sewage sludge, and piled in tanks. The compost atmosphere, sampling procedures, and culturing techniques used during the study are described and experiments to determine the ability of selected isolates to grow on cellulose are outlined. During the study pure cultures of 304 isolates were established. These included Aspergillus fumigatus, Chaetomium thermophile, Humicola lanuginosa, Mucor pusillus, Thermoascus aurantiacus, and Torula thermophila. It was demonstrated that (1) a thermophilic relationship exists between temperature and growth, (2) a requirement exists for aerobic growth conditions, and (3) only C. thermophile utilized cellulose as a carbon source. It was concluded that thermophilic fungi are present during composting in a mechanically assisted digestion. They were isolated at all times during the composting and there is no apparent succession of species. High temperature, acidity, and anaerobic conditions may limit growth in the interior of the pile and thus restrict the role of these fungi.

INDEX TERMS: Waste disposal, Cultures, Sampling, Monitoring, Environmental effects, Temperature, Growth rates, Aerobic conditions, Cellulose, Oxygen, Carbon dioxide, Hydrogen ion concentration, Acidity, Thermophilic fungi, Compost.

AMIC-9826
"OIL-INDUCED MORTALITIES IN JUVENILE COHO AND SOCKEYE SALMON", Morrow, J. E., Journal of Marine Research, Vol. 31, No. 3, September 15, 1973, pp 135-143.

A laboratory study was undertaken to determine the effects of crude oil in concentrations that might occur from an oil spill on sockeye and coho salmon. Specimens aged 9 to 13 months that had been raised from eggs were first acclimated to artificial seawater of 3 percent salinity. Crude oil was introduced in concentrations from 500 to 3500 ppm and the water temperature was set at 3, 8, or 13 C. Stress behavior under the influence of oil was also investigated. Mortality rates of up to 100 percent were produced in 96 hrs. The majority of the 96-hour experimental mortality rates were significantly higher than the mortality rates of control animals. The mortality rates were directly related to the concentration of oil, but appeared to be inversely related to water temperature. Mortality apparently was caused by some component of crude oil that is soluble in water and is also volatile and/or easily oxidized. It was found that crude oil loses its toxicity to salmon after exposure to air, probably through the loss of volatile toxic components. Hence, conclusions based on bioassay work with oil of unknown history may be less valuable than those derived from studies wherein the handling history of the oil is known.

INDEX TERMS: Sockeye salmon, Toxicity, Water temperature, Lethal limit, Fish behavior, Bioassay, Sea water, Mortality, Stress, Arctic, Coho salmon, Crude oil.

AMIC-9876
"EFFECT OF POLLUTION ON THE BLOOD CHARACTERISTICS OF TILAPIA ZILLII G.", Saad, M. A. H., Ezzat, A., Shabana, M. B., Water, Air, and Soil Pollution, Vol. 2, No. 2, June 1973, pp 171-179.

Lake Mariut, a shallow brackish water basin near Alexandria (U.A.R.), was a highly productive lake; however, it now receives large quantities of pollutants resulting in greatly reduced or depleted DO. The extremely low O2 content of the lake water has had hazardous effects on fish. Tilapia zillii G., which constitute a major part of the Egyptian lake fisheries, were sampled from Lake Mariut in order to study the effect of O2 deficiency on the blood characteristics of these fish. Under the stress of asphyxia, Tilapia showed a considerable increase in all blood constituents. The erythrocytes of asphyxiated Tilapia were characterized by a smaller corpuscular volume and a higher mean corpuscular hemoglobin count. A marked increase in total proteins, alpha globulin, glucose and creatinine was observed in asphyxiated fish. The results obtained from the experimentally asphyxiated fish and fish sampled from the O2 deficient area of Lake Mariut are nearly similar. It can be concluded that when the fish enters this O2 deficient area it begins to undergo asphyxiation, after which it may die.

INDEX TERMS: Water pollution effects, Dissolved oxygen, Fish, Bioassay, Pesticides, Fertilizers, Lakes, Brackish water, Industrial wastes, Organic matter, Mortality, Tilapia zillii, Blood.

AMIC-9877
"TOXICITY OF LEAD NITRATE TO ALGAE", Malanchuk, J. L., Gruendling, G. K., Water, Air, and Soil Pollution, Vol. 2, No. 2, June 1973, pp 181-190.

The fixation of radioactive C was used to measure the toxicity of Pb(NO3)2 to five species of freshwater algae. Portions of unialgal cultures were inoculated into low salt medium and were used to test all species at 10, 20 and 30 ppm Pb. This medium approximated the salt concentrations of natural aquatic environments. Three different cell weights were used for each concentration of Pb and for the control to determine a relationship between cell weight and toxicity. The concentration of Pb causing a 50 percent reduction of C-14-labelled CO2 fixation as compared to the control was called the ED sub 50 (median effective dose). These values were extrapolated from graphs of ppm Pb vs dpm/mg dry cell weight. The ED sub 50 for three of the species tested (Anabaena, Chlamydomonas and Navicula) was between 15 and 18 ppm Pb. A desmid, Cosmarium, had an ED sub 50 of 5 ppm. This species has a higher surface: volume ratio than the other species tested and this may account for its increased sensitivity. An ED sub 50 for Ochromonas was not obtained. Throughout this experiment the fixation of C-14 labelled CO2 increased with increasing Pb concentrations and is not readily explained.

INDEX TERMS: Toxicity, Lead, Aquatic environment, Anabaena, Chlamydomonas, Radioactivity techniques, Cultures, Carbon dioxide, Primary productivity, Ecosystems, Lead nitrate.

AMIC-9878
"DISTRIBUTION OF FORAMINIFERA NEAR POLLUTION SOURCES IN CHALEUR BAY", Schafer, C. T., Water, Air, and Soil Pollution, Vol. 2, No. 2, June 1973, pp 219-233.

Benthonic foraminifera samples were collected seasonally near several isolated sources of sewage and (or) industrial effluent in the Restigouche estuary. Distinct biotopes based on species diversity and population density are developed locally especially near Dalhousie peninsula and Belledune Point in response to the effects of effluent discharge. Averaged diversity indices calculated in known polluted areas describe an initially depressed curve that reflects the development of near-abiotic conditions close to the effluent source and, at some distance offshore, an anomalously high diversity which may be indicative of a zone near each outfall in which certain components of the effluent generate a temporary favorable artificial environment. The Elphidium incertum/clavatum group usually dominates the living fauna near sewage outfalls and appears to be able to invade and maintain itself on nearshore sediment substrates which have pH values in excess of 6.4.

INDEX TERMS: Estuaries, Distribution patterns, Water pollution effects, Protozoa, Sewage, Industrial wastes, Sediments, Hydrogen ion concentration, Water temperature, Salinity, Oxygen, Lead, Zinc, Fertilizers, Chlorine, Alkalis (bases), Powerplants, Pulp wastes, Foraminifera.

AMIC-9924
"STREAM POLLUTION AND A SIMPLIFIED DIVERSITY INDEX", Egloff, D. A., Brakel, W. H., Journal Water Pollution Control Federation, Vol. 45, No. 11, November 1973, pp 2269-2275.

Biological indexes of diversity of benthic macroinvertebrate communities were determined at seven stations in a stream subjected to pollution by secondarily treated domestic wastewater. Indexes based on three different levels of taxonomic classification (genus, order, and class) all reflected the effect of the discharge on the biological communities. The advantages of using an index of biological diversity based on higher taxonomic categories include (1) direct assessment of the biological impact of pollution, (2) a great savings in time and technical expertise usually required to identify biological specimens to low taxonomic categories, and (3) the retention of some taxonomic information, which is required for making many biological inferences, especially with respect to the effect of pollution on biological food chains.

INDEX TERMS: Water pollution, Natural streams, Bioindicators, Benthic fauna, Waste water (pollution), Biological communities, Water quality, Water pollution effects, Species diversity index, Macroinvertebrates.

AMIC-9928
"USING ARTEMIA TO ASSAY OIL DISPERSANT TOXICITIES", Zillioux, E. J., Foulk, H. R., Prager, J. C., Cardin, J. A., Journal Water Pollution Control Federation, Vol. 45, No. 11, November 1973, pp 2389-2396.

Criteria established for a procedure to assay oil dispersants included the following: (1) The assay must not require special training or skills by a technical level person. (2) Only common laboratory equipment would be required. (3) Materials and time must be minimal. (4) The results must be accurate and available in a short time. (5) The end point must be quantitatively measurable. (6) The organism must be sensitive to chemical changes, yet suitable for laboratory tests. (7) The species must be commercially available, be capable of being raised in the laboratory, and not require care between assays. (8) Large numbers of the organisms must require small volumes of medium. (9) Neither the assay nor the organisms must require a permanent allotment of laboratory space. These criteria were satisfied at least partially by designing a bioassay procedure which uses nauplii of Artemia salina in synthetic seawater under defined chemical and physical conditions. The brine shrimp are stored as eggs which are incubated and hatched when needed. Sodium dodecyl sulfate is used as a reference toxicant to indicate differences in the condition of organisms that may occur during the test. The procedures were used to compare 48 hr TL sub 50 values of six proprietary oil dispersants with that of sodium dodecyl sulfate. Factors and variations in method that may affect bioassay results are discussed. Conclusions are that Artemia is a suitable bioassay species to determine comparative toxicity of oil dispersant compounds but that it should not be used to determine limiting environmental concentrations for protection of marine life.

INDEX TERMS: Bioassay, Design criteria, Brine shrimp, Oil dispersants, Standard methods.

AMIC-9941
"BIOLOGICAL RESPONSE TO DETERGENT AND NONDETERGENT PHOSPHORUS IN SEWAGE - PART II", Porcella, D. B., Cowan, P. A., Middlebrooks, E. J., Water and Sewage Works, Vol 120, No. 12, December 1973, pp 36-46.

The responses are presented of Anabaena flos-aquae and Selenastrum capricornutum to detergent and nondetergent phosphorus. Maximum growth and mean growth rate are discussed with maximum growth being based upon the first and last biomass measurements during the growth cycle (18 or 21 days). Mean growth rate represents growth over a 7-day period. Correlation between particulate carbon (PC), optical density (OD) and suspended solids (SS) was performed to establish the relations between the individual parameters. Dilution studies were made to detect toxicity, indicated by unusual growth as a function of dilution. Deionized and reservoir water were used to dilute effluents from secondary and tertiary sewage treatment. In summary, the results indicate the following conclusions: (1) no differences exist between baseline and test samples; (2) response was greater in secondary than tertiary effluents; and (3) iron and trace elements appeared to stimulate slightly greater growth. Samples of various wash products were added to a solution of two percent test secondary effluent in reservoir water. The results showed no significant difference in maximum growth. It can be concluded that the addition of the wash products to treated sewage did not affect the bioassay response. (See also: AMIC-9657)

INDEX TERMS: Phosphorus, Bioassay, Sewage effluents, Plant growth, Toxicity, Biomass, Measurement, Waste dilution, Nutrients, Water pollution effects, Selenastrum capricornutum, Anabaena flos-aquae.

AMIC-9943
"TEMPERATURE CONTROL OF REPRODUCTION AND PRODUCTIVITY IN A SUBARCTIC CORALLINE ALGA", Adey, W. H., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 111-118.

Based on detailed quantitative distributional data for the North Atlantic and qualitative data for the North Pacific, a hypothesis of winter temperature control of reproduction and distribution is formulated for the crustose coralline alga Clathromorphum circumscriptum. The hypothesis, that winter temperatures below 2-3 C are required for reproduction, was tested by growing plants for extended periods under various light and temperature conditions. Regimes from constant light cycle (12-12) and intensity (1200 lux) at a temperature of 12-13 C, to reduction of both light and temperature over a 5 month interval to 6-18 hr light-dark periods, 130 lux and 0 C, were employed in a manner approximately simulating the natural pattern in the shallow sublittoral of the Maine coast. Although conceptacle production was initiated in those tanks where the light cycle was reduced from 12 to 6 hr per day, mature conceptacles with bispores developed only in the tanks where the temperature was reduced. The most prolific plants were those subject to reduction of light cycle and intensity. In tanks having neither temperature nor light cycle reduction, only a very small percentage of primordial conceptacles were initiated and none of these developed to maturity. The productivity of Clathromorphum circumscriptum, based on oxygen exchange measured with a precision polarographic electrode, was examined at light intensities ranging from 0-4000 lux and temperatures ranging from 0-20 C. The compensation point was reduced markedly with temperature, reaching levels of only 35 lux near 0 C. This indicates a high level of efficiency in net productivity at very low temperatures, and suggests that under arctic conditions holoautotrophic plants probably

AMIC-9943 (Continued) Card 2/2

can survive even where ice cover and winter darkness significantly reduce total light received.

INDEX TERMS: Water temperature, Primary productivity, Reproduction, Bioassay, Light intensity, Limiting factors, Growth rates, Ice cover, Clathromorphum circumscriptum.

AMIC-9944
"INFLUENCE OF IODINE ON GROWTH AND DEVELOPMENT OF THE BROWN ALGA ECTOCARPUS SILICULOSUS IN AXENIC CULTURES", Woolery, M. L., Lewin, R. A., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 131-138.

A quantitative evaluation was made of the iodine requirement of the brown alga Ectocarpus siliculosus using solely the female clone. Cultures were grown in (1) artificial seawater medium, of the same composition and prepared by the same method as was the starvation medium; (2) artificial seawater medium prepared similarly, but with sodium chloride which had not been pre-treated to remove iodine and bromine; (3) natural seawater; and (4) seawater similarly depleted of iodine and bromine. In a preliminary experiment prepared in quadruplicate, iodine and bromine were added, independently and together, and after 2,4,6, and 8 wk, growth in the first set of tubes was assayed colorimetrically for mixed chlorophylls and carotenoids. Another experiment was carried out to determine the effects of iodine concentrations lower than that in seawater. After 2,3, and 4 wk, the algae were examined microscopically for the abundance of reproductive organs and zoospores and assayed colorimetrically. Nutrient-supplemented cultures were then incubated for an additional 6 wk, and reassayed for restoration of pigmentation. Filaments of E. siliculosus survived for at least 12 wk in iodine-deficient media; however iodine is an essential nutrient for growth. Iodine is not replaceable by bromine at any of the concentrations tested. At least 0.0015 microgram at iodine/l is required for any appreciable vegetative growth, while 0.025 microgram at/l is needed for the normal formation and maturation of plurilocular sporangia. (Natural seawater contains about 0.4 microgram at iodine/l). In 12-wk cultures, 0.2 microgram at iodine/l promotes maximum growth, equivalent to 4 g dry weight per litre of medium. Concentrations up to one hundred times as high are tolerated without evident inhibitory effects.

AMIC-9944 (Continued) Card 2/2

INDEX TERMS: Marine algae, Plant growth, Iodine, Essential nutrients, Deficient elements, Phaeophyta, Bioassay, Plant physiology, Ectocarpus siliculosus, Axenic cultures, Survival.

AMIC-9945
"YAMADAPHYCUS, A NEW GENUS OF THE DELESSERIACEAE (RHODOPHYTA)", Mikami, H., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 139-143.

The structure and reproduction of Yamadaphycus carnosus gen. et sp. nov. from the southeastern coast of Hokkaido, Japan, are described, and the taxon's relationship to other members of Delesseriaceae is discussed. The structure of the apex belongs to Kylin's Delesseria type. The female and asexual reproductive organs occur on special proliferations that are formed in clusters and at random on both surfaces of the fronds.

INDEX TERMS: Rhodophyta, Marine algae, Speciation, Systematics, Marine plants, Plant morphology, Reproduction, Plant physiology, Plant groupings, Yamadaphycus carnosus, Japan, Delesseria.

AMIC-9946
"CULTURE STUDIES OF ENTEROMORPHA LINZA (L.) J.Ag. AND ULVARIA OXYSPERMA (KUTZING) BLIDING (CHLOROPHYCEAE, ULVALES) FROM CENTRAL AMERICA", Kapraun, D. F., Flynn, E. H., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 145-152.

Enteromorpha linza and Ulvaria oxysperma from Colombia and Costa Rica, respectively, were studied by observations of material collected from nature and laboratory culture experiments. Cultures were maintained in enriched seawater media in an open-room incubator illuminated with 1500 lux incident light at 23 C with 12-hr light and a 12-hr dark cycle. The algae were stained for chromosomes using a modified technique described by Kapraun (1970). Plant material was fixed in an I2KI-formalin solution during the middle of the dark cycle, washed in distilled water after 12 hr, and placed in an iron-alum mordant. Fronds were soaked in the mordant 2-5 min, rinsed thoroughly in distilled water and stained in acetocarmine for observation. Results of these investigations were compared with the literature from Japanese and European studies. Both E. linza and U. oxysperma were shown to be haplobiontic, reproducing exclusively by bi- and quadriflagellate zoospores. Results of cytological investigations are discussed: N equals 10 was indicated for E. linza, while no determination was possible for Ulvaria.

INDEX TERMS: Cultures, Chlorophyta, Marine algae, Cytological studies, Plant morphology, Marine plants, Chromosomes, Benthic flora, Central America, Enteromorpha linza, Ulvaria oxysperma, Culture media, Sample preservation, Sample preparation, Columbia, Costa Rica.

AMIC-9947
"AN EXAMINATION OF THREE STRAINS OF THE BLUE-GREEN ALGAL GENUS, FREMYELLA", Wyatt, J. T., Martin, T. C., Jackson, J. W., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 153-161.

Placed in the family Scytonemataceae by some authorities and by others in the Microchaeteaceae, the blue-green algal genus Fremyella often exhibits seemingly paradoxical behavioral patterns. Its growth characteristics and its metabolic rates indicate the genus to be ecologically competitive. On the other hand, its infrequent occurrence in most experimental algal collections suggests just the opposite. Three strains of Fremyella produced widely different data which suggested that the genus probably occupies terrestrial, subaquatic, and aquatic systems. However, the results did not truly explain the rarity of the genus.

INDEX TERMS: Growth stages, Cultures, Metabolism, Behavior, Plant morphology, Fremyella.

AMIC-9949
"THE GENUS NEOCHLORIS STARR (CHLOROPHYCEAE, CHLOROCOCCALES)", Archibald, P. A., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 187-193.

Study and culture of five isolates of the genus Neochloris revealed three previously undescribed species. A morphological key to all current species of Neochloris as cultured under standard conditions is provided. Supplementary growth patterns and physiological attributes are reported.

INDEX TERMS: Aquatic algae, Soil algae, Chlorophyta, Plant morphology, Plant growth, Plant physiology, Speciation, Neochloris.

AMIC-9951
"NORTH CAROLINA MARINE ALGAE. II. NEW RECORDS AND OBSERVATIONS OF THE BENTHIC OFFSHORE FLORA", Schneider, C. W., Searles, R. B., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 201-211.

Twenty new records from North Carolina are reported including four species of green algae, two species of brown algae, and fourteen species of red algae. Nineteen of these collections constitute the northernmost records of these species, though most are found in the Bermudian flora. The other new record, that of Gigartina stellata (Stackhouse) Batters, represents a new southern extension for this northern species. Two previously questionable records and one species known only from shallow water in North Carolina are verified as members of the deep water offshore flora. A clarification of the records of Agardhiella tenera (J. Agardh) Schmitz in this area is given.

INDEX TERMS: Marine algae, Chlorophyta, Phaeophyta, Rhodophyta, Benthic flora, North Carolina, Distribution.

AMIC-9952
"A BIOASSAY COMPROMISE", Cain, J. R., Trainor, F. R., Phycologia, Vol. 12, Nos. 3/4, December 1973, pp 227-232.

Selenastrum capricornutum was used as a test organism for assaying the nutrient condition of natural waters. Using an actively growing culture, inoculated, sterile-filtered water was incubated at 22 C in continuous fluorescent illumination. Organisms were grown in tubes on a roller tube rotator, and transferred daily, reestablishing a population of 400,000 cells each day. Averages of 5-day runs showed no evidence for nutrient carry-over when 1 plus doublings/day were recorded; carry-over usually was not apparent on days 3-5 when nutrient poor waters were examined. Sites were examined above and below a sewage treatment plant, in different rivers and during fall, winter and spring. The assay, as measured in doublings of Selenastrum/day, shows clear differences in the carrying capacity of the rivers at these sites.

INDEX TERMS: Bioassay, Water quality, Nutrients, Growth rates, Bioindicators, Natural waters, Selenastrum capricornutum.

AMIC-9953
"LEAD INHIBITION OF HORMOTILA BLENNISTA (CHLOROPHYCEAE, CHLOROCOCCALES)", Monahan, T. J., Phycologia, Vol. 12, Nos. 3/4, December 1973, p 247.

Hormotila blennista, a unicellular green soil alga, was cultured in modified Bristol's solution deficient in the potassium phosphate salts to which had been added the trace element mix of Watt and Fogg (1966) and known concentrations of lead chloride. Autoclave sterilization, axenic cultures, and sterile techniques were routinely used. After autoclaving, culture media ranged between pH 6.4 and 6.6. Cultures were grown in 50 ml of medium and incubated at 22 plus or minus 1.0 C under continuous fluorescent illumination supplying 3000 to 4000 lux light intensity. Dark experiments were performed by placing cultures in sealed cardboard boxes in the growth chamber. Cells were harvested during the declining growth phase and counts made to determine the effect of lead on growth. When contrasted to control cultures, significant inhibition was noted in the light at all lead concentrations tested from 50-500 ppb (P less than 0.001) and in the dark at 50 ppb (P less than 0.01), and 100, 250, and 500 ppb (P less than 0.001). It was concluded that the effects of lead among the algae may be particularly accentuated under stressful conditions of essential nutrient deficiency, such as phosphate and potassium as exemplified by H. blennista.

INDEX TERMS: Lead, Inhibition, Plant growth, Bioassay, Deficient elements, Pollutant effects, Survival, Hormotila blennista.

See also: Category 1, AMIC-9663, 9688, 9700, 9721, 9727, 9745, 9835, 9837.

AMIC-9614
"MIXED CULTURE BIOOXIDATION OF PHENOL. I. DETERMINATION OF KINETIC PARAMETERS", Pawlowsky, U., Howell, J. A., Biotechnology and Bioengineering, Vol. 15, No. 5, September 1973, pp 889-896.

A mixed culture derived from soil and activated sludge organisms was used to degrade phenol which was inhibitory to microorganisms at higher concentrations. The purpose of the experiments was to determine the kinetic parameters governing growth of the organisms by measuring growth rates in batch culture. To maintain a constant inoculum for the experiments inoculum was taken from a continuously operating continuous culture. Two populations were studied corresponding to two separate residence times in the continuous culture apparatus. One contained predominatly filamentous organisms, the other nonfilamentous. Five kinetic models were applied to the data and the best kinetic parameters for each model were determined by nonlinear least squares techniques. The models were then evaluated for best relative fit to the data. No significant differences were found between the models on the basis of fit and so a choice was made on the grounds of simplicity. A model proposed by Haldane was chosen as the best. No function however gave a satisfactory fit at the highest growth rates obtained. This experimental maximum in the plot of growth rate against substrate concentration was very sharp.

INDEX TERMS: Phenols, Oxidation, Cultures, Kinetics, Growth rates, Activated sludge, Protozoa, Statistical methods, Rotifers, Sphaerotilus, Algae, Fungi, Metabolism, Biooxidation, Ultraviolet spectrophotometry.

AMIC-9615
"MIXED CULTURE BIOOXIDATION OF PHENOL. II. STEADY STATE EXPERIMENTS IN CONTINUOUS CULTURE", Pawlowsky, U., Howell, J. A., Biotechnology and Bioengineering, Vol. 15, No. 5, September 1973, pp 897-903.

A problem in steady-state analysis of the continuous stirred tank biological reactor is the failure to predict the effect of high dilution rate near the washout condition. One cause could be apparatus effects, the most likely of which is bacterial growth on the walls of the reactor. This study attempted to test the applicability of a wall-growth factor in a model developed for the case of substrate inhibited kinetics. Continuous culture experiments, using a mixed population of organisms on phenol, were performed in continuous stirred tank biological reactors. Steady state phenol concentrations were measured by ultraviolet spectrophotometry for a range of inlet concentrations from 100 to 800 mg at various dilution rates. These results were compared with those predicted from the model. It was found that the effect of growth on the walls of the vessel was considerable and increased by a factor of up to 3X the dilution rate of the 90 percent conversion of phenol could be obtained.

INDEX TERMS: Phenols, Model studies, Cultures, Kinetics, Biomass, Sewage bacteria, Biooxidation, Continuous cultures, Wall growth, Steady state experiments, Biological reactors, Mixed cultures, Substrate utilization.

AMIC-9616
"MIXED CULTURE BIOOXIDATION OF PHENOL. III. EXISTENCE OF MULTIPLE STEADY STATES IN CONTINUOUS CULTURE WITH WALL GROWTH", Pawlowsky, U., Howell, J. A., Chi, C. T., Biotechnology and Bioengineering, Vol. 15, No. 5, September 1973, pp 905-916.

It is shown that two steady states exist in certain regions of operation of a 2-liter continuous stirred tank biological reactor. Transition was made from one steady state to another by applying shock loads of either phenol substrate which is inhibitory to the culture at high concentrations or by adding large additional amounts of concentrated organisms. The existence of the multiple steady states is ascribed to the existence of wall growth, and their position is determined by the amount of wall growth. Transient behavior of the system did not follow the predictions of the simple wall growth model but the culture appeared to undergo a lag period immediately after applying the shock load to the system. It is concluded that the stability of a continuous culture utilizing an inhibitory substrate is improved by increasing the degree of wall growth and decreasing the substrate feed concentration. It is also concluded that small scale experiments can usually not be interpreted correctly unless the effect of wall growth is taken into account.

INDEX TERMS: Phenols, Model studies, Sewage bacteria, Cultures, Biomass, Biooxidation, Continuous cultures, Wall growth, Steady state experiments, Biological reactors, Shock loading, Mixed cultures, Substrate utilization.

AMIC-9617
"TEMPERATURE-GRADIENT INCUBACTOR FOR THE GROWTH OF CLOSTRIDIA", Matches, J. R., Liston, J., Canadian Journal of Microbiology, Vol. 19, No. 9, September 1973, pp 1161-1165.

A temperature-gradient incubator was constructed and used for the growth of clostridia. With this instrument the minimum, optimum, and maximum temperatures can be obtained for 12 organisms at one time. The incubator can also be adjusted for psychrophiles, and thermophiles. This unit is mounted on wheels, self-contained, and can easily be moved from room to room. The main part of the portable unit is the block of aluminum which measures 36 in. X 13 in. X 41/4 in. This block contains 12 rows of 11/16-in. holes 4 in deep, with 32 holes per row, spaced at 1-in. centers, giving a total of 384 tubes. The block is drilled and tapped at both ends with 1-in. pipe threads through which the cooling and warming liquids are pumped. The antifreeze for the cold end and water for the warm end of the incubator are held in 6.2-gal stainless steel tanks containing 5.6 gal. each. One bath is colled with a 1/3 horsepower sealed refrigeration unit connected to a cylindrical shaped evaporator constructed from 31 ft of 1/4-in. copper tubing. The other bath is heated with a 500-W tube-type immersion heater. The temperature in both tanks is controlled with mercury to platinum thermoregulators and solid state mercury plunger relays. The incubator was designed so that the desired temperature could be obtained rapidly and the incubator could be operated with the covers open without appreciable change in the temperature gradient.

INDEX TERMS: Clostridium, Cultures, Incubation, Thermophilic bacteria, Incubators, Mesophilic bacteria, Psychrophilic bacteria.

AMIC-9620
"PHENOTYPIC VARIABILITY OF THE ENVELOPE PROTEINS OF KLEBSIELLA AEROGENES", Robinson, A., Tempest, D. W., Journal of General Microbiology, Vol. 78, No. 2, October 1973, pp 361-370.

The envelope proteins of Klebsiella aerogenes (syn. Aerobacter aerogenes) grown in glucose-, sulphate-, phosphate-, ammonia-, potassium- and magnesium-limited environments, in chemostats, have been isolated, and compared by SDS-polyacrylamide gel electrophoresis; marked differences were evident. The envelopes from glucose- and sulphate-limited organisms were examined further: protein content was growth-rate dependent, but sulphate-limited envelopes always contained less protein than glucose-limited envelopes, and this protein had a lower sulpur content. The sulphate-limited envelopes contained one major protein component with a molecular weight of 30,000 daltons whereas the glucose-limited envelopes contained three main protein components (molecular weights of 46000, 38000 and 28500 daltons). Selective extraction of membrane proteins with Triton X-100 indicated that both wall and membrane proteins altered in response to changes in the growth environment. Similarly, the soluble proteins of the organisms varied, but the ribosomal proteins remained almost constant.

INDEX TERMS: Proteins, Isolation, Cultures, Sulfur, Nutrients, Growth rates, Separation techniques, Electrophoresis, Carbohydrates, Potassium, Magnesium, Phosphates, Ammonia, Sulfates, Klebsiella aerogenes, Glucose.

AMIC-9621
"THE EFFECT OF HYPOCHLORITE ON THE GERMINATION OF SPORES OF CLOSTRIDIUM BIFERMENTANS", Wyatt, L. R., Waites, W. M., Journal of General Microbiology, Vol. 78, No. 2, October 1973, pp 383-385.

To investigate the effect of hypochlorite on germination of spores, a suspension of Clostridium bifermentans containing about 3.5 mg dry wt spores was centrifuged at 15000 g for 10 min and the spore pellet resuspended in 5 ml of a solution of 100 micrograms sodium hypochlorite/ml containing 50 micrograms free chlorine. The suspension was incubated for 10 min at 0 C and centrifuged at 35000 g for 3 min, and the spores were washed once in 10 ml glass-distilled water and stored at 4 C and then resuspended in 15 ml glass-distilled water and stored at 0 C until required for measurement of germination rates. Germination rates were measured at 37 C either spectrophotometrically or microsopically. Incubation with a solution of sodium hypochlorite increased the germination rate of spores of mutants of Clostridium bifermentans by up to 3500-fold and in some cases to about that of the wild-type. Hypochlorite treatment resulted in about a 60 percent decrease in viable spores. The efficiency of chlorinating agents as disinfectants may be due, in part, to stimulation of spore germination followed by inactivation of the germinated spore.

INDEX TERMS: Clostridium, Germination, Spores, Cultures, Disinfection, Hypochlorites.

AMIC-9645
"MICROBIOLOGICAL DETERMINATION OF THIRAM", Rappe, A., Mauquoy, G., Baur, S., Journal of the AOAC, Vol. 56, No. 6, November 1973, pp 1517-1518.

A rapid and simple agar plate method has been developed for the microbiological determination of thiram, using Saccharomyces carlsbergensis ATCC 9080 as the test organism. With this organism, as little as 25 ng thiram/well or 200 ng/disk can be detected, well below the levels that can be detected with either Bacillus licheniformis or Flavobacterium as the test strain. The choice of the technique used for assay (well or disk) will depend on the nature of the solvent and the amount of thiram to be analyzed. The assay technique was applied to the dietetic carrot paste preparation spiked with known amounts of thiram. An inhibition zone appeared for 10 ppm thiram, or 10 micrograms thiram/g sample. Although other fungicides, such as nabam, ziram, and captan, also exibit an antibacterial effect on the 3 strains tested, the effect is at higher concentrations. With Saccharomyces carlsbergensis, the limit of detection using the disk method is 2 micrograms for nabam and 1 microgram for ziram or captan. Mercuric derivatives also have an antibacterial activity and thus can be detected by the assay described. The lower limit of detection of phenylmercury nitrate is 1 microgram.

INDEX TERMS: Pesticides, Pollutant identification, Food processing industry, Separation techniques, Pesticide residues, Thiram, Saccharomyces carlsbergensis, Bacillus licheniformis, Flavobacterium, Microbiological determination, Nabam, Ziram, Captan, Ferbam.

AMIC-9653
"OCCUPATIONALLY RELATED HEALTH HAZARDS IN WASTEWATER TREATMENT SYSTEMS", Viraraghavan, T., Water Pollution Control Federation Highlights, Vol. 10, No. 11, November 1973, pp D2-D3.

A study was undertaken by Ontario municipalities to evaluate the health hazards to the workers in their wastewater systems. Twenty-five municipalities were addressed for specific information on the number of workers in their collection and treatment systems who, during the period of 1970 to October 1972, and as a result of their occupations, contracted any of the following diseases: typhoid/paratyphoid fevers, bacillary dysentery, amoebic dysentery, roundworm or other worm infections, tuberculosis, poliomyelitis, infections hepatitis, and leptospirosis (Weil's disease). The cities were also requested to state whether any of those diseases contracted resulted from accidental falls into the works or from prolonged exposure only. Three municipalities reported four occupational cases of infectious hepatitis in their workers. No municipality reported any of the other seven diseases as having been contracted resulting from the occupations of the wastewater workers. This preliminary study indicated that health hazards may exist among the workers in wastewater treatment works, although the actual incidence of disease may not be high. The few cases of infectious hepatitis reported could also be chance occurrences. There is need for (1) further detailed studies in which the health of a worker before he joins the works is fully ascertained and documented and (2) periodical examination for many of these diseases.

INDEX TERMS: Municipal wastes, Waste water treatment, Pathogenic bacteria, Human diseases, Public health, Hazards, Occupational health Hepatitis.

AMIC-9692
"INABILITY TO DETECT SPORES OF CLOSTRIDIUM BOTULINUM IN FISH PROTEIN CONCENTRATES (FPC)", Hauschild, A. H. W., Pivnick, H., Regier, L. W., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1760-1762.

Samples of fish protein concentrates from a total of 124 production lots prepared in pilot plants by three different methods have been tested for the presence of viable Clostridium botulinum spores by incubating them in cooked meat medium and assaying the culture supernatant fluids for toxin. The samples were divided into three groups. The 38 lots of group A were prepared by a hot isopropanol extraction method from skate, dogfish, cod frames and fillets, flounder, ocean perch, sand lance, swordfish, herring, capelin, and haddock frames. The 62 lots of group B were prepared from cod fillets by a more gentle procedure (unpublished, patent pending) which includes dispersion of the meat in water, centrifuging, resuspension of the sediment in dilute brine, pH adjustment to 8.5, holding, adjusting to pH 4.5, heating and cooling, adjusting to pH 6.9, centrifuging, three repeated lipid extractions of the sediment with isopropanol at ambient temperature, drying in a rotating cone vacuum drier at 70-75 C, and grinding in a Hammer mill. The 24 lots of group C were prepared by hot isopropanol extraction of hake, menhaden, and anchovy. No spores of C. botulinum could be demonstrated wit certainty in any of the 124 samples of FPC tested. Two of the supernatant fluids were lethal to mice, but their lethal effects appeared to be caused by factors other than C. botulinum toxin.

INDEX TERMS: Botulism, Proteins, Spores, Cultures, Lethal limit, Toxicity, Separation techniques, Fish protein concentrate, Clostridium botulinum, Mice.

AMIC-9769
"LIPOPOLYSACCHARIDE AND PROTEINS OF THE CELL ENVELOPE OF VIBRIO MARINUS, A MARINE BACTERIUM", Deneke, C. F., Colwell, R. R., Canadian Journal of Microbiology, Vol. 19, No. 10, October 1973, pp 1211-1217.

Lipopolysaccharides isolated from the marine bacterium Vibrio marinus strain PS-207 were found to be similar to the lipopolysaccharides of R mutants of enteric organisms, with respect to extraction characteristics, percentage of lipid A (61 percent), and sugars of the polysaccharide side chain (glucose and heptose). A high ratio (2:1) of phosphate to amino sugar was found in the lipid A. Hydroxy fatty acids constituted only 14 percent of the total fatty acids of the lipid A fraction, whereas branched and straight-chain fatty acids were present in greater abundance. The major envelope proteins of V. marinus strain PS-207 fell into three molecular weight classes determined by SDS gel electrophoresis. Numerous protein species were observed in urea - acetic polyacrylamide gel electrophoresis preparations.

INDEX TERMS: Proteins, Cytological studies, Lipids, Phosphates, Acids, Electrophoresis, Vibrio marinus, Lipopolysaccharides, Sugars, Fatty acids, Thin layer chromatography, Gas liquid chromatography, Flame ionization gas chromatography.

AMIC-9771
"GROWTH OF STREPTOCOCCUS CREMORIS AND STREPTOCOCCUS LACTIS IN A CHEMOSTAT. PRODUCTION OF CELLS AND SURVIVAL OF BACTERIA DURING FROZEN STORAGE", McDonald, I. J., Reiter, B., Rogers, P. L., Canadian Journal of Microbiology, Vol. 19, No. 10, October 1973, pp 1285-1295.

Streptococcus cremoris HP and Streptococcus lactis 829 were grown in chemostats in tryptone yeast extract broth and in supplemented 2 percent skim milk medium. In both media, lactose was the limiting nutrient. Cultures were grown at various dilution rates in media poised at constant pH and temperature and also at constant dilution rates in media controlled at different pH levels and temperatures. The effects of the various conditions of growth on production of bacteria, viable counts, and acid-producing activities of cells and on the ability of bacteria to survive subsequent frozen storage were determined. None of the conditions of growth tested had very pronounced effects on the ability of cells to survive or on the inability of cells to retain acid-producing activity after being frozen at - 70 C and stored at - 40 C.

INDEX TERMS: Streptococcus, Growth rates, Cytological studies, Cold resistance, Nutrients, Hydrogen ion concentration, Freezing, Cultures, Sample preservation, Survival, Culture media, Viable count, Chemostat.

AMIC-9772
"OXIDATION OF n-ALKANES BY CLADOSPORIUM RESINAE", Walker, J. D., Cooney, J. J., Canadian Journal of Microbiology, Vol. 19, No. 10, October 1973, pp 1325-1330.

Cells of two hydrocarbon-using strains of Cladosporium resinae grown on glucose oxidize hydrocarbons without a lag when transferred to dodecane, hexadecane, or their primary alcohols, aldehydes, or acids. Cycloheximide does not limit oxygen uptake when cells are transferred from glucose to dodecane or hexadecane. Isocitrate lyase levels are not higher in alkane-grown cells than in glucose- or glutamic acid-grown cells. Glucose-grown cells have higher Q sub O2 values than hydrocarbon-grown cells when placed on dodecane or hexadecane. Thus, n-alkane-oxidizing enzymes are constitutive in C. resinae. Cells oxidize dodecanal and hexadecanal though they do not grow on them. Whole cells and cell-free preparations oxidize dodecane, hexadecane, and their primary alcohols and aldehydes, indicating that the oxygenated compounds may be intermediates in alkane oxidation. Hexane, which supports little growth, inhibits oxygen uptake of whole cells below the endogenous level, as do hexanol and hexanal, although cell-free preparations oxidize all three six-carbon compounds. Hexane inhibits oxygen uptake on hexadecane. Therefore, hexane does not appear to be transported into cells and may interfere with membrane function.

INDEX TERMS: Cultures, Microbial degradation, Substrate utilization, Biooxidation, Cladosporium resinae, Dodecane, Hexadecane, Hexane, Hexanol, Hexanal, Dodecanal, Hexadecanal,

AMIC-9796
"SURVIVAL IN MATURATION PONDS OF COLIFORM BACTERIA WITH TRANSFERABLE DRUG RESISTANCE", Grabow, W. O. K., Middendorff, I. G., Water Research, Vol. 7, No. 11, November 1973, pp 1589-1597.

The use of antimicrobial drugs which produces bacterial resistance that is mediated by R factors and is transferrable to other species raises questions regarding the survival of these bacteria in maturation ponds. Consequently studies were undertaken to investigate the behavior of drug-resistant coliform bacteria in a series of sewage maturation ponds in South Africa. Samples were collected from three ponds, the coliforms isolated, and E. coli I identified. The nalidixic acid-resistant strains E. coli E25 and Salmonella typhi N were used as recipients. Groups of 20 resistant coliforms selected at random from every sample were tested for transferable resistance. The average reduction through the ponds of coliforms resistant to ampicillin, chloramphenicol, kanamycin, streptomycin or tetracycline was 6.83 percent lower than that of drug-sensitive bacteria. This difference was mainly due to coliforms with transferable resistance (R(plus) coliforms) which increased from 0.86 percent to 2.45 percent through the ponds. The spectrum of transferable resistance of coliforms in the effluent did not differ notably from that of coliforms in the influent. The average incidence of Escherichia coli I among R(plus) coliforms decreased from 66.08 percent to 62.09 percent. This indicates that low-level transfer of R factors may occur in ponds. Possible mechanisms and the epidemiological significance of the increased survival of R(plus) coliforms in maturation ponds are discussed.

INDEX TERMS: Water pollution effects, Resistance, Sewage treatment, E. coli, Sewage lagoons, Drugs, Survival, Salmonella typhi, Ampicillin, Chloramphenicol, Kanamycin, Streptomycin, Tetracycline.

AMIC-9815
"DETECTION AND QUANTITATIVE MEASUREMENT OF FECAL WATER POLLUTION USING A SOLID-INJECTION GAS CHROMATOGRAPHIC TECHNIQUE AND FECAL STEROIDS AS A CHEMICAL INDEX", Dougan, J., Tan, L., Journal of Chromatography, Vol. 86, No. 1, November 1973, pp 107-116.

Gas chromatography was used to detect the fecal steroids, cholesterol, coprostanol, and coprostanone in surface waters to evaluate the usefulness of this procedure for detecting fecal pollution. Samples were extracted with hexane and further processed to produce a residue. This residue was qualitatively analyzed by gas-liquid chromatography by adding dioxane, applying the solution to the spiral part of the solids injector syringe, evaporating, and injecting into a combined OV-1/OV-210 column. The remaining solution was air dried and kept for further purification by thin-layer chromatography. Samples were quantitatively analyzed by injecting the sample and a standard solution into the gas chromatograph, producing traces, and determining weight ratios by cutting and weighing peak areas. Coliform counts were also made on separate portions of the samples for comparison with the results from chromatography. On the basis of the results obtained, coprostanone appears to be the best index of fecal pollution. It is possible to measure this compound at a contamination level in the 400 picogram per milliliter range. No simple relationship seems to exist between coprostanone content of polluted water samples and classical coliform counts. To be most useful the method should be combined with classical microbiological measurements.

INDEX TERMS: Gas chromatography, Pollutant identification, Separation techniques, Fecal pollution, Coprostanone, Sample preparation.

AMIC-9831
"THE DIRECT ENUMERATION OF ESCHERICHIA COLI IN WATER USING MACCONKEY'S AGAR AT 44 C IN PLASTIC POUCHES", Mossel, D. A. A., Vega, C. L., Health Laboratory Science, Vol. 10, No. 4, October 1973, pp 303-307.

Twenty-five water samples were examined by one of the European MPN standard techniques, for E. coli (enrichment in brilliant green bile lactose broth and isolation on MacConkey agar at 44 C followed by MacKenzie, et al modification of Eijkman's elevated temperature test), and by direct enumeration of E. coli in MacConkey agar, using plastic pouches incubated in a water bath at 44 C. Some forty strains of E. coli freshly isolated from water, stools, fresh meats and poultry were examined by conventional plating in McConkey's agar at 37 C and in pouches at 44 C. The results obtained in both series of tests substantiated the validity of the suggested direct enumeration procedure, which combines simplicity, reliability and rapidity.

INDEX TERMS: Cultures, E. coli, Water analysis, Method validation, Direct enumeration, Feces, Meats.

AMIC-9832
"RELATIVE EFFICIENCY OF CELL CULTURES FOR DETECTION OF VIRUSES", Cooney, M. K., Health Laboratory Science, Vol. 10, No. 4, October 1973, pp 294-302.

Viruses were collected from nasal and pharyngeal swabs and fecal specimens were used in a comparison of the relative efficiency of HEK cells and WI-38 cells were more efficient for recovery of adenovirus and poliovirus strains and that coxsackievirus (B group) recovery was limited to HEK. Conversely, WI-38 cells were more efficient for recovery of Herpesvirus hominis and the echovirus types encountered. Recovery of CMV and rhinoviruses was accomplished only in WI-38 cells. Supplemental cell systems were necessary for the recovery of respiratory syncial and, usually, CMV viruses. Mixtures of two viruses in the same specimen were identified much more frequently in HEK cells than in WI-38 cells.

INDEX TERMS: Viruses, Cultures, Pollutant identification, Isolation, Adenoviruses, Polioviruses, Coxsackie viruses, Rhinoviruses, Enteroviruses, Echoviruses, Myxoviruses, Cytomegaloviruses.

AMIC-9833
"A BACTERIOLOGICAL PRESSURE-RETAINING DEEP-SEA SAMPLER AND CULTURE VESSEL", Jannasch, H. W., Wirsen, C. O., Winget, C. L., Deep-Sea Research, Vol. 20, No. 7, July 1973, pp 661-664.

In order to overcome the decompression problem in bacteriological deep-sea sampling, an instrument was constructed that can be operated both as a sampler and pressurized culture vessel. The 1-liter sample does not undergo a change of pressure during filling at the site of sampling nor during retrieval to the surface and prolonged periods of incubation in the laboratory. Sub-samples of 13 ml may be withdrawn and added without affecting the pressure within the vessel. Means for easy pressure adjustment as well as internal mixing are provided. The sampler was built for operation at pressures of up to 200 atm with a 2 1/2-fold safety margin. It has been successfully tested under internal and external maximum pressure and was used for laboratory experiments. Another instrument to be used for sampling at depths of up to 6000 m is under construction. The sampler consists of two stacked cylinders, each containing a floating piston. It includes three chambers, one of which is divided in two sections by a fixed block containing the adjustable orifice and port for prefilling with sterile distilled water. The sample chamber is lined with non-porous Teflon. The upper end-cap contains the sample inlet valve, the bottom end-cap and a valve for charging the third chamber with air. Six tie-rods clamp the components into a pressure-tight assembly.

INDEX TERMS: Marine bacteria, Sampling, Cultures, Pressure, Incubation, Mixing, Instrumentation, Deep water, Culturing vessels, Deep sea sampler.

AMIC-9843
"IDENTIFICATION OF BACTERIA BY COMPUTER: GENERAL ASPECTS AND PERSPECTIVES", Lapage, S. P., Bascomb, S., Willcox, W. R., et al., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 273-290.

A probability method for identification of bacteria is discussed. Gram-negative, rod-shaped bacteria were chosen as a model and a table (matrix) was constructed which contained the estimated probabilities of a positive result in each test for each taxon. The results of tests on an unknown strain were compared with the stored probabilities and the likelihood that the strain belonged to each of the matrix taxa was calculated in turn by multiplication of the relevant probabilities. These likelihoods were normalized and the value for each taxon referred to as the identification score for that taxon. This procedure was applied to reference strains and to freshly isolated strains (field strains) from various medical diagnostic bacteriological laboratories. The resulting data were used to improve the matrix, investigate the number of tests needed for identification, estimate test differences between laboratories and for test selection strategies. The matrix was stored in a computer in which all calculations were carried out. Identification rates for fermentative bacteria of 90.8 percent for reference strains and 89.4 percent for field strains were obtained, and for non-fermentative bacteria of 82.1 percent and 70.8 percent respectively. The field strains were received because they were difficult to identify in the medical diagnostic laboratory; higher rates of identification might be expected for typical strains. (See also AMIC-9844 and 9845)

INDEX TERMS: Aerobic bacteria, Numerical analysis, Computer programs, Enteric bacteria, Probability, Statistical methods, Laboratory tests.

AMIC-9844
"IDENTIFICATION OF BACTERIA BY COMPUTER: IDENTIFICATION OF REFERENCE STRAINS", Bascomb, S., Lapage, S. P., Curtis, M. A., et al., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 291-315.

The results of the identification of 1079 reference strains of Gram-negative, aerobic, rod-shaped bacteria by the probabilistic method in a computer are given. Comparison of identification by conventional methods and by computer showed that 90.8 percent of fermentative and 82.1 percent of non-fermentative strains could be identified on the best available probability matrix. Many of these strains were atypical and had caused difficulty in identification in the medical diagnostic laboratory. The implications of various factors in successful computer identification are discussed and the results are given for each taxon by genus and species. (See AMIC-9843 for description of the statistical method and AMIC-9845 for computer theory and programming details.)

INDEX TERMS: Pollutant identification, Numerical analysis, Computer programs, Enteric bacteria.

AMIC-9845
"IDENTIFICATION OF BACTERIA BY COMPUTER: THEORY AND PROGRAMMING", Willcox, W. R., Lapage, S. P., Bascomb, S., Curtis, M. A., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 317-330.

The methods incorporated in the computer program used in a trial of computer-aided identification of bacteria are described. The identification method is based on Bayes's theorem and allows for dependent tests and missing data in the probability matrix. It was found useful in developing the method to take account of the occurrence of errors in bacteriological testing. The method suggests a definite identification only if the Bayesian probability of one of the taxa exceeds a threshold level; if not, a separate procedure selects the best tests to continue the identification. (See also AMIC-9843 for general study description and AMIC-9844 for identification matrix and discussion.)

INDEX TERMS: Aerobic bacteria, Computer programs, Pollutant identification, Bayesian probability.

AMIC-9849
"ATTACHMENT OF BACTERIA TO SULPHUR IN EXTREME ENVIRONMENTS", Weiss, R. L., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 501-507.

Sulfolobus attaches to sulphur deposited in acid hot springs by means of pili characterized as follows: (1) generally irregular shape with sligt curves and bends; (2) adhesiveness that enables bacteria to attach to sulphur; (3) acid-stable, resistant to pH values as low as 2; (4) heat-stable, resistant to temperatures as high at 75 C. Sulfolobus attached to sulphur in nature and in culture eroded the sulphur crystal where the bacteria were attached. Sulfolobus undergoes the following two forms of attachment: (1) to sulphur by pili which separate the bacterium from the sulphur crystal and permit lateral movement of bacteria; (2) to glass slides by firm adhesion of the wall to the surface of the slide. Attachment to sulphur in flowing springs enables Sulfolobus to colonize these low pH (2 to 3) high temperature (70 to 75 C) habitats.

INDEX TERMS: Sulfur bacteria, Hot springs, Adhesion, Hydrogen ion concentration, Cultures, Incubation, Sediments, Electron microscopy, Sulfur, Sulfolobus, Pili, Media, Yellowstone National Park.

AMIC-9850
"THE EFFECT OF DISCONTINUOUS METHANOL ADDITION OF THE GROWTH OF A CARBON-LIMITED CULTURE OF PSEUDOMONAS", Brooks, J. D., Meers, J. L., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 513-519.

A study was undertaken to investigate an earlier observation that regular oscillations in pH and DO tension occurred in carbon-limited cultures of Pseudomonas methylotropha growing continuously at low dilution rates. These oscillutions occurred with the same ferquency as the addition of the methanol carbon source. P. methylotropha was isolated from soil and maintained on methanol agar slopes at 37 C. The continuous culture equipment used allowed the mode of addition of methanol and nutrient salts solutions to be altered in four ways. As the interval between methanol additions was increased beyond 20 s the yield of bacterial dry wt/g of methanol fell significantly. Discontinuous methanol additions also caused cycling in the values of a number of parameters, including pH, dissolved oxygen tension, CO2 production and amino acid pool concentration. It is suggested that after each additon of methanol a burst of growth occurred, followed by a period of starvation. These observations are discussed in the light of continuous culture practice and theory. The results challenge established theories of how bacteria grow in continuous cultivation devices. If organisms growing in the apparatus that is normally used by microbiologists are in fact growing discontinuously, with bursts of growth happening with a regularity that depends on the imposed dilution rate, then the explanations offered by many authors for variations in different phenomena with 'growth rate' must be reconsidered.

INDEX TERMS: Pseudomonas, Growth rates, Hydrogen ion concentration, Dissolved oxygen, Carbon dioxide, Amino acids, Centrifugation, Specific gravity, Chromatography, Fermentation, Methanol, Continuous cultures, Pseudomonas, Methyltropha, Fermenters.

AMIC-9851
"PRODUCTION OF BACTERIOPHAGE BY LYOPHILIZED AND OXYGEN-EXPOSED ESCHERICHIA COLI", Israeli, E., Shapira, A., Journal of General Microbiology, Vol. 79, No. 1, November 1973, pp 159-161.

An investigation was conducted to determine whether protein and DNA synthetic mechanisms could function correctly under some other control than that of the cell. E. coli strains were used to investigate the ability of freeze-dried, oxygen-exposed (FDO) bacteria to produce phage. There was no difference in the burst size in phage-infected bacteria between FDO and control organisms. These results suggested that the mechanism of DNA and protein synthesis in FDO bacteria remained intact after oxygen exposure, and was able to function only under a different control. Although the present results do not show any difference in response to phage infection between lyophilized and FDO bacteria, the phage production capacity of lyophilized bacteria before or after exposure to oxygen was only 10 percent of non-lyophilized controls. The percentage of bacteria producing phage was related to the percentage of microscopically observed filamentous forms in the population of such pre-incubated, lyophilized as well as FDO bacteria. It seems that the main cause of death of bacteria upon freeze-drying and exposure to O2 is not damage to DNA, RNA or protein synthesis mechanisms per se, but rather interference with a control mechanism, probably linked with the initiation of the new reproductive cycle.

INDEX TERMS: E. coli, Oxygen, Bacteriophage, Freeze drying, Bioindicators, Proteins, Analytical techniques, Synthesis, Cultures, Lyophilized bacteria, DNA, FDO bacteria, RNA.

AMIC-9880
"DISSIMILATORY REDUCTION OF INORGANIC SULFUR BY FACULTATIVELY ANAEROBIC MARINE BACTERIA", Tuttle, J. H., Jannasch, H. W., Journal of Bacteriology, Vol. 115, No. 3, September 1973, pp 732-737.

Growth experiments were conducted utilizing newly isolated facultatively anaerobic marine bacteria for the purpose of demonstrating dissimilatory reduction of thiosulfate and sulfite. Three strains of the isolates, which resembled a thiobacilli-type bacteria, were used. Inorganic sulfur compounds other than sulfate, were anaerobically reduced in a basal salts medium in three patterns: (1) sulfite and thiosulfate were reduced to sulfide, and tetrathionate was reduced to thiosulfate; (2) tetrathionate was reduced to thiosulfate only; or (3) thiosulfate was reduced to sulfide only when pyruvate was the substrate. Comparison of anaerobic growth in the presence or absence of inorganic sulfur compounds indicated true dissimilatory reductions. Evidence that these reductions involve dissimilation of inorganic sulfur are (1) the failure of the bacteria to grow anaerobically in the absence of a reduced sulfur compound, or (2) the significant increase of anaerobic growth in the presence of a reduced sulfur compound. The observed increase may be an expression of increased growth rate, increased cell yield, or both. The reduction of tetrathionate by the isolates 12W and 16B appears to be consistent with that described for Bacterium paratyphosum-B and Citrobacter. Although none of the isolates was able to use sulfate as an electron acceptor, it is clear that assimilatory reduction of sulfate occurs when sulfate is the sole sulfur source in growing cultures.

INDEX TERMS: Marine bacteria, Sulfur, Reduction (chemical), Anaerobic bacteria, Growth rates, Sulfides, Cultures, Proteins, Hydrogen ion concentration, Sulfites, Thiosulfates, Tetrathionates, Trithionates.

AMIC-9882
"SYNCHRONOUS CULTURES OF BACILLUS SUBTILIS OBTAINED BY FILTRATION WITH GLASS FIBER FILTERS", Sargent, M. G., Journal of Bacteriology, Vol. 116, No. 2, November 1973, pp 736-740.

A simple method of potentially wide applicability for obtaining synchronous cultures of Bacillus subtilis based on size selection is described. Using glass fiber filters, a population (about 1 to 2 percent of the parent population) can be obtained substantially enriched for small cells which grow synchronously. A method for rapidly concentrating dilute suspensions of cells is described. Batches of cells (500 ml) at an optical density (OD) of 1.5 to 2.0 (540 nm) were placed in the filtration unit, and the water pump was started. For most purposes the negative pressure was increased steadily from 0 to about 15 cm of mercury. By changing the filters once, 1 liter of selected cells (yield about 4 percent) could be obtained in 2 min. Further selection and concentration was achieved by passing the filtrate through another pad of glass fiber filters, a collection filter (GF/C, 5.5 cm) (mounted in a smaller apparatus), at a negative pressure of 30 to 40 cm of mercury. The increase in retentiveness at high negative pressures provides an especially useful method of combining a selection and concentration step. Cell obtained by filtration in this way grow synchronously.

INDEX TERMS: Filters, Bacteria, Cultures, Cytological studies, Radioactivity techniques, Size, Growth rates, Proteins, Synthesis, Filtration, Bacillus subtilis, Synchronous cultures, DNA, Coulter counter.

AMIC-9884
"GLUCOSE AND PYRUVATE METABOLISM OF SPIROCHAETA LITORALIS, AN ANAEROBIC MARINE SPIROCHETE", Hespell, R. B., Canale-Parola, E., Journal of Bacteriology, Vol. 116, No. 2, November 1973, pp 931-937.

The pathways of glucose and pyruvate metabolism in Spirochaeta litoralis, a free-living, strictly anaerobic marine spirochete, were studied. Addition of 0.2 to 0.4 M NaCl (final concentration) to suspending buffers prevented cell lysis and was necessary for gas evolution from various substrates by cell suspensions. The organism fermented glucose mainly to ethanol, acetate, CO2, and H2. Determination of radioactivity in products formed from C-14-labeled glucose and assays of enzymatic activities in cell extracts indicated that S. litoralis catabolized glucose via the Embden-Meyerhof pathway. A clostridial-type clastic reaction was utilized by the spirochete to degrade pyruvate to acetyl-coenzyme A, CO2, and H2. Formation of acetate from acetyl-coenzyme A was catalyzed by phosphotransacetylase and acetate kinase. Nicotinamide adenine dinucleotide-dependent acetaldehyde and alcohol dehydrogenases converted acetyl-coenzyme A to ethanol. A reversible hydrogenase activity was detected in cell extracts. S. litoralis cell extracts contained in rubredoxin similar in spectral properties to other bacterial rubredoxins.

INDEX TERMS: Metabolism, Anaerobic bacteria, Marine bacteria, Cytological studies, Sodium chloride, Fermentation, Carbon dioxide, Radioactivity techniques, Enzymes, Chemical reactions, Reduction (chemical), Hydrolysis, Phosphates, Spirochaeta litoralis, Glucose, Pyruvates.

AMIC-9887
"INVESTIGATION OF THE ENERGETICS OF METHANE-UTILISING BACTERIA IN METHANE- AND OXYGEN-LIMITED CHEMOSTAT CULTURES", Nagai, S., Mori, T., Aiba, S., Journal of Applied Chemistry and Biotechnology, Vol. 23, No. 7, July 1973, pp 549-562.

A special apparatus was used to establish methane- and oxygen-limited chemostat cultures of a methane-utilizing bacterium, at 30 C, pH equals 7.0, respectively. The characteristic feature of this arrangement is a complete absence of direct gassing with both methane and air (oxygen). Instead, two vessels (initial working volume equals 3 l, magnetically stirred) were provided in which fresh medium was saturated separately with methane and oxygen; the medium, saturated with either methane or oxygen, was then charged separately into the culture vessel (working volume equals 1 litre, placed on a magnetic stirrer) using a peristaltic pump. The culture vessel was filled up with the medium after inoculation from the preculture so as to provide a cell mass concentration of nearly 10 mg/l. Although total growth yields with respect to methane and oxygen were hardly affected by dissolved oxygen concentration in the medium, provided dilution rate was kept nearly at 0.1/hr, these values appeared to increase slightly with the increase of dilution rate. Assuming that no metabolites other than carbon dioxide and water were produced during bacterial growth, maintenance coefficients and true growth yields were assessed from specific rates of methane uptake and respiration. These energetic constants, nearly independent of the limiting substrates, either methane or oxygen, were compared with those from published data on facultative and obligate aerobes, including a mixed culture of methane-utilizing bacteria.

INDEX TERMS: Methane bacteria, Cultures, Oxygen, Methane, Growth rates, Absorption, Respiration, Dissolved oxygen, Chemostat, Dilution rate, Continuous cultures, Aerobacter aerogenes, Azotobacter vinelandii, Saccharomyces cerevisiae, Energetics.

AMIC-9923
"METHOD OF PREPARING WASHED SUSPENSIONS OF ANAEROBIC BACTERIA FOR METABOLIC STUDIES", Roche, C., Albertyn, J., Kistner, A., Laboratory Practice, Vol. 22, No. 10, October 1973, pp 633-634.

In preparing washed suspensions of anaerobic bacteria for various microbiological studies, it is essential to avoid any exposure of the organisms to air or oxygen. An apparatus that minimizes the risk of exposure during centrifugation is described along with procedures for its use. Culture vessels were de-aerated using gas mixtures that were passed through a catalytic gas purifier cartridge. Copper and butyl rubber tubing were used to minimize diffusion of oxygen into the purified gas. In producing and maintaining low redox potentials during washing the composition of the reducing solution was arranged to be similar in ionic concentration to the growth medium. Deionized water, which was boiled and prepared under a blanket of oxygen-free gas, was used for preparing the media and mineral solution. Membrane filtration was also used. All transfers of media and solution were made with sterile syringes. A specific application of the procedure to cultures of Butyrvibrio species is described.

INDEX TERMS: Anaerobic bacteria, Centrifugation, Metabolism, Oxidation-reduction potential, Cultures, Washed suspensions, Butyrivibrio, Sample preparation.

See also: Category 2, AMIC-9736, 9774.

AMIC-9493
"A SYSTEMATIC APPROACH TO THE ANALYSIS OF MEANS. PART II. ANALYSIS OF CONTRASTS. PART III. ANALYSIS OF NON-NORMAL DATA", Schilling, E. G., Journal of Quality Technology, Vol. 5, No. 4, October 1973, pp 147-159.

The derivation of analysis of means from the experiment model discussed in Part I (A Systematic Approach to the Analysis of Means) provides a systematic procedure for application of Ott's method to a variety of experiment designs. Analysis of contrasts makes available an extension of the Ott technique for 2 to the p power experiments to other forms of contrasts. For 2 to the p power experiments they are equivalent. The use of Scheffe's S-Method for setting limits on the contrasts introduces the ability to assess contrasts selected either before or after the experiment was run. Thus it can be used to supplment analysis of means. While each procedure may be used independently, a rational analysis might consist of the following three elements: (1) ANOVA-to initially detect significance, (2) ANOME-to describe the fluctuations in the data leading to significance and graphically reveal the results of the experiment, (3) ANCON-to test and graphically present differences apparent after running ANOME. Many examples exist of practical and profitable application of the Lewis-Ott procedure to a variety of problem areas. Extension of analysis of means to non-normal distributions and to attributes data where the normal approximation to the binomial distribution does not apply should increase the potential for application of the method still further.

INDEX TERMS: Statistical methods, Quality control, Analysis of contrasts, Analysis of means.

AMIC-9794
"SAMPLE SIZES REQUIRED FOR TWO-SIDED COMPARISONS OF TWO TREATMENTS WITH A CONTROL", Steffens, F. E., de Villiers, R., Technometrics, Vol. 15, No. 4, November 1973, pp 915-921.

The two-sided bivariate t-test for simultaneous comparison of two treatments with a control is studied. The problem of allocating a given number of observations to the treatments and the control is discussed, and it is concluded that, in the absence of preferences, a general purpose rule would be to choose the sample sizes equal. A table is presented which gives the sample size required to ensure that the null hypothesis will be rejected with at least a prescribed probability, given the significance level and the standardized differences between the treatments and the control. Similar tables are provided for use when the object is to ensure that both treatment means will be found significantly different from the control mean with at least a given probability, or to ensure that a specified treatment will be found significant with at least a given probability.

INDEX TERMS: Statistical methods, Testing, Mathematical studies, Quality control, Probability, Treatment, Comparison, Sample size, Bivariate t-test.

AMIC-9495
"A SURVEY OF PREDICTION INTERVALS AND THEIR APPLICATIONS", Hahn, G. J., Nelson, W., Journal of Quality Technology, Vol. 5, No. 4, October 1973, pp 178-188.

Prediction intervals to contain the results of a single future sample with a specified probability gamma are discussed. Also given are simultaneous prediction intervals to contain with probability gamma the results of each of k future samples. Precise definitions of these two types of intervals are given in a section of this article, and a section is devoted to a variety of prediction intervals for a future sample from a normal population. Prediction intervals are provided for samples from a binomial population, and distribution-free prediction intervals are discussed. References concerning prediction intervals for various other situations are given. The discussion is limited to describing and illustrating the methods for constructing prediction intervals. It is assumed throughout that both the past and the future samples are obtained with simple random sampling from the same population. The validity of prediction intervals depends strongly on this key assumption.

INDEX TERMS: Statistical methods, Forecasting, Probability, Regression analysis, Prediction intervals, Binomial distribution, Exponential distribution, Poisson distribution, Weibull distribution, Bayesian prediction, Lognormal distribution, Gamma distribution, Multivariate normal distribution.

AMIC-9863
"PROCEDURES FOR TESTING THE DIFFERENCE OF MEANS WITH INCOMPLETE DATA", Lin, P.-E., Journal of the American Statistical Association, Vol. 68, No. 343, September 1973, pp 699-703.

Procedures for testing the difference of means are obtained in sampling from a bivariate normal distribution with covariance matrix sigma when some of the observations on one of the variables are missing. A UMP test procedure is obtained when sigma is known. When sigma is not known, exact test procedures may be obtained by discarding partial data. To make use of all available data, approximate test procedures are proposed. These procedures are compared to the exact tests, obtained by discarding partial data, using Monte Carlo methods.

INDEX TERMS: Testing, Statistical methods, Average, Sampling, Monte Carlo method, Difference of means, Bivariate normal distribution.

See also: Category 1, AMIC-9625, 9648
Category 3, AMIC-9831.

AMIC-8987
"A CALIBRATION OF INSTRUMENTS WITH NON-RANDOM ERRORS", Pepper, M. P. G., Technometrics, Vol. 15, No. 3, August 1973, pp 587-599.

Problems of instrument calibration are considered using a mathematical model which represents the measurement error as the sum of random walk and an independent observational error. The model is demonstrated by application to on-line and on-stream calibrations and repetitive calibration schemes in which there are M-1 different sample sources.

INDEX TERMS: Calibrations, Measurement, Mathematical models, Instrumentation, Errors.

AMIC-9399
"A HIGH SPEED MICROPROGRAMMED SYSTEM FOR GENERATION AND ACQUISITION OF SIGNALS", Zornig, J. G., McDonald, J. F., The Review of Scientific Instruments, Vol. 44, No. 9, September 1973, pp 1217-1221.

A high speed microprogrammed system has been constructed to perform the synthesis and recording of high frequency nonrepeating pulse signals. The system can drive an analog device with arbitrarily designed waveforms and record individual pulses from several sensors in return. The present design operates at frequencies up to 1.5 MHz and can accept pulse durations of up to 16000 samples. Accuracy is limited by the available ADC and computer word size and is presently 8 bits (0.3 percent). A primary advantage of the design is the reliance to the maximum extent on the hardware of a small general purpose computer. Very little more external hardware is required than the ADC, DAC, and multiplexer. Waveforms are read directly from and stored directly in the host computer core memory. This enables the maximum flexibility in the design of service programs for particular experiments. At present the system is used for an experiment in which a fast pulse input is to be adjusted adaptively in real time based on the measured outputs of a system.

INDEX TERMS: Computers, Data processing, Data storage and retrieval, Design criteria, Computer programs, Analog-to-digital converters.

AMIC-9487
"NEW APPLICATIONS OF CRT DISPLAYS", Zimmer, E., Measurements and Data, Vol. 7, No. 5, September/October 1973, pp 88-91.

Descriptions are given of installations which have replaced TTY units with CRTs to monitor computerized process control systems.

INDEX TERMS: Electronic equipment, Process control, Cathode ray tubes, Information displays, Displays.

AMIC-9488
"PIEZOELECTRIC PRESSURE TRANSDUCERS", Measurements and Data, Vol. 7, No. 5, September/October 1973, pp 92-98.

The theory of piezoelectric transducers is reviewed, and manufacturers, types of pressure tranducers and their sensitivity, range, frequency response, special capabilities, and price are listed.

INDEX TERMS: Pressure, Measurement, Electrical equipment, Pressure transducers, Piezoelectric transducers, Sensors.

AMIC-9502
"AUTOMATIC CONTROL OF LEVEL, PRESSURE, AND FLOW", Wolfe, L., Journal American Water Works Association, Vol. 65, No. 10, October 1973, pp 654-662.

Various types of valves for controlling level, pressure, and flow are diagrammed and the best ways for using them are discussed. Mechanical float, hydraulic float, solenoid, altitude, backpressure-control, rate-of-flow, relief, modulating float, pressure-reducing, pressure-sustaining, and check valves are considered.

INDEX TERMS: Automatic control, Pressure, Flow rates, Water levels, Valves.

AMIC-9578
"GUIDE TO SELECTING PROGRAMMABLE DC POWER SUPPLIES", Krigman, A., Instruments and Control Systems, Vol. 46, No. 10, October 1973, pp 46-53.

Operation, performance, and available features of programmable dc power supplies are discussed. Manufacturers and specific equipment capabilities are listed.

INDEX TERMS: Electrical equipment, Electronic equipment, Programmable power supplies, Power supplies.

AMIC-9623
"DIFFERENTIAL ELECTROLYTIC POTENTIOMETRY WITH PERIODIC POLARISATION. PART XXI. INTRODUCTION AND INSTRUMENTATION", Bishop, E., Webber, T. J. N., Analyst, Vol. 98, No. 1171, October 1973, pp 697-711.

Previous work on periodic polarisation of indicator electrodes is reviewed and discussed, and is faulted on the premise that perfectly symmetrical, bias-free waveforms may not have been used. A statement of intent of the present work is made. The fabrication, activation and testing of electrodes is described, waveform generators are critically discussed, and measuring instruments for periodic and d.c. potentials are both described and evaluated. A simple device for interfacing instruments to recorders, offering a high degree of band spread, is described. High-voltage square-wave generation by use of relays is also discussed. Waveform monitoring was a crucial factor in the work, and the accurate balancing of shape, amplitude and half-cycle duration is described. Frequency measurement and timing by means of a crystal clock, and amplitude and bias detection by integration and by d.c. differential electrolytic potentiometry, are appraised. Finally, the working assembly is described, together with the technique for the elimination of electrical interference.

INDEX TERMS: Instrumentation, Electrodes, Differential electrolytic potentiometry, Ion selective electrodes, Potentiometric titration, Periodic polarization.

AMIC-9624
"DIFFERENTIAL ELECTROLYTIC POTENTIOMETRY WITH PERIODIC POLARISATION. PART XXII. SYMMETRICAL PERIODIC CURRENT DIFFERENTIAL ELECTROLYTIC POTENTIOMETRY IN OXIDATION - REDUCTION TITRIMETRY", Bishop, E., Webber, T. J. N., Analyst, Vol. 98, No. 1171, October 1973, pp 712-724.

The application of pure, symmetrical, bias-free square, sine and triangular wave periodic polarisation to all types of oxidation - reduction titrations is reported. Electrode configuration and earthing and the destructive effect of bias are examined. Titration curve shapes are the same as those of classical d.c. differential electrolytic potentiometry, but the periodic current densities required are much higher than for d.c. The electrode response speed is greatly accelerated, unpoised potentials are steady, warning is given of the approach of the end-point in type II (b) titrations, electrodes retain full activity for very long periods and errors in titrations of iron (II) with dichromate or cerium (IV) are eliminated in the periodic method as against the d.c. method. Discrimination in type II reactions is slightly attenuated in the periodic method, and in titrations at low concentrations it is considerably attenuated. The nature and the conditions of the titration, the speed of the electrode charge-transfer process, the ballast load, the current density, the electrode area, the shape of the applied waveform, the applied frequency, and the deactivation of electrodes, are examined in detail. The benefit of the constant-current mode over the constant-potential mode is demonstrated.

INDEX TERMS: Aqueous solutions, Electrochemistry, Potentiometric titration, Differential electrolytic potentiometry, Periodic polarization.

AMIC-9735
"A DEVICE FOR MEASURING THE AVERAGE TEMPERATURE OF WATER, SOIL, OR AIR", Brown, J. M., Ecology, Vol. 54, No. 6, Autumn 1973, pp 1397-1399.

It is possible to directly measure average temperature with a simple electronic circuit and avoid the usual time-consuming arithmetic integration of temperature records. Instructions are given for the construction of an electronic integrating thermometer composed of a thermistor in a simple Wheatstone bridge and a mercury coulometer that provides a direct readout of the average temperature of soil, air, or water over a designated time interval.

INDEX TERMS: Water temperature, Measurement, Air, Soils, Electronic integrating thermometer.

AMIC-9782
"SELECTRODE - THE UNIVERSAL ION-SELECTIVE ELECTRODE. PART VI. THE CALCIUM(II) SELECTRODE EMPLOYING A NEW ION EXCHANGER IN A NONPOROUS MEMBRANE AND A SOLID-STATE REFERENCE SYSTEM, Ruzicka, J., Hansen, E. H., Tjell, J. C., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 155-178.

The correlation between extraction data and electrode behavior was used to explain the vital properties of organophosphate-based calcium electrodes, and in suggesting a new liquid ion exchanger, di-(n-octylphenyl) phosphoric acid. This compound was synthesized and used in various electrode constructions including a newly developed membrane selectrode with a solid-state inner reference system. The resulting calcium(II) selectrode, calibrated in a series of calcium buffers, was subjected to potential-pH measurements, and used in EDTA titrations. The selectivity parameters of this electrode towards Na(plus), H(plus) and other foreign ions were found to be substantially better than those of any other calcium sensors previously described.

INDEX TERMS: Water analysis, Materials, Fabrication, Calibrations, Ion selective electrodes, Calcium electrodes, Stability, Selectivity.

AMIC-9783
"SELECTRODE - THE UNIVERSAL ION-SELECTIVE ELECTRODE. PART VII. A VALINOMYCIN-BASED POTASSIUM ELECTRODE WITH NONPOROUS POLYMER MEMBRANE AND SOLID-STATE INNER REFERENCE SYSTEM", Fiedler, U., Ruzicka, J., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 179-193.

A potassium electrode utilizing a solution of valinomycin in diphenylether and a porous membrane is compared with selectrodes in which the diphenylether has been replaced by a suitable plasticizer and the porous membrane support by a polymer net-work. The development of the polymer membrane allows the use of simplified selectrode construction with a "solid-state" calomel reference system. Rules for a successful choice of a suitable solvent-polymer combination are suggested and used for development of new polyvinylchloride- and polyurethane-based membranes.

INDEX TERMS: Potassium, Water analysis, Aqueous solutions, Ion selective electrodes, Chemical interference.

AMIC-9789
"A UNIVERSAL ION-SELECTIVE ELECTRODE BASED ON GRAPHITE PASTE", Sapio, J. P., Colaruotolo, J. F., Bobbitt, J. M., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 240-242.

A design is proposed for a universal ion-selective electrode which includes many of the advantages of the selectrode, but of a much simpler construction. The electrode consists of a graphite paste prepared from a liquid ion exchanger containing the ion of interest and commercial graphite powder. Chloride, nitrate, and calcium ion-selective pastes were prepared for use in electrodes to be tested. The chloride and nitrate electrodes gave linear plots of E versus-log a over the activity range of 0.003-0.85 M with a slope of 54 mV/decade activity change. No interference occurred with the chloride electrode when 0.0001 M Br, I, NO3, and C104 were present. The nitrate electrode was unaffected by 0.0001 M Cl, Br, I, and C104. The calcium electrode plot was linear over the activity range of 0.001-0.1 M with a slope of 30 mV/decade. At an activity level of 0.0001 M Ca, 0.001 M Mg and Ba and 0.01 M Na caused no interference.

INDEX TERMS: Water analysis, Nitrates, Chlorides, Calcium, Design criteria, Ion-selective electrodes, Chemical interference, Detection limits.

AMIC-9790
"A LIQUID ION-EXCHANGE NITRATE-SELECTIVE ELECTRODE BASED ON CARBON PASTE", Qureshi, G. A., Lindquist, J., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 243-245.

To overcome the disadvantages of inner reference electrodes and membranes, a liquid ion-exchange nitrate selective electrode was constructed using wax-treated carbon powder mixed with Orion Liquid 92-07-02. The wax isolates the carbon to prevent pH-responses from surface oxides. The basic preparation procedure consisted of dissolving ceresin wax in n-hexane, adding graphite powder, heating, mixing the dried powder with the ion-exchange liquid, and compacting in a 10 mm teflon rod fitted with a metal piston which also served as the contact. The reference electrode was a saturated calomel electrode with a fiber junction. Calibration of the electrode in the range of 0.1-0.000001 M sodium nitrate showed reproducibility to be plus or minus 0.2 mV. Response was linear from 0.1 to 10 to the minus 4.5 power with a slope of 58 mV/decade activity. Selectivity was as good or better than that of commercial electrodes when phosphate, sulfate, chloride, bromide, perchlorate, and iodide were present. Response time was 8-10 minutes with a new surface, but decreased to 2-3 minutes. Lifetime was 4-6 months when the electrode was stored in a glass tube.

INDEX TERMS: Design criteria, Nitrates, Water analysis, Calibrations, Ion selective electrodes, Detection limits, Reproducibility, Nitrate electrodes, Chemical interference, Lifetime, Response time.

AMIC-9834
"AN INEXPENSIVE S.T.D. DATA LOGGING SYSTEM", Morrison, G F., Deep-Sea Research, Vol. 20, No. 7, July 1973, pp 665-668.

This paper describes an inexpensive and convenient method of storing and retrieving frequency modulated signals in the audio frequency band. The signal is recorded on one channel of a stereophonic tape with a crystal derived clock frequency on the other. During retrieval the clock frequency is increased in a phase locked loop and is used as an external standard for a commercial counter/timer which measures the period of the signal in terms of this reference. The system has been used to record salinity, temperature and depth data from the Plessey Environmental System instrument, and this application is discussed.

INDEX TERMS: Data storage and retrieval, Salinity, Temperature, Depth, Tape recorders.

AMIC-9889
"SUSPENDED SEDIMENT OBSERVATIONS FROM ERTS-1", Klemas, V., Borchardt, J. F., Treasure, W. M., Remote Sensing of Environment, Vol. 2, No. 4, 1973, pp 205-221.

Satellite imagery from four successful ERTS-1 passes over Delaware Bay during different portions of the tidal cycle are interpreted with special emphasis on visibility of suspended sediment and its use as a natural tracer for gross circulation patterns. The MSS red band (band 5) appears to give the best contrast, although the sediment patterns are represented by only a few neighboring shades of grey. Color density slicing improves the differentiation of turbidity levels. However, color additive enhancements are of limited value since most of the information is in a single color band. The ability of ERTS-1 to present a synoptic view of the surface circulation over the entire bay is shown to be a valuable and unique contribution of ERTS-1 to coastal oceanography.

INDEX TERMS: Remote sensing, Satellites (artificial), Data collections, Telemetry, Suspended solids, Sediment transport, Currents (water), Tides, Suspended sediments, ERTS-1, Multispectral scanner, Delaware Bay, Multispectral sensing system, Cape Henlopen, Cape May, Color density slicing.

AMIC-9891
"REMOTE MEASUREMENT OF SALINITY IN AN ESTUARINE ENVIRONMENT", Thomann, G. C., Remote Sensing of Environment, Vol. 2, No. 4, 1973, pp 249-259.

The microwave emission of seawater is dependent upon salinity in the low microwave spectrum and it appears possible to measure remotely surface salinity at 21 cm wavelength with an accuracy up to one part salt per thousand parts water for a 5-35 parts per thousand salinity range. The dielectric constant of seawater can be represented by that of NaCl, except the seawater conductivity is retained. The effects of the atmosphere, cosmic noise, sea surface roughness, and constant radiometer errors can be corrected using surface calibration measurements. Experiments were performed in Mississippi and Louisiana coastal waters. Salinity accuracies of 3-5 parts per thousand were obtained - it is believed the accuracy was limited by the radiometer used.

INDEX TERMS: Salinity, Remote sensing, Calibrations, Sea water, Accuracy.

See also: Category, 2, AMIC-9656, 9691, 9747.