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No. 24



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NOTICE

This bulletin, which is a continuation of Report Series EPA-R4-73-023, is prepared monthly by the staff of the Analytical Methodology Information Center (AMIC), Information and Communications Systems Research Department, Battelle, Columbus Laboratories, Columbus, Ohio, under EPA Contract No. 68-01-1832, to inform personnel of the Methods Development and Quality Assurance Research 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 represented in each article.

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REVIEWS OF CURRENT LITERATURE ON
ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 24

By

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NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM
ANALYTICAL QUALITY CONTROL LABORATORY

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

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1. PHYSICAL AND CHEMICAL METHODS

AMIC-9277

"A NEW COLORIMETRIC PROCEDURE FOR THE DETERMINATION OF BENOMYL", Kvalvag, J., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 137-139.

A colorimetric procedure for the combined determination of the fungicide benomyl and metabolites hydrolyzable to 2-aminobenzimidazole is described. The procedure is based on the intense blue color that appears when hypochlorite or hypobromite is added to an aqueous solution of 2-aminobenzimidazole. An extraction, hydrolysis, and cleanup procedure described elsewhere is used. The final evaporation is halted when sufficient ethyl acetate has evaporated to leave an essentially aqueous solution. This solution is poured into a 10 ml centrifuge tube, the beaker is washed with 3 ml hot water, and this is added to the solution in the tube. After cooling, the volume is adjusted to 5 ml and part of the contents is transferred to an optical cell. Measurement is made at 560 nm against water, and the sample discarded if absorbance is higher than 0.015. Two drops of sodium hypochlorite are added to an acceptable solution, and the cell is placed quickly in the colorimeter compartment. The absorbance is compared with a standard curve. If the uncertainty span is confined to three times the absorbance mentioned above, the limit of detection is slightly above 2 micrograms/ml 2-aminobenzimidazole which corresponds to 0.5 ppm benomyl in a 50-g sample based on a 5 ml final volume. In order to check precision of the method four different crops were fortified with 2 ppm of benomyl and analyzed.

INDEX TERMS: Colorimetry, Pollutant identification, Fungicides, Aqueous solutions, Hydrolysis, Separation techniques, Fruit crops, Vegetable crops, Benomyl, Metabolites, 2-Aminobenzimidazole, Cleanup, Sodium hypochlorite.

AMIC-9280

"MULTIPLE ORGANOCHLORINE PESTICIDE RESIDUES IN JAPAN", Suzuki, M., Yamato, Y., Watanabe, T., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 145-150.

Organochlorine pesticide residues were analyzed in agricultural soil of the Kyushu district in Japan. Soil samples were taken 15 cm deep, stored at -30 C, then air-dried, pulverized, screened in a 20-mesh sieve, and mixed. For analysis, one hundred grams of dry soil was mixed with a 0.70 volume of water in a high speed mixer and deactivated for 30 min. After this treatment, 200 ml of acetonitrile was added and blended at a high speed for 5 min. An extract was filtered, and the filtrate was poured into a 1-liter separatory funnel, shaken with 100 ml of n-hexane for 5 min., and partitioned with 600 ml distilled water by shaking for 1 min. Then the n-hexane layer was washed twice with 100 ml distilled water. The n-hexane layer was dried. The column was rinsed twice with approximately 5 ml of n-hexane, and washings were mixed into the layer. The dried n-hexane solution was applied to a gas chromatograph equipped with a tritium foil electron capture detector. Gas chromatographic determination was carried out by combining three different columns. The typical multiple organochlorine pesticide residues in soil are given. Alpha-, beta-, gamma-, and delta-BHC were detected in all 99 soil samples. Considerable residual amounts of aldrin, dieldrin and endrin and high residual levels of DDT and its related compounds were detected.

INDEX TERMS: Pesticide residues, Soils, Gas chromatography, Aldrin, Dieldrin, Endrin, DDE, DDT, Vegetable crops, BHC, Japan, Sample preservation, Sample preparation.

AMIC-9515

"DETERMINATION OF OIL CONCENTRATION AND SIZE DISTRIBUTION IN SHIP BALLAST WATERS. METHOD AND REPRESENTATIVE RESULTS", Witmer, F. E., Gollan, A., Environmental Science and Technology, Vol. 7, No. 10, October 1973, pp 945-948.

Straightforward techniques to determine the state of dispersion - i.e., quantity and droplet size distribution - for oily ballast waters are outlined. Oil concentrations were determined by using light transmittance through an ultrasonically emulsified, surfactant-stabilized sample, while oil droplet size distributions were directly measured using a microscopic photography cell. When these techniques were applied to actual deballasting operations, it was confirmed that oily ballast clarifiers for crude oil tankage must be able to handle oil fines that are as small as microns in diameter along with very high levels of oil contamination which may exceed 10 percent on occasion. The concentration of crude and Bunker C oil (10-5000 ppm) in distilled water samples was reproducibly measured on a turbidity meter. The instrument consisted of a light source, sample holder cell, an ultrasonic emulsifier, and a photocell. Transmitted light was used to make the measurement. Since output was sensitive to the oil type, calibration curves have been obtained with standards produced from Kuwait, and Venezuela crudes and Bunker C. The droplet size distribution apparatus consists of a small transparent flow cell 1/4 in. wide by 3/8 in. mounted on a microscope platform. Photographs are taken of the sample stream while it flows through the cell. The optical system consists of a direct light source (transmitted through the sample cell), microscope barrel and reflex camera. The microscope and light source have been mounted to a shock-insulated platform to facilitate field use.

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INDEX TERMS: Oily water, Separation techniques, Dispersion, Surfactants, Stabilization, Emulsions, Analytical techniques, Turbidity, Light transmittance, Microscopic photography, Ballast water, Droplet size, Crude oil, Bunker C oil.

AMIC-9516

"SOLVENT EXTRACTION OF SULFUR FROM MARINE SEDIMENT AND ITS DETERMINATION BY GAS CHROMATOGRAPHY", Chen, K. Y., Moussavi, M., Sycip, A., Environmental Science and Technology, Vol. 7, No. 10, October 1973, pp 948-951.

The purpose of this paper is to examine the feasibility of elemental sulfur extraction and analytical determination by gas chromatography (gc). To get maximum response from the gc, various experiments were performed using different parameter settings. The operating conditions at which optimum responses for sulfur were obtained occurred at the following settings: injection port temperature - 220 C, over column temperature - 190 C, EC detector temperature - 265 C, and gas flow - 84-90 ml/min. These settings, after injection of standards or extracts, the predominant sulfur species eluted were S₄, S₆, and S₈. The S₈ species exhibits the largest area and peak height. The recovery of sulfur from sediment was carried out initially with a sediment sample of unknown sulfur content. The purpose was to evaluate the efficiency of different solvents in recovering sulfur and to evaluate their suitability for subsequent determinations by both colorimetry and chromatography. Only benzene and toluene exhibited high recovery efficiencies and showed consistent results in both methods. The detection limit of the method described was at the picogram level, unmatched by other known methods. Neither the coefficient of variation nor mean values for sulfur were significantly different in comparisons between the gc method and a standard colorimetric method.

INDEX TERMS: Sulfur, Solvent extractions, Separation techniques, Sediments, Gas chromatography, Comparative techniques, Sample preservation.

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AMIC-9657

"GRADIENT TITRATION - A NOVEL APPROACH TO CONTINUOUS MONITORING USING ION-SELECTIVE ELECTRODES", Fleet, B., Ho, A. Y. W., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 9-11.

A new approach to the automation of titration processes using ion-selective electrodes is described. Based on the gradient titration principle, the method involves the semicontinuous monitoring of a sample stream with a reagent stream where the concentration of the latter increases linearly in the form of a gradient. The flow rates of both sample and reagent streams are maintained constant, and a suitable ion-selective electrode monitors the approach to the equivalence point. The method is, in principle, the constant volume analog of conventional titrimetry. The results obtained for the determination of sulfide ion using mercuric nitrate as gradient reagent and a sulfide membrane electrode are presented. The initial study has shown that the gradient titration technique is experimentally feasible when an appropriate ion-selective electrode with a rapid response is available as the end-point sensor. No sophisticated potential measuring device is required; simple, inexpensive operational amplifier modules can be used for the potential readout. The procedure as described is not fully automatic, however, with part of the sample (and reagent titrant) handling step being done manually. Full automation, however, is possible by incorporating a modified Technicon Sampler into the system.

INDEX TERMS: Volumetric analysis, Aqueous solutions, Automation, Methodology, Ion selective electrodes, Continuous monitoring, Gradient titration,

AMIC-9592

"SUMMARY OF THE STATE OF THE ART IN RADIOCHROMATOGRAPHY", Prydz, S., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2317-2326.

Film registration in radiochromatography is discussed. Low-temperature fluorography gives the lowest detection limits, 3.0 and 0.06 nCi-day/sq cm for tritium and radiocarbon, respectively. Various detectors for one- and two-dimensional scanning, comprising windowless gas-flow GM detectors, solid state detectors, and vacuum-operated channel electron multipliers are treated. The luminescence detection method, applying scintillators in the chromatogram and a scanned photon detector, is discussed. For tritium, the latter method is about 30 times more efficient than GM detection. Two radio-labels may be counted simultaneously using pulse height discrimination. The beta camera, the spark chamber, and the possibility of using image intensifiers are also discussed. The application of a computer to increase the signal-to-noise ratio and, hence the sensitivity, of scanners is mentioned. A comparison of the sensitivities of the available detection techniques and an appendix giving prices and technical details of the commercially available scanners are given.

INDEX TERMS: Reviews, Carbon radioisotopes, Tritium, Radiochemical analysis, Radioactivity techniques, Computers, Prices, Radiochromatography, Film registration, Fluorography, Detectors, Luminescence, Photon detector, Scintillators, Image intensifiers, Scanners.

AMIC-9627

"RECOVERY OF ARSENIC BY DRY ASHING FROM ANIMAL TISSUE FORTIFIED WITH ORGANOARSENICALS OR ARSENIC TRIOXIDE", George, G. M., Frahm, L. J., McDonnell, J. P., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1304-1305.

A study was conducted to establish whether or not arsenic recovery from animal tissue is independent of arsenic source. Control chicken liver and kidney tissues were fortified with 1.0 or 2.0 ppm arsenic from arsenic trioxide, roxarsone, arsanilic acid, nitarsone, or carbarsone. The tissue samples were dry ashed and total arsenic was determined colorimetrically. Arsenic recovery for the organoarsenical-fortified tissue samples is essentially complete for all drugs tested. Mean recoveries ranged from 98 to 109 percent of the theoretical amount expected.

INDEX TERMS: Chemical analysis, Poultry, Methodology, Arsenic, Chemical recovery, Animal tissues, Organoarsenicals, Arsenic trioxide, Dry ashing, Liver, Kidneys.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9629

"ACID AMMONIUM ACETATE EXTRACTION AND ELECTRON CAPTURE GAS CHROMATOGRAPHIC DETERMINATION OF CARBOFURAN IN SOILS", Caro, J. H., Glotfelty, D. E., Freeman, H. P., Taylor, A. W., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1319-1323.

A method is presented for determining carbofuran residues in soils that gives improved recovery, especially in weathered soils, and allows quantitation of as little as 0.1 ppm without cleanup. The soil is extracted with 0.5 M acid ammonium acetate and the carbamate in the extract is determined by electron capture gas chromatography as the dinitrophenyl ether. A systematic study was conducted to optimize extraction conditions. In tests of soils fortified with 1 ppm carbofuran, using optimized extraction conditions, recoveries varied with soil type, ranging from 61 percent in a peat to 92 percent in a silt loam. Recoveries of the metabolites 3-hydroxy- and 3-ketocarbofuran from field soils were at least as efficient as by HCl extraction. In addition to carbofuran, other methylcarbamate insecticide residues that may be determined by this method include Landrin, propoxur, and Bux.

INDEX TERMS: Pollutant identification, Soil analysis, Methodology, Pesticide residues, Carbamate pesticides, Solvent extractions, Carbofuran, Electron capture gas chromatography, Chemical recovery, Metabolites, Detection limits.

AMIC-9632

"OBSERVATIONS ON THE GAS CHROMATOGRAPHY OF KELTHANE (DICOFOL)", Ives, N. F., Journal of the Association of Official Analytical Chemists, Vol. 56, No. 6, November 1973, pp 1335-1338.

Problems associated with the GLC of Kelthane (dicofol) are discussed. The contribution of inlet glass wool to the decomposition of dicofol to p,p'-dichlorobenzophenone is investigated and steps to minimize the problem are suggested. An impurity of the technical material, which eluted immediately after dicofol, was isolated and tentatively identified as 1,1-bis(p-chlorophenyl)-1,2,2,2-tetrachloroethane by infrared and mass spectrometry.

INDEX TERMS: Degradation (decomposition), Gas liquid chromatography, Kelthane, Sample preparation, Dichlorobenzophenone, Infrared spectrophotometry.

AMIC-9746

"OXYCHLORDANE RESIDUES IN HUMAN ADIPOSE TISSUE", Biros, F. J., Enos, H. F., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 5, November 1973, pp 257-260.

Twenty-seven specimens of adipose tissue collected from post-mortem examinations and therapeutic surgery were analyzed for a series of organochlorine residues by gas and thin-layer chromatography. Results were confirmed using mass and infrared spectral analyses. Two columns were employed for gas chromatography: 1.5 percent OV-17/1.95 percent QF-1, RRT sub aldrin of oxychlordane, 1.38 at 200 C and 5 percent OV-210 RRT sub aldrin of oxychlordane, 1.56 at 180 C. The tissue was extracted with petroleum ether. Results showed the presence of beta-HCH, oxychlordane, p,p'-DDE, o,p'-DDT, p,p'-DDT, and heptachlor epoxide. The occurrence of storage of oxychlordane residues in general population human adipose tissue may indicate consistent previous exposure to chlordane insecticide and/or oxychlordane from many possible sources.

INDEX TERMS: Adipose tissue, Oxychlordane, Beta-HCH, Biological samples, Heptachlor epoxide, Pesticide residues, Gas chromatography, Mass spectrometry, DDE, DDT, Separation techniques.

AMIC-9748

"CONFIRMATION OF HEXACHLOROBENZENE BY CHEMICAL REACTION", Baker, E. E., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 5, November 1973, pp 279-284.

When hexachlorobenzene (HCB) is treated with sodium ethoxide, monoethoxypentachlorobenzene is formed. This chemical reaction can be used to identify and confirm the presence of HCB. That this same derivative can be used to identify HCB in the presence of isomers of lindane has been confirmed. A hexane solution of 1 microgram each of HCB and lindane was treated with sodium ethoxide and mixed with water. Sufficient HCl was added to give an acid reaction, the mixture extracted with hexane, dried over sodium sulfate, and analyzed by GC. After heating under reflux for 1 hr, product analysis showed the presence of unreacted HCB, MEPCB, and an unidentified peak X.

INDEX TERMS: Chemical reactions, Pollutant identification, Methodology, Hexachlorobenzene.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9760

"VOLTAMMETRIC BEHAVIOUR OF COPPER(III) AND ITS ANALYTICAL APPLICATIONS", Raspi, G., Zanello, P., Cingantini, A., Corti, P., Analytica Chimica Acta, Vol. 66, No. 3, October 1973, pp 435-442.

The voltammetric behavior of diperiodatocuprate(III) and ditelluratocuprate(III) complexes was investigated in aqueous solution at a platinum microelectrode for which the diffusion layer was periodically renewed. The voltammetric determination of Cu(II) was also investigated. The copper(II) and copper(III) complexes with periodate or tellurate ligands are electroactive at a smooth platinum electrode, giving an anodic, cathodic or cathanodic wave in the presence of alkaline hydroxide solutions containing copper(II), copper(III), or copper(II)-copper(III) species, respectively. The following analytical applications are proposed: (a) amperometric titration of copper(III) solutions; (b) voltammetric determination of copper. Results of amperometric titrations of copper(III) were similar to those by an established procedure. Voltammetry of copper(II) allows the metal to be determined down to concentrations of 0.00001 M, even in the presence of different ions; the procedure can be applied to such heat-transfer media for nuclear reactors as sodium and potassium metals and their hydroxides.

INDEX TERMS: Copper, Electrochemistry, Chemical analysis, Aqueous solutions, Voltammetry, Metal complexes, Ligands.

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INDEX TERMS: Trace elements, Calcium, Potassium, Sodium, Phosphorus, Aluminum, Cadmium, Copper, Chromium, Iron, Manganese, Lead, Sulfur, Flameless atomic absorption spectrophotometry, Biological samples, Wet ashing, Human tissue.

AMIC-9775

"DETERMINATION OF EIGHT METALS IN THE INTERNATIONAL BIOLOGICAL STANDARD BY FLAMELESS ATOMIC-ABSORPTION SPECTROMETRY", Schramel, P., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 69-77.

Flameless atomic-absorption spectrometry was used to measure the concentration of trace elements (Al, Cd, Cr, Cu, Fe, Mn, Pb, and V) in biological material prepared by a wet-ashing procedure. The final wet-ashing procedure, applied in the present work, was as follows: cover 100-150 mg of dry sample with 100 microliters of concentrated sulphuric acid, and heat until fumes of sulphur trioxide appear. Then add dropwise 1.5-2 ml of 50 percent hydrogen peroxide until a clear solution is reached. Cool and dilute to 10 ml with twice-distilled water. Solutions prepared in this way were suitable for all the elements studied. All calibration curves were obtained with 10-microliter amounts of each 'pure' standard solution prepared in 0.18 M sulphuric acid. Subsequently, the effects of the matrix elements, calcium, potassium, sodium, and phosphorus were investigated. The interference of sulphur was taken into consideration by applying a 0.18 M sulphuric acid standard solution. The results showed that there were no interferences for the elements Al, Cd, Cu, Cr, Fe, and Mn; for all these metal ions, the calibration curves found were the same as with 'pure' standard solutions. There are very strong interferences with the absorbance signal in the case of lead. The 'pure' standard solutions of this element gave absorbance signals which were about three times higher than the signals in the case of the IBS matrix. Interferences were less significant in the case of vanadium. The results verified the usefulness and speed of the wet-ashing procedure for destroying biological materials and of the flameless atomic absorption procedure for analyzing particular trace elements in these materials.

AMIC-9779

"COULOMETRIC DETERMINATION OF IRON(II)-1,10-PHENANTHROLINE WITH CERIUM(IV)", McClean, S. W., Purdy, W. C., Analytica Chimica Acta, Vol. 67, No. 1, November 1973, pp 113-118.

Iron bound to 1,10-phenanthroline (ferroin) was determined by coulometric titration with electrogenerated cerium(IV). Titrations were performed in which generation was stopped from 1 min after about 80 percent of the sample had been titrated. No significant differences were observed between these titrations and those run with no delay. Those iron samples in the range 0.1-130 micrograms were titrated with a relative standard deviation of 0.7-5.0 percent and a relative error of 0-4.0 percent with the greatest inaccuracies and imprecision being at the lower end of the range, where titration times were shortest. The end-point detection system consisted of a platinum and a saturated calomel electrode across which a constant voltage is impressed. This voltage is such that the platinum electrode is 1.025 V vs N.H.F. The current between the indicating electrodes is monitored with a current-sensing device possessing a sensitivity of 0.0001 microA/mm.

INDEX TERMS: Iron, Electrochemistry, Pollutant identification, Methodology, Coulometric titration, Cerium, Ferroin, Precision, Accuracy.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9792

"TOXIC MATERIALS ANALYSIS OF STREET SURFACE CONTAMINANTS", Pitt, R. E., Amy, G., URS Research Company, San Mateo, California, Report No. EPA-R2-73-283, EPA Contract No. 14-12-921, August 1973, 133 pp.

Because of the large amounts of toxic materials (especially heavy metals) found associated with street surface particulates during the course of a previous study (Water Pollution Aspects of Street Surface Contaminants), additional work has recently been completed which defines the distribution and range of heavy metals on the nation's city streets. This project defined the breakdown of the particulates' compositions by having mass spectrographic analyses performed on various samples. Using these results, the heavy metals which were determined to have the greatest water pollution potential (As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Sr, Ti, Zn, and Zr) were analyzed in each of about 75 samples collected nationwide in 10 cities in the previous study. Other analyses conducted included: size affinities of the metals, solubilities and toxicities of the road surface runoff mixture, and certain organic analyses on selected samples. Additional sampling was conducted on rural road, highway and airport surfaces and particulates were analyzed for the following common water pollution parameters: BOD sub 5, COD and nutrients, plus selected heavy metals, for comparison with values representative of normal city streets.

INDEX TERMS: Mass spectrometry, Chemical analysis, Toxicity, Urban runoff, Surface runoff, Heavy metals, Water pollution sources, Organic compounds, Roads, Solubility, Oil, Pesticides, Polychlorinated biphenyls, Nutrients, Runways, Street surface contaminants, Atomic absorption spectrophotometry, Elemental composition, Grease.

AMIC-9805

"PICLORAM MOVEMENT FROM A CHAPARRAL WATERSHED", Davis, E. A., Ingebo, P. A., Water Resources Research, Vol. 9, No 5, October 1973, pp 1304-1313.

This study was conducted in conjunction with a brush control treatment with picloram (4-amino-3,5,6-trichloropicolinic acid) on an experimental watershed to determine the effect of a brush-to-grass conversion on water yield. It is concerned with the extent and duration of stream water contamination by picloram and with the estimation of the loss of picloram from the watershed to stream water. Picloram pellets were applied to the soil (9.3 lb acid equivalent per acre of a 2.1-acre side slope of a 46-acre chaparral watershed in central Arizona. Water samples from a stream at the base of the watershed were collected at irregular intervals until picloram was no longer detected. The samples were stored in 1-pint brown polyethylene bottles at 35-38 F before analysis. The water samples were analyzed by a sand culture bioassay method in which safflower (Carthamus tinctorius) was used as the indicator plant. Maximum measured concentrations (350-370 ppb) occurred during the first 3 months after treatment and were associated with heavy rainfall. After 14 months and 40 inches of accumulated rainfall, picloram was no longer detected in the stream water. An estimated 4.5 percent of the picloram applied was lost to stream water. Direct use of stream water from the outlet of the treated watershed when picloram levels were 46-370 ppb could have damaged sensitive crops such as cotton.

INDEX TERMS: Watersheds (basins), Streams, Persistence, Soils, Runoff, Hydraulic conductivity, Water sampling, Bioassay, Bioindicators, Chaparral, Precipitation, Streamflow, Picloram, Sample preservation, Sand culture.

AMIC-9806

"CESIUM 137 IN A MOUNTAIN STREAM CHANNEL", Hubbard, J. E., Striffler, W. D., Water Resources Research, Vol. 9, No. 5, October 1973, pp 1440-1442.

Concentration of the radionuclide Cs-137 in water, sediment, and channel vegetation was determined in a Colorado mountain watershed in 1967. No measurable Cs-137 was found in stream water. Specific Cs-137 activity in sediment decreased exponentially with distance from the headwaters. Its concentration was 124 pc/g at the headwaters, where a snowfield has existed continuously since the atmospheric testing of nuclear weapons, to 4 pc/g 5600 meters downstream. Stream vegetation samples also indicated a similar decrease in specific Cs-137 activity with site location downstream. Radiation from the samples was measured in a steel-walled low-background shield. The samples in plastic containers were mounted in uniform geometry above an 8 X 4 inch NaI(Tl) scintillation crystal. Gamma emissions from the sample resulted in scintillations from the crystal that were detected by matched photomultiplier tubes. These were connected to a RIDL 34-12 multichannel pulse height analyzer. The pulse data were stored in 200 channels representing successive 10-kev increments of absorbed gamma energy from 0 to 2 Mev. The spectra were presented for visual inspection of an oscilloscope tube and punched on Hollerith cards for Cs-137 activity calculations.

INDEX TERMS: Cesium, Radioisotopes, Radioactive wastes, Watersheds (basins), Streams, Sediments, Mountains, Colorado, Sampling, Vegetation, Radioactivity techniques, Mosses, Data processing, Gamma spectrometry, Cs-137.

AMIC-9813

"INTERFACING A PROGRAMMABLE ELECTRONIC CALCULATOR WITH AN AUTOMATIC AMINO ACID ANALYZER", Fishman, M. L., Landgraff, L. M., Burdick, D., Journal of Chromatography, Vol. 86, No. 1, November 1973, pp 37-51.

The rapid calculation of data from an automatic amino acid analyzer by a programmable electronic calculator is now possible. The programmable electronic calculator offers a less expensive and more flexible alternative to large computers. Typically, data in the form of retention times and peak areas are read from a punched tape and converted into final values with a minimum of data handling. A digital integrator, teletypewriter with tape punch and reader, tape editor and printer also are required. A mathematical program is described that has been devised to convert raw data from a 4-h protein hydrolyzate run into final values. The final printout presents in tabular form each amino acid as a percentage of the sample dry weight and crude protein. The total weight percentage of amino acids and percentage recovery of protein based on Kjeldahl nitrogen are also calculated. Other features of the program include the ability to eliminate up to 20 extraneous peaks from the sample and to correct for sampling errors with the aid of internal standards. Amino acid molecular weights and color constants, which are also calculated, are stored without destruction so as to permit the calculation of an unlimited number of samples from the same set of standards.

INDEX TERMS: Amino acids, Chemical analysis, Data processing, Interfaces, Electronic equipment, Costs, Instrumentation, Data interpretation, Automatic amino acid analyzer, Programmable electronic calculator.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9816

"IDENTIFICATION OF AROMATIC NITRILES BY REACTION PAPER CHROMATOGRAPHY", Franc, J., Pospisilova, K., *Journal of Chromatography*, Vol. 86, No. 1, November 1973, pp 159-165.

A procedure involving reaction paper chromatography for the determination of the number of nitrile groups in molecules from the shift in the $R_{\text{sub M}}$ values of the substance before and after reaction has been developed. A technique for the detection of substances with a nitrile group, which can be used with advantage even for other substances, has been devised. To 1 ml of 15-20 percent hydrogen peroxide, 1-2 drops of 15 percent aqueous NaOH solution and several milligrams of a sample of a substance containing a nitrile group were added. The mixture was shaken and filtered after 2-3 min, and the residue on the filter was dissolved in either dimethyl sulphoxide or ethanol. The solution obtained was applied directly on to the chromatographic paper as a 5 percent solution. The substances were chromatographed on Whatman No. 3 paper using n-propanol-ammonia (2:1) as the solvent. The detection was carried out by spraying with two reagents. The first reagent was prepared by mixing 5 g of hydroxylamine hydrochloride with an equivalent amount of anhydrous sodium carbonate and adding 200 ml of 96 percent ethanol. After stirring, the solution was filtered and the filtrate was used for spraying. The second reagent was a saturated aqueous solution of copper(II) acetate. The chromatogram was sprayed with the first reagent and, after drying either freely in the air or in an oven at 80 C, it was sprayed with the second reagent. The coloration of the spots was observed immediately under UV light. Some substances fluoresced brightly in various colours, and some were visible even under normal light.

INDEX TERMS: Chromatography, Aromatic compounds, Acids, Nitriles, Paper chromatography, Dinitriles, Diamides, Carboxylic acid, Cyanobenzoic acid, Dicarboxylic acid.

AMIC-9817

"SELECTIVE CHROMATOGRAPHIC SEPARATION OF URANIUM(VI) ON DEAE-CELLULOSE LAYERS IN DILUTE ACETIC ACID MEDIA", Kuroda, R., Oguma, K., Watanabe, H., *Journal of Chromatography*, Vol. 86, No. 1, November 1973, pp 167-172.

In dilute acetic acid solutions, U(VI) shows a useful chromatographic distribution on DEAE-cellulose layers, while most other metals ions migrate upwards to the solvent front or remain at or near the start. This chromatographic behavior of U(VI) enables a selective method for the separation of U(VI) by thin-layer chromatography to be developed. The $R_{\text{sub f}}$ values on DEAE-cellulose and Avicel SF are quoted for 34 metal ions as a function of acetic acid concentration in the range 1-6 M. Results for two- and three-component separations by elution with 1 M acetic acid are given in order to illustrate the effectiveness and utility of the present method.

INDEX TERMS: Cellulose, Separation techniques, Ions, Acids, Uranium, Thin layer chromatography, Acetic acid, DEAE-cellulose.

AMIC-9839

"A HIGHLY SENSITIVE AUTOMATED TECHNIQUE FOR THE DETERMINATION OF AMMONIUM NITROGEN", Brown, M. W., *Journal of the Science of Food and Agriculture*, Vol. 24, No. 9, September 1973, pp 1119-1123.

The catalytic action of nitroprusside on the phenol hypochlorite reaction has been utilized to design a more sensitive automated technique for determining ammonium nitrogen in soil extracts. The method gives reproducible results in close agreement with manual methods. Sensitivity is such that as little as 0.1 ppm of N in solution can be determined without the use of recorder range expansion. Using this procedure, 10 g of air-dried soil were shaken for one hour with 100 ml 2 M-potassium chloride. The supernatant extract was fed into the analyzer without prior filtration, along with standard solutions. Where the anticipated level of nitrogen was greater than 4 ppm, the soil extract was first suitably diluted with 2 M-potassium chloride. Agreement between the two sets of results is very good. Statistical tests, Student's t , show there is no significant difference between the two sets of results even at the 20 percent probability level. Experience with the basic phenol hypochlorite method strongly suggests that the method would also be suitable for the analysis of fertilizers and natural waters.

INDEX TERMS: Ammonium compounds, Soils, Automation, Chemical analysis, Fertilizers, Water analysis, Ammonium nitrogen, Phenol hypochlorite reaction, Autoanalyzer, Catalytic methods.

AMIC-9860

"GAS CHROMATOGRAPHIC STUDIES OF MIXED-LIGAND COMPLEXES OF DIVALENT CATIONS", Burgett, C. A., *Journal of Chromatographic Science*, Vol. 11, No. 11, November 1973, pp 611-614.

Volatile complexes of iron(II), cobalt(II) and nickel(II) are prepared by solvent extraction using the mixed-ligand system 1,4,1,2,2,6,6,7,7,7-decafluoro-3,5-heptanedione, H(FHD), di-n-butylsulfoxide, (DBSO). The composition of the extracted species is reported to be $M(\text{FHD})_2 \cdot \text{DBSO}$. Thermogravimetric analysis of the complexes is reported. The complexes were eluted from the gas chromatographic column without decomposition as determined by mass spectrometric detection. Separation of iron(II) and cobalt(II) from nickel(II) was readily achieved; however, iron(II) and cobalt(II) were not separated.

INDEX TERMS: Cations, Gas chromatography, Solvent extractions, Iron, Cobalt, Nickel, Gravimetric analysis, Mass spectrometry, Separation techniques, Ligands, Thermogravimetric analysis, Thermal stability, Divalent cations.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9865

"RESIDUES OF ATRAZINE, CYANAZINE, AND THEIR PHYTOTOXIC METABOLITES IN A CLAY LOAM SOIL", Sirons, G. J., Frank, R., Sawyer, T., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1016-1020.

The degradation of 2-chloro-4-ethylamino-6-isopropylamino-s-triazine (atrazine) and 2-chloro-4-(1-cyano-1-methylethylamino)-6-ethylamino-2-triazine (cyanazine) was investigated in Perth clay loam soil. Atrazine and cyanazine were applied at rates of 1, 2, and 3 lb/A of active ingredients as pre- and postemergence treatments. Soil was sampled from plots after 0, 2, 3.5, 5, and 12 months at 0-2.5, 2.5-5, and 5-10 in. depths. Atrazine, cyanazine, and their phytotoxic metabolites were extracted with a 65 percent acetonitrile-water mixture and quantitated on a Coulson conductivity detection system. Presented data indicate that atrazine is converted into deethylated atrazine (2-chloro-4-amino-6-isopropylamino-s-triazine) as a major and deisopropylated atrazine (2-chloro-4-amino-6-ethylamino-s-triazine) as a minor phytotoxic metabolite and that cyanazine is changed to deisopropylated atrazine as a major phytotoxic metabolite. Cyanazine amide (2-chloro-4-(1-carbamoyl-1-methylethylamino)-6-ethylamino-s-triazine) was found. It is proposed that the hydrolysis precedes the microbiological degradation to the deisopropylated atrazine.

INDEX TERMS: Clay loam, Pesticide residues, Degradation (decomposition), Triazine pesticides, Persistence, Metabolites, Coulson conductivity detector, Quantitative analysis, Chemical recovery.

AMIC-9873

"NATURE AND TOXICITY OF TWO OXYCHLORDANE PHOTOISOMERS", Ivie, G. W., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1113-1115.

A mixture of 2.5 mmol each of oxychlordane and xanthone in 50 ml of chloroform was streaked over the surface of several 0.25-mm silica gel chromatoplates to a concentration of about 0.2 mg of oxychlordane/sq cm. The plates were exposed to direct sunlight for 24 hr over a period of 3 days; then the gel was scraped and the products were extracted with chloroform. Tlc revealed two major photoproducts in addition to the parent compound. These derivatives were methylene-bridged isomers, one containing a keto group generated by photochemical cleavage of the oxychlordane oxirane ring and the other with an intact epoxide moiety. Their formation was greatly accelerated by xanthone photosensitizer. Oxychlordane and its keto photoisomer are quite toxic to white mice, but the second isomer is of very low toxicity.

INDEX TERMS: Pesticide toxicity, Oxychlordane, Photodecomposition, Photoisomers.

AMIC-9874

"REDUCTION IN MERCURY CONTENT OF FISH PROTEIN CONCENTRATE BY ENZYMATIC DIGESTION", Archer, M. C., Stillings, B. R., Tannenbaum, et al., Journal of Agricultural and Food Chemistry, Vol. 21, No. 6, November/December 1973, pp 1116-1117.

The effect of proteolytic digestion on the distribution of mercury in fish protein concentrate (FPC) has been investigated. A two- to sevenfold concentration of mercury in the insoluble FPC fraction and a corresponding reduction of mercury level in the soluble FPC fraction was achieved after proteolysis. The following commercial enzyme preparations were used: Pancreatin, B grade (porcine pancreas), Calbiochem; Pronase, B grade (*Streptomyces griseus*), Calbiochem; and Monzyme PA-1 (*Bacillus subtilis*), Monsanto. FPC samples were prepared from either Pacific hake (*Merluccius productus*) or swordfish (*Xiphias gladius*). Ten percent slurries of FPC were digested for periods of 1 and 6 hr at 50 C with Monzyme at pH 8.8 and with Pronase and Pancreatin at pH 8.5. After digestion for 1 or 6 hr, the reaction was stopped by pouring the mixture into two 50-ml centrifuge tubes and spinning down the residue at 4 C for 5 min and 5090 X g. The residue was suspended in distilled water and recentrifuged. The clear supernatants were combined and freeze-dried after most of the water was removed by flash evaporation at a bath temperature of 40 C. The residue was also freeze-dried. The soluble and insoluble fractions were then analyzed for mercury content.

INDEX TERMS: Mercury, Reduction (chemical), Digestion, Proteins, Separation techniques, Enzymes, Centrifugation, Fish protein concentrate, Proteolysis, Sample preparation.

AMIC-9904

"KAEMPFEROL (3,5,7,4'-TETRAHYDROXYFLAVONE) AS A CHROMOGENIC REAGENT FOR TIN(IV)", Garg, B. S., Singh, R. P., Microchemical Journal, Vol. 18, No. 5, October 1973, pp 509-519.

Tin(IV) forms a deep yellow chelate with the ligand kaempferol in aqueous ethanolic medium. This color reaction has been investigated in terms of using it for the spectrophotometric determination of tin. Those parameters studied were acidity, ethanol, time and temperature, reagent concentration. With the method used, the sensitivity of the color reaction 0.0029 microgram of Sn/sq cm is identical to log I sub o/I equals 0.001, at 430 nm in 0.1 N HCl medium and Beer's law is obeyed up to 3.6 ppm of tin. Several complexing anions do not interfere and they have been used for masking some of the cations which interfere in the determination.

INDEX TERMS: Spectrophotometry, Aqueous solutions, Methodology, Pollutant identification, Color reactions, Tin, Chromogenic reagents, Kaempferol, Metal chelates, Ionic interference, Sensitivity, Precision.

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-9911 "MICRODETERMINATION OF RESORCINOL IN PRESENCE OF PHENOL", Sarwar, M., Butt, K.-U., <u>Mikrochimica Acta</u>, No. 5, 1973, pp 679-682.</p> <p>A displacement titration method using N-bromosuccinimide as the titrant has been devised for estimation of resorcinol in phenol. One ml of the resorcinol test solution is placed in a 50-ml Erlenmeyer flask. One ml of potassium iodide and 0.5-1.0 ml of fresh starch is added. The solution is titrated against 0.01 N solution of N-bromosuccinimide added dropwise from a microburette. The end point is reached when a bluish color appears and persists for 30 seconds. A similar procedure is repeated for the estimation of resorcinol in phenol. The method is very simple, rapid, and accurate.</p> <p>INDEX TERMS: Phenols, Volumetric analysis, Aqueous solutions, Resorcinol.</p>	<p>AMIC-9929 "THE DETERMINATION OF COBALT IN FISH TISSUE BY ATOMIC ABSORPTION SPECTROPHOTOMETRY", Julshamn, K., Braekkan, O. R., <u>Atomic Absorption Newsletter</u>, Vol. 12, No. 6, November-December 1973, pp 139-141.</p> <p>A method is described for the determination of cobalt in fish. The samples were prepared for analysis by freeze-drying and homogenization. A portion of 10 g was pre-ashed with infrared heat and then ashed in a muffle furnace at 480 C. The residue was dissolved in 0.1 N hydrochloric acid, chelated with ammonium pyrrolidine dithiocarbamate, extracted with methyl isobutyl ketone, and analyzed by atomic absorption spectroscopy. Levels down to 0.01 microgram cobalt per g of fish tissue may be estimated with an average recovery of 96 percent and a coefficient of variation of 5.7-14.2 percent.</p> <p>INDEX TERMS: Cobalt, Chemical analysis, Fish, Trace elements, Animal tissues, Atomic absorption spectrophotometry, Sample preparation, Chemical recovery, Detection limits, Precision.</p>
<p>AMIC-9925 "REACTIONS OF CHLORAMINES WITH ACTIVE CARBON", Bauer, R. C., Snoeyink, V. L., <u>Journal Water Pollution Control Federation</u>, Vol. 45, No. 11, November 1973, pp 2290-2301.</p> <p>The purpose of this study was to determine the nature of the NH_2Cl-active carbon and NHCl_2-active carbon reactions. These reactions are of importance if carbon is to be used to eliminate combined residual chlorine from an effluent and if it is to aid in the oxidation of $\text{NH}_3\text{-N}$ to N_2. The tests were performed in small-scale batch systems with pH control being used to maintain either NH_2Cl or NHCl_2 as the predominant species in the Cl-NH_3 solution. $\text{NHCl}_2\text{-N}$ is readily oxidized by carbon to N_2. $\text{NH}_2\text{Cl-N}$ is reconverted to ammonia by fresh carbon; however, carbon that has an accumulation of surface oxides, which develop through reaction of free and combined chlorine with carbon, will partially oxidize $\text{NH}_2\text{Cl-N}$ to N_2.</p> <p>INDEX TERMS: Chemical reactions, Activated carbon, Nutrient removal, Chloramines, Monochloramine, Dichloramine.</p>	<p>AMIC-9931 "THE QUANTITATIVE DETERMINATION OF CHROMIUM IN URINE BY FLAMELESS ATOMIC ABSORPTION SPECTROSCOPY", Schaller, K. H., Essing, H.-G., Valentine, H., et al., <u>Atomic Absorption Newsletter</u>, Vol. 12, No. 6, November-December 1973, pp 147-150.</p> <p>Flameless atomic absorption spectrophotometry is considered to be the most suitable method for the determination of chromium in body fluids. This method has been applied to the direct determination of the chromium content of urine. Fifty microliters of a 24-hr urine sample are injected into an electrically heated graphite tube and the determination made at 358 nm. No prior sample preparation is required. To check the accuracy of the method, 5 micrograms/l Cr was added to urine samples not previously exposed to chromium. The median recovery was 93 percent. To determine precision in a series, one urine sample was analyzed twenty times. With a median chromium concentration of 6.02 micrograms/l and a standard deviation of 0.9 microgram/l, the coefficient of variation was equal to 15 percent. The precision from day-to-day, over the course of one week, expressed as the coefficient of variation was 17 percent at the 6-microgram/l level. The detection limit (equivalent to 1 percent absorption) was 0.2 microgram/l chromium in urine using a sample quantity of 50 microliters, equivalent to 10 pg of chromium absolute.</p> <p>INDEX TERMS: Chemical analysis, Urine, Chromium, Methodology, Heavy metals, Pollutant identification, Reliability, Trace elements, Body fluids, Flameless atomic absorption spectrophotometry, Biological samples, Chemical recovery, Precision, Detection limits, Absorbance.</p>

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9932

"A REVIEW OF WATER ANALYSIS BY ATOMIC ABSORPTION", Ediger, R. D., Atomic Absorption Newsletter, Vol. 12, No. 6, November-December 1973, pp 151-157.

A review is presented of the analysis of water samples by atomic absorption. A brief summary of preservation and storage methods is presented, along with information on some of the more useful concentration methods and specialized atomization techniques. Each element of major interest in water quality analysis is considered separately and typical analytical procedures are discussed.

INDEX TERMS: Water analysis, Methodology, Heavy metals, Alkaline earth metals, Alkali metals, Reviews, Pollutant identification, Atomic absorption spectrophotometry, Natural waters, Sample preparation, Sample preservation, Sample storage, Preconcentration.

AMIC-9936

"PYROGRAPHIC ANALYSIS OF WASTE WATERS", Lysyj, I., Environmental Science and Technology, Vol. 8, No. 1, January 1974, pp 31-34.

Based on the theory of multicomponent pattern recognition and differentiation, a new analytical approach represents a fundamental departure from the traditional working concept of analytical chemistry. Multicomponent pattern recognition permits definition of a complex chemical composition as a separate entity, and provides means for studying its interactions with other compositions found in environmental matrices. In the pyrographic method, organic matter is subjected to elevated temperatures in the absence of oxygen, leading to thermal decomposition of organic molecules into several preferential fragments. The nature and quantity of such fragments reflect the elemental and structural character of the parent material. Through identification of the pyrolytically produced derivative composition by means of gas chromatography, the nature of the parent material can be defined. By comparing pyrograms of unknown matter with that of known materials, the qualitative nature of the substance in question could be determined. Analysis of water samples is performed automatically. No sample preparation, such as extraction or separation, is required. Interpretation of data is aided by two computer programs. The technique has been studied and evaluated in waste source identification and differentiation, industrial effluent analysis, control of waste treatment process, characterization of organic content of natural waters, and process control in beer brewing and other fields. Its use for stream monitoring, industrial effluent analysis, and waste treatment control are discussed.

INDEX TERMS: Water analysis, Monitoring, Waste water (pollution), Mathematical studies, Gas chromatography, Organic matter, Statistical methods, Computer programs, Water quality, Industrial wastes, Pyrographic analysis, Pattern recognition, Thermal decomposition.

AMIC-AMIC-9935

"A TECHNIQUE FOR EXTRACTION AND STORAGE OF WATER SAMPLES FOR Mn, Cd, and Pb DETERMINATION BY ATOMIC ABSORPTION SPECTROSCOPY", Olsen, R. D., Sommerfeld, M. R., Atomic Absorption Newsletter, Vol. 12, No. 6, November/December 1973, pp 165-166.

A method has been developed for stabilizing metal chelates thus allowing extracted metals to be stored for at least 2 weeks at room temperature in an acetone-HCl solution. The stability is attained when the metal chelates are transferred from methyl isobutyl ketone to the acetone-HCl solution. Other limited tests indicate that Co, Cr, Cu, Fe, Ni, and Zn may also be coextracted and stored in acetone-HCl with similar stability. Some signal enhancement associated with MIBK solutions is also retained with the acetone-HCl solution. This technique should permit greater time flexibility in atomic absorption analysis involving multi-element organic extractions of large numbers of water samples.

INDEX TERMS: Solvent extractions, Manganese, Cadmium, Lead, Methodology, Chemical analysis, Water analysis, Trace elements, Stability, Metal chelates, Atomic absorption spectrophotometry, Sample storage.

AMIC-9937

"ATRAZINE, PROPACHLOR, AND DIAZINON RESIDUES ON SMALL AGRICULTURAL WATERSHEDS", Ritter, W. F., Johnson, H. P., Lovely, W. G., Molnau, M., Environmental Science and Technology, Vol. 8, No. 1, January 1974, pp 38-42.

Atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine), propachlor (2-chloro-N-isopropylacetanilide), and diazinon (O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate) losses in sediment and surface runoff were measured from four watersheds ranging in size from 1.9-3.8 acres and located in the loessial soil region of western Iowa. Two of the watersheds were planted to ridged corn, and two were planted to surface-contoured corn. Movement of atrazine, propachlor, and diazinon in the soil profile and degradation of these pesticides were measured. Water and sediment samples were obtained from the four watersheds with single-stage sediment samplers. All water and sediment samples were collected in glass bottles, transferred to polyethylene bottles, and frozen immediately after collection. Soil samples were taken within 24 h after pesticide application and at 7-day intervals for the first few weeks. The Geigy Chemical Corp. (1965) ultraviolet method was used for atrazine analysis. Propachlor and diazinon were determined by electron capture gas chromatography. Pesticide losses were much greater from the surface-contoured watersheds than the ridged watershed. Significant amounts of surface-applied atrazine and propachlor were removed from the surface-contoured watersheds by storms occurring shortly after the pesticides were applied. Insignificant amounts of diazinon were removed in the surface runoff and sediment. Generally, pesticide concentrations were higher in the sediment than in the runoff water; however, greater total losses were associated with the greater volume of water.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9937 (Continued)

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INDEX TERMS: Pesticide residues, Agricultural watersheds, Pesticide kinetics, Triazine pesticides, Phosphothioate pesticides, Chlorinated hydrocarbon pesticides, Small watersheds, Degradation (decomposition), Surface runoff, Movement, Water pollution sources, Persistence, Fate of pollutants, Pesticide loss, Chemical concentration.

AMIC-9939

"COAGULATION IN ESTUARIES", Edzwald, J. K., Upchurch, J. B., O'Melia, C. R., Environmental Science and Technology, Vol. 8, No. 1, January 1974, pp 58-61.

The stability of clay suspensions as a function of ionic strength was determined from observations of coagulation rates. The stability value, alpha, depends on the type of clay mineral and on chemical solution parameters such as salinity and pH. These studies indicated that clays can be destabilized in estuaries by compression of the electrical double layer. Measurements of the composition and stability of sediments collected along the 35-mile length of the Pamlico Estuary indicated that the sediments in the upper end of the estuary were less stable than those collected in the downstream brackish areas. Kaolinite, a relatively unstable clay, was predominant in the upstream sediments while illite, a more stable clay, accumulated in the sediments near the mouth of the estuary. These observations are consistent with the view that sediment deposition in the estuary is influenced by coagulation.

INDEX TERMS: Coagulation, Colloids, Clay minerals, Chemical reactions, Suspended solids, Soil stability, Pamlico Estuary, Coagulation rates, Ionic strength.

AMIC-9938

"PHOSPHATES IN SEDIMENTS OF PAMLICO ESTUARY", Upchurch, J. B., Edzwald, J. K., O'Melia, C. R., Environmental Science and Technology, Vol. 8, No. 1, January 1974, pp 56-58.

Of concern is the amount of available phosphorus present in the bottom sediments of North Carolina's Pamlico Estuary along the length of the estuary from a freshwater to an estuarine environment. Bottom sediments were collected at 23 sites from the middle of the Pamlico River with an Ekman dredge. The sediments were frozen, thawed, mixed, dried in an oven at 110 C for 24 hr, and ground. A modified HCl-H₂SO₄ extraction procedure was used to extract the available phosphorus from the sediments. After extraction, the phosphorus was measured using the vanadomolybdophosphoric acid colorimetric method. The amount of "available" phosphorus extracted from sediment samples along the 35-mile length of the Pamlico Estuary, was observed to decrease from 1.6 mg P/g sediment in freshwater to 0.3 mg P/g sediment in water with a salinity of 18 ppt. A high correlation (r equals 0.99) between available phosphorus and oxalate-extractable iron was found in the upper reach of the estuary (salinity less than 1 ppt). In the lower part of the estuary the Fe-P correlation decreased (r equals 0.86). The decrease in the available P and in the Fe-P correlation along the length of the estuary is consistent with the suggestion that P is held to suspended sediments by some type of Fe-inorganic P complex of limited stability. Suspended materials entering the estuary in the freshwater inflow could lose phosphorus to solution as they are transported through waters of increasing salinity to the mouth of the estuary.

INDEX TERMS: Phosphates, Bottom sediments, Phosphorus, Freshwater, Estuarine environment, Mixing, Saline water-freshwater interfaces, Methodology, Inflow, Pamlico Estuary.

AMIC-9955

"POLYCHLORINATED BIPHENYLS IN THE SEASTAR ACANTHASTER PLANCI", McCloskey, L. R., Deubert, K. H., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 5, November 1973, pp 261-264.

Procedures for separating PCB in small amounts of gonad tissue specimens from the starfish *Acanthaster planci* are described. Cleanup was done using disposable Pasteur pipettes. The columns were filled with Florisil activated for 24 hours at 130 C. Columns were packed in petroleum ether (30-60 C) and washed with 20 ml of petroleum ether prior to use. Extracts equivalent to one to two grams of fixed tissue were used for cleanup and PCBs were eluted with a volume (5-7 ml) of petroleum ether (30-60 C) that eluted 1 microgram of Aroclor 1254 to approximately 96 percent. A solvent blank was run with each extraction. Eluates were concentrated to 0.5 ml, and 1- to 5-microliter aliquots were analyzed by GLC-EC. TLC analysis was also carried out. Nitration of cleaned-up residues did not change the basic peak pattern, except to add new peaks. All tissue extracts produced peaks with the following retention times relative to p,p'-DDE: 0.45, 0.79, 1.0, 1.09, 1.35, 1.70, 2.14, 2.61, and 3.19. These peaks were also obtained with Aroclor 1254, and they did not disappear after nitration. TLC analysis of the extracts produced spots with R_f values 0.72, 0.80, and 0.92, whereas Aroclor 1254 produced two overlapping spots. Approximate R_f values were 0.7 and 0.8. The accuracy of the quantitation cannot be determined because of the differences between the peak patterns produced by Aroclor 1254 and the extracts. However, quantities estimated in this study seem to be in agreement with data obtained in similar studies on marine organisms.

INDEX TERMS: Polychlorinated biphenyls, Pesticide residues, Gas chromatography, Separation techniques, Starfish, Cleanup, Tissue.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9956

"FIELD IONIZATION MASS SPECTROMETRY: A NEW TOOL FOR THE ANALYTICAL CHEMIST", Anbar, M., Aberth, W. H., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 59-64.

Multipoint field ionization sources developed in recent years are discussed in detail and some new applications of mass spectrometry made possible by field ionization are reviewed. This technique provides nonfragmented and isotopically nonscrambled mass spectra which will open up at least two important areas of application: (1) analysis of complex multicomponent mixtures without preparation and (2) isotope dilution analysis by use of multilabeled molecular tracers. Field ionization spectra are shown for methaqualone, phenobarbital, norchlorpromazine, and No. 6 fuel oil. Field ionization mass spectrometry promises to provide a powerful tool in a diversity of fields including environmental research.

INDEX TERMS: Mass spectrometry, Ionization, Tracers, Isotope studies, Oil, Chemical analysis, Field ionization, Molecular tracers, Isotope dilution.

AMIC-9963

"CHARACTERIZATION OF WOOD-PRESERVING COAL-TAR CREOSOTE BY GAS-LIQUID CHROMATOGRAPHY", Nestler, F. H. M., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 46-53.

Six whole coal-tar creosotes, two of which represent contemporary commercial production, were analyzed by GLC on an SE-30 packing. Retention data for 14 standard compounds were determined for the four liquid phases: SE-30, ApL, OV-17, DEGS. The linear relationship observed between log relative retention in SE-30 and atmospheric boiling point permitted the quantitative interpretation of isothermal chromatograms in terms of a simulated distillation analysis. The latter results agreed very well with precision fractional distillation data, but much less so with the American Wood-Preservers' Association Standard Method. The boiling ranges selected for comparison of the three sets of data were those established for the AWP Standard Method. (Reprinted from Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 46-53. Copyright 1974 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Creosote, Wood preservatives (pesticides), Coal tar coating, Physical properties, Characterization, Gas liquid chromatography, Retention time, Aromatic hydrocarbons, Precision.

AMIC-9960

"ANODIC STRIPPING VOLTAMMETRY OF ZINC IN SEAWATER WITH A TUBULAR MERCURY-GRAPHITE ELECTRODE", Lieberman, S. H., Zirino, A., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 20-23.

A tubular mercury-graphite electrode (TMGE) has been used to measure zinc in flowing solutions by anodic stripping voltammetry. Fabrication of the electrode and a new method of applying and maintaining a consistently active mercury thin film on a graphite electrode are described. Application of the TMGE to anodic stripping voltammetry of Zn in seawater yields peak currents that are linear with concentration. Measurements are reproducible with a relative standard deviation of plus or minus 9.5 percent at the 0.3 nM level. The system is more sensitive than a comparable static system. Five-minute analysis times permit detection of zinc in seawater at concentrations of 1 nM. The Zn peak current and trace metal peak potentials are described as a function of plating time, rate of solution flow, and other variables. (Reprinted from Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 20-23. Copyright 1974 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Zinc, Sea water, Pollutant identification, Water analysis, Trace elements, Anodic stripping voltammetry, Tubular mercury-graphite electrodes, Detection limits, Precision, Accuracy.

AMIC-9964

"USE OF MULTIPLE R SUB F VALUES FOR IDENTIFICATION BY PAPER AND THIN-LAYER CHROMATOGRAPHY", Connors, K. A., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 53-58.

This paper attempts to define how many chromatographic solvent systems should be used in identifying unknowns and how these systems should be selected. Maximum information from chromatography for qualitative analysis is obtained when the R sub fx value for a compound in system X is independent of its value R sub fy in another system Y. It is found, for such systems, that the distribution of points in the R sub fx, R sub fy plane is closed to a Poisson distribution. The number of independent R sub f values required to identify a compound at a specified level of uncertainty can be calculated. Independence of R sub f values is enhanced by using chromatographic systems that are qualitatively different from each other. In many analytical situations, the analyst might make planned use of the considerations presented in this paper. A rough estimate of the size of the population can usually be made. The nature of the distribution of points in the R sub fx, R sub fy plane can be established experimentally, and application of the above guideline experimentally, and application of the above guideline may lead to efficient selection of uncorrelated systems.

INDEX TERMS: Chromatography, Solvents, Statistical methods, Pollutant identification, R sub f values, Paper chromatography, Thin layer chromatography.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9965

"NEW ULTRAVIOLET RATIO SPECTROPHOTOMETRIC SYSTEM FOR THE DETERMINATION OF TRACE AMOUNTS OF PHENOLIC COMPOUNDS", Fountaine, J. E., Joshipure, P. B., Keliher, P. N., et al., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 62-66.

A novel type of instrumental system, which uses two conventional sealed hollow cathode lamps to monitor the ultraviolet bathochromic shift which occurs when phenolic compounds are made basic, is described. The ultraviolet ratio spectrophotometric system has been used for the determination of several phenols at the low ppb range including phenol, o-cresol, p-cresol, resorcinol, thymol, p-methoxy phenol, and tyrosine. Comparison is made with the standard ASTM Method D-1783-70 (colorimetric reaction with 4-aminoantipyrine), and results for both the ASTM method and the ultraviolet ratio spectrometric method are presented. In general, results with the ultraviolet ratio spectrometric method are higher, due to the presence of para-blocked phenols which do not react with 4-aminoantipyrine. Samples from several rivers were analyzed using the procedure.

INDEX TERMS: Instrumentation, Phenols, Water analysis, Aqueous solutions, Rivers, Industrial wastes, Potable water, Pollutants, Pollutant identification, o-Cresol, p-Cresol, Resorcinol, Thymol, p-Methoxy phenol, Tyrosine, Ultraviolet ratio spectrophotometry, Schuykill River, Trace levels,

AMIC-9970

"PRESERVATION OF DILUTE MERCURY SOLUTIONS", Feldman, C., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 99-102.

Distilled water solutions containing 0.1-10.0 ng Hg/ml were stored for 10 days in glass and polyethylene containers. Those which were untreated, or treated with nitric acid, sulfuric acid plus potassium permanganate, or potassium chromate, lost substantial fractions of their mercury in this period. Solutions stored in polyethylene and treated with 5 percent (v/v) nitric acid plus 0.05 percent chromate ion stayed at full strength for at least ten days. Solutions stored in glass and treated with 5 percent (v/v) nitric acid plus 0.01 percent chromate ion stayed at full strength for as long as five months. The causes of losses in distilled and natural water samples are discussed.

INDEX TERMS: Water, Storage, Mercury, Sample preservation, Stability, Chemical loss, Reference samples.

AMIC-9968

"INDUCTIVELY COUPLED PLASMA-OPTICAL EMISSION ANALYTICAL SPECTROMETRY. A COMPACT FACILITY FOR TRACE ANALYSIS OF SOLUTIONS", Scott, R. H., Fassel, V. A., Kniseley, R. N., et al., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 75-80.

This paper describes a compact inductively coupled plasma-optical emission system for the trace determination of metallic elements in solution. Theoretical considerations are presented to determine operating parameters which agree well with the empirically determined values. The aerosol desolvation system commonly used with this type of source has been eliminated, and pneumatic nebulization is employed in place of the more elaborate ultrasonic method. Some characteristics of the plasma are reported. Detection limits are in the range of 0.1-10 mg/ml for Al, Ba, Ca, Co, Cr, Ni, Pb, Se, Ti, V, Y, and Zn. The facility is readily adaptable to simultaneous multielement trace analysis.

INDEX TERMS: Heavy metals, Aqueous solutions, Laboratory equipment, Trace elements, Plasma-optical emission spectroscopy, Detection limits.

AMIC-9971

"SOLVENT EXTRACTION OF METAL CHELATES INTO WATER-IMMISCIBLE ACETONE", Matkovich, C. E., Christian, G. D., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 102-106.

Acetone is separated from aqueous solutions via salting-out with either saturated calcium chloride or 65 wt percent sucrose. Several metal ammonium 1-pyrrolidinecarbodithioate and dithizone chelates were successfully extracted from calcium chloride solutions into the acetone phase while metal oxine chelates were extracted from sucrose solutions. Solvent extraction curves are reported. The metals considered include Sc, Cr, Mn, Fe, Co, Ni, Cu, Ti, and Zn.

INDEX TERMS: Separation techniques, Solvent extractions, Aqueous solutions, Heavy metals, Metal chelates.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-9972

"ESTERIFICATION OF (2,4-DICHLOROPHENOXY)ACETIC ACID - A QUANTITATIVE COMPARISON OF ESTERIFICATION TECHNIQUES", Horner, J., Que Hee, S. S., Sutherland, R. G., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 110-112.

Esterification of 2,4-D with BF₃/alcohol mixtures for gas chromatography produces esters in greater than 90 percent yield in 20 minutes with few byproducts. Diazoalkylation is also efficient but produces many impurities. In addition, the reagent is more difficult to make and is more labile than the BF₃/alcohol mixtures. Mineral acid catalysis of 2,4-D/alcohol mixtures is time consuming and inefficient. The esters produced by silylation are unstable. The purity of the ester was determined by GLC analysis with thermal conductivity, flame ionization, and electron capture detectors. Mass, infrared, and NMR spectra of the pure compounds were used to confirm the presence of the prepared esters, and the identity of collected compounds separated by thermal conductivity GLC. Retention times of the prepared esters were compared with those of authentic esters.

INDEX TERMS: 2 4-D, Sample preparation, Esterification, Purity, Gas liquid chromatography.

AMIC-9978

"DETERMINATION OF TRACE AMOUNTS OF C2-C5 ACIDS IN AQUEOUS SOLUTIONS BY GAS CHROMATOGRAPHY", Di Corcia, A., Samperi, R., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 140-143.

An improved chromatographic method is reported for the rapid determination of aqueous solutions of the seven acids at concentrations down to 0.3 ppm, using Graphitized Carbon Black (GCB) modified with appropriate amounts of H₃PO₄ and polyethylene glycol 20 M. Column packings were prepared by dissolving appropriate amounts of the two phases, H₃PO₄ and polyethylene glycol (PEG) 20 M (Carlo Erba), in methanol and coating on the GCB by a slurry technique. Methanol was removed with use of a heat lamp. While drying, stirring of these materials must be avoided, as it may cause in some measure crushing of the graphitized carbon particles. Dried materials were resieved to maintain the proper mesh range. Columns made from glass tubings whose dimensions are specified in the captions of the figures were packed by moderately vibrating with the aid of a vibrator. The first four centimeters of the inlet side of each column were left empty to use them as an expansion chamber for injected liquid samples. Columns were then conditioned for 24 hours at 240 C. Using a suitably modified GCB surface allows quantitative determinations of C2-C5 acids to be made quite easily even at sub-ppm concentrations. The effect of adding PEG-20 M is twofold: first, it neutralizes residual 'hot sites' and, second, it reduces the surface area available for adsorption of eluate molecules, thus decreasing retention times.

INDEX TERMS: Aqueous solutions, Gas chromatography, Separation techniques, Fatty acids, Acetic acid, Propionic acid, Isobutyric acid, Butyric acid, 2-Methylbutyric acid, 3-Methylbutyric acid, Valeric acid, Flame ionization detector, Graphitized carbon black, Polyethylene glycol, Phosphoric acid.

AMIC-9976

"EFFECTS OF SURFACTANTS ON ATOMIC ABSORPTION ANALYSIS OF DILUTE AQUEOUS COPPER AND NICKEL SOLUTIONS", Venable R. L., Ballad, R. V., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 131-133.

Dilute (approximately 3 micrograms/ml) Cu and Ni solutions were analyzed by atomic absorption spectrophotometry upon the addition of the anionic surfactant, sodium dodecyl sulfate (SDS). One effect was the enhancement of absorption in acidic copper and nickel solutions containing SDS above the critical micelle concentration (CMC) over the same acidic copper and nickel concentrations without surfactant present. The second effect seemed to be either prevention of precipitate formation or stabilization of a colloidal dispersion in basic solutions at surfactant concentrations approaching and above the CMC. It was concluded that certain anionic surfactants can cause erroneous results in the AAS analysis of dilute aqueous metal ion solution. However, SDS and maybe other such surfactants can potentially be used to keep metals in solution where acidic pH values are not tolerable.

INDEX TERMS: Aqueous solutions, Copper, Nickel, Stabilization, Anionic surfactants, Atomic absorption spectrophotometry, Absorbance.

AMIC-9982

"ANALYSIS OF PRIMARY AROMATIC AMINES AND NITRITE BY DIAZOTIZATION AND PYROLYSIS GAS CHROMATOGRAPHY", Savitsky, A., Siggia, S., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 153-155.

A pyrolysis gas chromatographic method for analysis of diazonium salts has recently been developed. Since only primary aromatic amines produce stable diazonium salts upon diazotization and only diazonium salts should liberate nitrogen upon mild pyrolysis, adaptation of the pyrolysis gas chromatographic method has been investigated as a specific method for measuring primary aromatic amine content of mixtures. The feasibility of the pyrolysis gas chromatographic technique was demonstrated by analysis of primary aromatic amines of known purity. The percent recoveries by pyrolysis indicate that diazotization proceeds quantitatively and that the manipulation of the diazonium salts preserves them for analysis. Low, though reproducible, results were obtained for benzidine. Generally the precision and accuracy of the analysis was on the order of 1-2 percent. The analysis of mixtures for primary aromatic amine content was carried out by diazotizing in platinum boats. This was necessary because of insolubility of the products of some secondary and tertiary aromatic amines. The ability of pyrolysis gas chromatography to selectively determine the diazonium salts produced upon reaction with nitrous acid was demonstrated. Analysis of nitrite in nitrate required special modification of the diazotization conditions. Anthranilic acid was chosen for diazotization because its diazonium salt has good water solubility.

INDEX TERMS: Gas chromatography, Nitrites, Aromatic compounds, Aromatic amines, Diazotization, Pyrolysis gas chromatography.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-10001

"A SAMPLER FOR THE CHEMICAL ANALYSIS OF FRESHWATERS USING EVACUATED TUBES", Jones, R., Stuart, C. J. S., Limnology and Oceanography, Vol. 18, No. 5, September 1970, pp 805-809.

A freshwater sampler is described having three evacuated glass tubes which fill simultaneously at the selected depth when each rubber sealing stopper is pierced by a hypodermic needle. Each tube acts as the sample collector and container. (Reprinted from Limnology and Oceanography, Vol. 18, No. 5, September 1973, pp 805-809. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Freshwater, Chemical analysis, Water sampling, Water analysis, Sampling equipment, Water sampler.

AMIC-10011

"EFFECT OF FEEDLOT MANURE ON SOIL AND WATER QUALITY", Sommerfeldt, T. G., Pittman, U. J., Milne, R. A., Journal of Environmental Quality, Vol. 2, No. 4, October-December 1973, pp 423-427.

Research was conducted (1) to determine the contribution of representative feedlots in semiarid southern Alberta to soil and water pollution, and (2) to determine the effect of long-term applications of manure on the N, P, and soluble salt content of cultivated soil under irrigation. The $\text{NO}_3\text{-N}$ and available P content of the surface soil adjacent to the feedlots was generally greater than that of the soil away from the feedlots, but at depths greater than 150 cm the differences were usually small. Similarly, the concentration of $\text{NO}_3\text{-N}$ and P in the ground water at 1- to 5-m depths was usually increased only adjacent to the feedlot and, with minor exceptions, remained within 'safe' limits most of the time. There was no evidence that a small lake or three permanent streams near feedlots were polluted by effluents from the feedlots. Manure applied annually for 40 years at a rate of 70 metric tons/ha did not cause an undesirable buildup of N, P, or soluble salts in the soil.

INDEX TERMS: Feed lots, Farm wastes, Water quality, Soil contamination, Water pollution sources, Effects, Nitrogen, Phosphorus, Base flow, Groundwater.

AMIC-10010

"PARAFFIN HYDROCARBON PATTERNS IN PETROLEUM-POLLUTED MUSSELS", Clark, R. C., Jr., Finley, J. S., Marine Pollution Bulletin, Vol. 4, No. 11, November 1973, pp 172-176.

This paper describes how an analysis of the n-paraffin content and pattern can be used to delineate the accumulation of petroleum hydrocarbons in nature below levels of detectable odour or taste. It is possible to detect very low levels (less than 5 ppb individual n-paraffins n-14C30H to n-37C76H) of paraffin hydrocarbons in intertidal marine organisms and to use these compounds with suitable baseline information for estimating the quantity of petroleum pollution uptake in the organisms. Under conditions of moderate to major oil pollution, this technique provides a calculation of residual paraffin hydrocarbon pattern in exposed organisms which can be compared to the pollutant hydrocarbon pattern. For low-level persistent pollution, the use of paraffin hydrocarbon patterns and content can often provide an indication of petroleum uptake but, in cases where the pollutant is low in paraffin hydrocarbons (lubricating oils, some crude oils, etc.) or where the rate of bacterial degradation is equivalent to the pollutant input different techniques of analysis are required. Exposed mussels (Mytilus spp.) collected under three differing degrees of suspected petroleum pollution are compared with unexposed control mussels: (1) 'high-level' pollution where a known pollutant was released in a single large discharge; (2) 'moderate-level' pollution where observable quantities of a known pollutant leaked over a long period; and (3) 'low-level persistent' pollution having multiple sources but no continuously visible oil slick on the water surface.

INDEX TERMS: Marine animals, Pollutant identification, Oil pollution, Chemical analysis, Mussels, Trace levels, n-Paraffins, Petroleum hydrocarbons, Sample preparation, Data interpretation, Background levels.

AMIC-10013

"SIGNIFICANCE OF pH AND CHLORIDE CONCENTRATION ON BEHAVIOR OF HEAVY METAL POLLUTANTS: MERCURY (II), CADMIUM (II), ZINC (II), AND LEAD (II)", Hahne, H. C. H., Kroontje, W., Journal of Environmental Quality, Vol. 2, No. 4, October-December 1973, pp 444-450.

Calculations were performed (1) to assess the degree to which Hg(II) , Cd(II) , and Pb(II) complex with hydroxyl and chloride ions and (2) to evaluate the significance of such complexation in natural systems. Results indicate that both the hydroxy and chloride complexes may contribute to the mobilization of these heavy metal ions in the environment. Hydrolysis of Hg(II) becomes important at pH values above 1 whereas Pb(II) , Zn(II) , and Cd(II) hydrolyze above pH 5, 7, and 8, respectively. Chlorides complex with Hg(II) at chloride concentrations above 1 mM (0.000035 ppm). HgCl_2 forms above 10 to the minus 7.5 power M $\text{Cl}(\text{minus})(0.0011 \text{ ppm})$, and HgCl_3 and HgCl_4 (2 minus) formation occurs above 0.01 M $\text{Cl}(\text{minus})(350 \text{ ppm})$. The MCl (plus) species of Zn(II) , Cd(II) , and Pb(II) appear at chloride concentrations above 0.001 M (35 ppm), and MCl_2 complexes occur above 0.01 M (350 ppm $\text{Cl}(\text{minus})$). The respective MCl_3 (minus) and MCl_4 (2 minus) species become important above 0.1 M $\text{Cl}(\text{minus})(3,500 \text{ ppm})$. Hydrolysis and chloride complexation of these heavy metal ions are important factors affecting the solubility of the sparingly soluble salts of these metal ions. This is most pronounced for mercuric salts. Intrinsic solubilities of the metal-ion hydroxides allow for 160 ppm Zn(II) and 107 ppm Hg(II) to be soluble as complexed Zn(OH)_2 and Hg(OH)_2 , respectively. These values are higher than calculated solubilities based on solubility products. An example of the competition between hydroxy and chloride complexes shows that at pH 8.5 and a chloride concentration range

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-10013 (Continued)</p> <p>Card 2/2</p> <p>of 350-60,000 ppm, Hg(II) and Cd(II) are mainly complexed by chlorides. Zn(II) and Pb(II), under these conditions, are predominantly in the form of hydroxy complexes.</p> <p>INDEX TERMS: Heavy metals, Path of pollutants, Environment, Hydrogen ion concentration, Chlorides, Ecosystems, Mobilization, Complexation, Hydroxides.</p>	<p>AMIC-10018</p> <p>"INOSITOL POLYPHOSPHATES IN ACTIVATED SLUDGE", Cosgrove, D. J., <u>Journal of Environmental Quality</u>, Vol. 2, No. 4, October-December 1973, pp 483-485.</p> <p>Although it is known that some of the soluble inorganic phosphate present in waste water can be fixed as organic forms in the activated sludge process, there is little knowledge of the chemical nature of these products. Recently, the extraction of 'inositol phosphate' from activated sludge was described, but whether the product consisted only of myo-inositol phosphates or was a mixture was not determined. In the present investigation, inositol polyphosphates were extracted from activated sludge using methods previously developed in investigations of soil organic phosphates. Ion exchange chromatography of the purified extract showed it to be a mixture of penta- and neo-inositol and thus to resemble the inositol polyphosphate component of soil organic matter. As the same polyphosphate mixture does not apparently occur in raw sewage (hydrolysates of dried raw sewage were found to contain no other inositol but the myo-isomer), it would appear that it is formed as a result of biological action during the aeration process.</p> <p>INDEX TERMS: Activated sludge, Chemical analysis, Pollutant identification, Methodology, Organophosphorus compounds, Phosphorus, Sample preparation, Inositol polyphosphates, Ion exchange chromatography, Paper chromatography.</p>
<p>AMIC-10015</p> <p>"A STUDY OF FACTORS INFLUENCING THE NITROGEN AND PHOSPHORUS CONTENTS OF NEBRASKA WATERS", Muir, J., Seim, E. C., Olson, R. A., <u>Journal of Environmental Quality</u>, Vol. 2, No. 4, October-December 1973, pp 466-470.</p> <p>The purpose of this investigation was to determine magnitude and sources of nutrient N and P in Nebraska waters. Water samples were taken from irrigation wells at the midsummer peak of the 1971 and 1972 irrigation seasons and from 32 sites on major streams of the state at quarterly intervals during 1970-72. The samples were analyzed for pH, NH₄-N, NO₃-N, and P. Surface water samples were analyzed for sediment concentration; rainwater collected at protected meteorological recording sites throughout the year was analyzed for N and P. Correlation studies reveal little relation between N and P concentrations of the water and agricultural use of fertilizers. Nutrient levels in the water are governed more by human and livestock densities and intensity of irrigation development than by agronomic production factors. Only at sites of intensive irrigation development on very sandy soils and with irrigation of valley positions of shallow water table has fertilizer N contributed substantially to a reduction in ground-water quality. Nutrient concentrations in streams fluctuate widely with (1) varied time and rate of organic waste intrusions and subsequent biological assimilation and (2) major runoff events. Reservoirs on streams also have a major modifying action in reducing sediment and fertility load. The observed higher N content of streams during periods of peak flow can be attributed partially to the high N content of precipitation and its direct runoff into streams during periods of high rainfall intensity.</p> <p>INDEX TERMS: Nitrogen, Phosphorus, Water pollution sources, Precipitation (atmospheric), Storm runoff, Sediment load, Fertilizers, Nutrient sources, Natural waters.</p>	<p>AMIC-10026</p> <p>"THE DETERMINATION OF BORON IN SOLUTION TO SUB-PPB CONCENTRATIONS BY HOLLOW-CATHODE EMISSION", Daughtrey, E. H., Harrison, W. W., <u>Analytica Chimica Acta</u>, Vol. 67, No. 2, December 1973, pp 253-258.</p> <p>Sub-ppb concentrations of boron in solution were determined by the use of a hollow-cathode emission source for the analysis of cathode surface film deposited from the solution. Solutions were prepared by dissolving boric acid or sodium tetraborate in distilled, deionized water. A Glomax demountable hollow-cathode lamp operating in the flow mode, was used with two modifications. A gas port modification and a replacement of the constricted flow concentric tubing (serving as both cooling water source and drain to the heat exchange block) with a Swagelok Tee-joint fitting and a short length of thin wall stainless steel tubing joined to the heat exchange block by a machine fitting. Copper proved to be an excellent cathode material, owing to low background and ease of boron sputtering from the surface. Clean-up of the cathode was a critical factor in reproducibility of hollow-cathode emission. The best signal-to-background intensity was at 0.7 torr pressure of argon, measured on the exit side of the tube. The lower limit of atomic emission detection is about 10 pg, although the sensitivity could be improved by multiple sample applications. The boron atomic line emission is 200 times as intense as boron oxide band emission.</p> <p>INDEX TERMS: Boron, Aqueous solutions, Detection limits, Hollow cathode emission.</p>

1. PHYSICAL AND CHEMICAL METHODS

AMIC-10027

"DETERMINATION OF CHROMIUM IN SEA WATER BY ATOMIC ABSORPTION SPECTROMETRY", Gilbert, T. R., Clay, A. M., *Analytica Chimica Acta*, Vol. 67, No. 2, December 1973, pp 289-295.

A method for the determination of chromium in seawater is described which requires minimal sample preparation. The chromium from filtered samples is oxidized with permanganate, extracted with ammonium pyrrolidine dithiocarbamate into MIBK, and analyzed by atomic absorption spectrometry in a fuel-rich air-acetylene flame. Non-filterable solids are extracted with 12 M hydrochloric acid and analyzed. Detection limits for the methods are 0.05 microgram/l in the soluble phase and 0.06 microgram/l in the particulate phase.

INDEX TERMS: Sea water, Chromium, Storage, Atomic absorption spectrophotometry, Sample preparation, Coprecipitation, Detection limits.

AMIC-10029

"THE SPECTROPHOTOMETRY AND SOLVENT-EXTRACTION BEHAVIOUR OF IRON(III), VANADIUM(IV) AND TITANIUM(IV) CHELATES OF 1-(o-CARBOXYPHENYL)-3-HYDROXY-3-METHYLTRIAZENE", Majumdar, A. K., Bhattacharyya, B. C., Roy, B. C., *Analytica Chimica Acta*, Vol. 67, No. 2, December 1973, pp 307-315.

1-(o-Carboxyphenyl)-3-hydroxy-3-methyltriazene is proposed as an excellent reagent for the spectrophotometric determination of iron(III) and titanium(IV), and also for the separation of titanium from a large quantity of iron as well as other cations and anions. Iron(III) forms an anionic violet 1:2 complex at pH 4.0-9.4, and a cationic green 1:1 complex at pH 1.5-2.0, with absorption maxima at 570 nm and 660 nm, respectively. The violet complex is quantitatively extracted in chloroform containing n-octylamine at pH 3.0-9.0. The green and the violet iron(III) complexes obey Beer's law, the respective optimal ranges between 8.9-35.8 and 3.9-11.2 ppm. The yellow titanium chelate extracted into chloroform (absorption maximum at 410 nm) between pH 1.0 and 3.5, can be reextracted into concentrated sulphuric acid and a violet color being produced with absorption maximum at 530 nm. Beer's law is obeyed in the ranges 0.8-5.7 ppm for the titanium complex in chloroform and 3.4-19.2 ppm when extracted in concentrated sulphuric acid. Interferences from diverse ions are not severe. Procedures for the separation and determination of titanium in the presence of a large quantity of iron are given. The isolation of the iron(III) and vanadium(IV and V) complexes, and their properties, are described.

INDEX TERMS: Spectrophotometry, Solvent extractions, Iron, Titanium, Separation techniques, Cations, Anions, Metal chelates, Vanadium, Chloroform, Sulfuric acid, Tartaric acid.

AMIC-10028

"THE EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM(III) WITH 4-(2-PYRIDYLAZO)-RESORCINOL", Yotsuyanagi, T., Takeda, Y., Yamashita, R., Aomura, K., *Analytica Chimica Acta*, Vol. 67, No. 2, December 1973, pp 297-306.

The extraction-spectrophotometric determination of chromium(III) with 4-(2-pyridylazo)-resorcinol (PAR) is described. PAR(H₂R) forms a 1:3 complex with chromium(III) in a boiling acetate buffer solution at pH 5. The complex forms an ion-association compound with tetradecyldimethylbenzylammonium ion (TDBA):Cr(R)(HR)₂ (minus)-TDBA which can be extracted into chloroform, the molar absorptivity being 47,000 at 540 nm. If EDTA is added as a masking agent after the Cr(HR)₃ has been formed, only iron, cobalt and nickel interfere seriously, and the method can be made specific for chromium by a preliminary extraction of these metals with cupferron. The sensitivity of the method is seven times higher than that of the diphenylcarbazide method.

INDEX TERMS: Separation techniques, Chromium, Aqueous solutions, Spectrophotometry, Chemical interference, Sensitivity.

AMIC-10030

"SYNERGIC SOLVENT EXTRACTION OF DIVALENT CATIONS WITH DECAFLUOROPENTANEDIONE AND DI-n-BUTYLSULFOXIDE", Burgett, C. A., *Analytica Chimica Acta*, Vol. 67, No. 2, December 1973, pp 325-330.

The synergic solvent extraction of iron(II), cobalt(II), nickel(II) and lead(II) with 1,1,1,2,2,6,6,7,7,7-decafluoro-3,5-heptanedione (H(FHD)) and di-n-butylsulfoxide (DBSO) into cyclohexane is described. The optimal pH, equilibration time, stoichiometry and stability of the extracted species were studied. Approximately 0.01 M solutions of the cations were prepared by dissolving the appropriate salt in deionized water. The stock solutions were then standardized by titration with EDTA, NAS serving as the indicator. Exactly 1.00 ml of the 0.01 M metal solutions was pipetted into a 15-ml screw-cap glass test tube. Then 1.00 ml of the appropriate buffer solution was added to each test tube. To each test tube 1.00 ml of a cyclohexane solution of DBSO and 1.00 ml of a cyclohexane solution of H(FHD) was added. The mixture was shaken for 1 h and the phases were allowed to separate. The equilibrium pH of the aqueous phase was measured. A 1.00-ml aliquot of the aqueous phase was removed for determination of the amount of unextracted metal by titration with EDTA as described above. For all of the metals studied, highly efficient extraction occurred at equilibrium pH values of 4.5-6.0. No detrimental effect from the presence of chloride, acetate, sodium or acetic acid was observed. The extraction was found to be quantitative after equilibration times of 15 min or more. All of the extracted species, except the iron(II) complex, were stable for a period of two weeks and could be dried at 100 C. The iron(II) complex was stable after one day at low pH, but at pH 6.0 the complex was stable for one week.

1. PHYSICAL AND CHEMICAL METHODS

<p>AMIC-10030 (Continued)</p> <p>Card 2/2</p> <p>INDEX TERMS: Solvent extractions, Iron, Cobalt, Nickel, Lead, Copper, Hydrogen ion concentration, Stability, Equilibration time, Stoichiometry.</p>	<p>AMIC-10036</p> <p>"NEUTRON IRRADIATION OF MERCURY IN POLYETHYLENE CONTAINERS", Weiss, H. V., Chew, K., <u>Analytical Chimica Acta</u>, Vol. 67, No. 2, December 1973, pp 444-447.</p> <p>When mercury is neutron-irradiated in polyethylene containers, its behavior is dependent on acidity of the solution. Mercury was irradiated for 10 and 60 min in solutions of different nitric acid concentration. For each of the time periods, the unacidified solutions contained less Hg-197 than their acidified counterparts; this difference was more pronounced for the 60-min irradiated samples. Comparison of activity levels for solutions irradiated for the two time intervals indicate the counting rates scale by a factor of six for the acidified solutions but not for water. Counting data are given for irradiation vials directly counted several days after neutron activation of cadmium and mercury solutions of varying acidity. With cadmium the counting rate decreased regularly as a function of nitric acid concentration, while with mercury the activity level in the unacidified sample was substantially less than for the samples in nitric acid solution. The relationship between the comparable nitric acid solutions of mercury parallels that of cadmium. From these results the conclusion is drawn that mercury in acidified solution is not lost during irradiation, at least not over the interval 10-60 min. But in the absence of acid, substantial loss is encountered. The loss appears to occur by two routes: adsorption and volatilization.</p> <p>INDEX TERMS: Mercury, Irradiation, Acidity, Plastics, Adsorption, Chemical loss, Volatilization.</p>
<p>AMIC-10033</p> <p>"THE APPLICATION OF PHOTO-OXIDATION TO THE DETERMINATION OF STABLE COBALT IN SEA WATER", Harvey, H. R., Dutton, J. W. R., <u>Analytica Chimica Acta</u>, Vol. 67, No. 2, December 1973, pp 377-385.</p> <p>A method is described for the determination of nanogram quantities of cobalt in a 1-l sample of seawater after preconcentration with sub-milligram quantities of manganese dioxide formed by the oxidation of manganese(II) in a photochemical reactor. The cobalt is measured by pulse polarography as the dimethylglyoximate after dissolving the manganese dioxide deposit adhering to the quartz jacket surrounding the ultraviolet lamp. The detection limit of the method is ca. 0.6 ng Co/l.</p> <p>INDEX TERMS: Cobalt, Sea water, Water analysis, Methodology, Photooxidation, Pulse polarography.</p>	<p>AMIC-10037</p> <p>"A SIMULTANEOUS DETERMINATION OF ZINC AND CADMIUM", Jensen, R. E., Kaehler, M., <u>Analytica Chimica Acta</u>, Vol. 67, No. 2, December 1973, pp 465-468.</p> <p>This particular method for the simultaneous determination of zinc and cadmium involves using picolinealdehyde-2-quinolyldiazone (PAQH) as the complexing agent, extracting from aqueous solution into chloroform, and completing the measurement by atomic absorption spectrophotometry. The most efficient complexation and extraction were obtained at pH 8.5. A study of excess of reagent on the zinc(II)-PAQH system showed that a fifteen-fold excess of ligand was sufficient for maximal complex formation. A twenty-fold excess of PAQH was necessary for maximal cadmium(II)-PAQH complex formation. Three 5-ml aliquots provided the greatest extraction efficiency. Solutions of both complexes were stable for at least one week. The Zn(II)-PAQH complex was found to obey Beer's law over a concentration range of 0.065-1.30 ppm. The sensitivity of measurement was calculated as 17.7 ppb, and the detection limit 3.13 ppb. A similar study of the Zn(II) complex absorbance over the same concentration range in aqueous solution gave the comparable sensitivity and detection limit as 27.8 ppb and 9.34 ppb, respectively. The Cd(II)-PAQH complex obeyed Beer's law over the same concentration range 0.113-2.26 ppm Cd(II). The sensitivity level was determined as 22.6 ppb, and the detection limit was 1.7 ppb. In comparable aqueous solutions, the sensitivity was 60.3 ppb, and the detection limit 10.5 ppb. Although it has been shown that there is no mutual interference between the zinc and cadmium complex systems, there are interferences from other cations. These interfering ions consume the reagent and must be removed before the analysis for zinc and cadmium.</p>

1. PHYSICAL AND CHEMICAL METHODS

AMIC-10037 (Continued)

Card 2/2

INDEX TERMS: Zinc, Cadmium, Aqueous solutions, Methodology, Chemical analysis, Pollutant identification, Stability, Trace elements, Cations, Picolinaldehyde-2-quinolyldiazone, Atomic absorption spectrophotometry, Metal complexes, Extraction efficiency, Sensitivity, Detection limits, Ionic interference.

AMIC-10039

"ANIONIC ELECTROPHORETIC PATTERN OF FIVE RUTHENIUM SALTS IN FRESH AND SEA WATER: EFFECTS OF AGEING AND DILUTION", Vos, J., Van Puybroeck, S., Van Der Borgh, O., *Analytica Chimica Acta*, Vol. 67, No. 2, December 1973, pp 480-485.

The presence of ruthenium species in the wastes of nuclear fuel reprocessing plants has led to considerable interest in the very complex behavior of ruthenium. In this study, five ruthenium salts (nitrosylhydroxynitrite, nitrosylchloride, chloride, nitrosylnitrate complexes, and nitrosylhydroxide) were studied for influence of dilution and ageing, by means of high-voltage electrophoresis: (1) in concentrated aqueous solutions; (2) after further dilution with freshwater; and (3) after further dilution with seawater. This study provides further evidence of the complexity of ruthenium in aqueous neutral solutions and emphasizes the following points, which are important for waste release management. (1) The behavior of the ruthenium salts is, in general, similar in filtered seawater and freshwater, except for fresh nitrosylnitrate solutions. (2) Ageing is still incomplete after one week except for the ruthenium-nitrosylchloride complexes where there are no such effects. (3) Ageing of the ruthenium solutions results generally in a decrease of the number of complexes, a decrease of their mobility and a severe decrease or total disappearance of the resolution of the separation pattern. (4) Ten-fold dilution had no important influence except for the fresh ruthenium chloride and the 7-day old nitrosylnitrate. (5) Nitrosylnitrite, and especially the aged solutions, contains an exceptionally low amount of Ru-106 adsorbed on the starting line. (6) The characteristics of nitrosylhydroxide solutions in fresh and seawater, are similar to the other salts. The freshly prepared solutions contain about 30 percent of negative complexes with comparatively high mobility in the electric field. (7) The number of species detected

AMIC-10038

"PHOTOMETRIC DETERMINATION OF DIPHENYLAMINE WITH CERIUM(IV) SULPHATE", Gandikota, M., Rao, G. G., *Analytica Chimica Acta*, Vol. 67, No. 2, December 1973, pp 469-472.

The conditions are established for the quantitative oxidation of diphenylamine with cerium(IV) sulfate to diphenylamine blue and its photometric determination. The results obtained from studying the effect of Cs(IV) concentration showed that with molar ratios of diphenylamine to Ce(IV) varying from 1:2.5 to 1:8 the diphenylamine blue is not destroyed even by a large excess of the oxidant over and above that required for the formation of the blue color. The stability of the blue color increases with increasing concentration of sulphuric acid, being about 5-6 min in 4 M sulphuric acid, about 6-7 min in 5 M sulphuric acid and about 9-10 min in 6 M sulphuric acid. Compared with the available procedures this has the advantages of speed, fewer reagents and freedom from interference from aniline (0.08 nmoles), methanol (59 moles), and ethanol (17 nmoles).

INDEX TERMS: Pollutant identification, Chemical analysis, Spectrophotometry, Cerium sulfate, Diphenylamine, Accuracy, Chemical interference.

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by high-voltage electrophoresis in phosphate buffer ranges up to 13 clearly defined bands and 2 vaguer tailings for freshly prepared concentrated neutral ruthenium-chloride complexes. Each salt gives a different electrophoretic separation picture, although complexes at 20-20.5 cm from the starting line appear in most solutions.

INDEX TERMS: Freshwater, Sea water, Aging (physical), Aqueous solutions, Chemical analysis, Salts, Nuclear wastes, Anionic electrophoresis, Ruthenium, Dilution.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-10041

"GAS CHROMATOGRAPHY OF SUBSTITUTED PHENYLUREAS BY FLASH-HEATER METHYLATION WITH TRIMETHYLANILINIUM HYDROXIDE", Tanaka, F. S., Wien, R. G., Journal of Chromatography, Vol. 87, No. 1, December 5, 1973, pp 85-93.

A simple method for the methylation of substituted phenylureas with trimethylanilinium hydroxide (methelute) is described. The methylation reaction product was the 3-N-methyl analog of the substituted phenylureas. Seven phenylureas (fluometuron, fenuron, monuron, metobromuron, linuron, diuron, and neburon) with a variety of structures were analyzed using six different chromatographic columns. The gas chromatographic response was linear with increased concentration of the 3-N-methyl analogs of monuron and diuron for both synthetic standards and flash-heater reaction products. Maximum methylation was obtained when the ratio of methylating reagent to phenylurea was approximately 2.5:1. This methylation technique provides for rapid qualitative and quantitative chromatography of substituted phenylureas without side-chain decomposition.

INDEX TERMS: Herbicides, Aromatic compounds, Urea pesticides, Gas chromatography, Phenylureas, Gas liquid chromatography, Flash heater methylation, Methylation, Monuron, Diuron, Fluometuron, Fenuron, Linuron, Metabromuron, Neburon.

AMIC-10042

"SEPARATION AND ANALYSIS OF MIXTURES OF CATIONIC SURFACE-ACTIVE AGENTS BY SALTING-OUT CHROMATOGRAPHY", Fudano, C., Konishi, K., Journal of Chromatography, Vol. 87, No. 1, December 5, 1973, pp 117-124.

This paper describes the separation and analysis of mixtures of cationic surface-active agents by salting-out chromatography, and also discusses some aspects of the separation mechanism of salting-out chromatography. The following cationic surfactants were synthesized and purified by recrystallization from acetone: alkyltrimethylammonium chloride (C12, C14, C16, C18); dialkyldimethylammonium chloride (C12, C14); alkylpyridinium chloride (C12, C14, C16, C18); alkylpyridinium iodide (C12, C18); alkyl dimethylbenzylammonium chloride (benzalkonium chloride, C12, C14, C16, C18); and Hyamine 1622. The chromatographic conditions finally adopted were as follows: resin, Amberlite CG-4B; column, Sephadex (25 mm I.D. and 410 mm long); eluent, aqueous 45 percent (or 55 percent) methanol-0.5 M sodium chloride solution; column temperature, 40.0 C; flow-rate, 0.7 ml/min; determination, two-phase titration method with bromophenol blue as indicator. Not only could a homologous series of cationic surface-active agents be separated quantitatively, but the separation and determination of the constituents of their mixtures also became feasible. It is presumed that cationic surfactant molecules are present in an ionic state and probably pass through the column accompanied by exchange of their counter ions for anions in the eluent. The solubility of a surfactant in an eluent decreases as the chain-length of the alkyl groups in the surfactant increases. Surfactant molecules with long alkyl groups can be easily salted out and adsorbed on the resin, and they therefore have large elution volumes. For this reason, dialkyldimethylammonium salts that have large hydrophobic

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groups were not eluted under the conditions mentioned above. The adoption of the gradient elution method, however, may not only enable these surfactants to be eluted successfully but also extend further the applicable range.

INDEX TERMS: Separation techniques, Volumetric analysis, Salts, Anion exchange, Resins, Salting-out chromatography, Cationic surfactants, Alkyltrimethylammonium chloride, Dialkyldimethylammonium chloride, Alkylpyridinium chloride, Alkylpyridinium iodide, Alkyldimethylbenzylammonium chloride, Hyamine 1622.

AMIC-10044

"PERHALOBENZENESULFINATES AS REAGENTS IN THE DETERMINATION OF INORGANIC MERCURY IN VARIOUS MEDIA BY GAS-LIQUID CHROMATOGRAPHY", Mushak, P., Tibbetts, F. E., Zarnegar, P., et al., Journal of Chromatography, Vol. 87, No. 1, December 5, 1973, pp 215-226.

Inorganic mercury and organomercurials present in water, urine and serum are evaluated by gas-liquid chromatography and the use of perhalobenzenesulfinates which react with inorganic mercury to yield a perhalophenyl mercury. Best results are obtained with lithium pentafluorobenzenesulfinate as arylating agent for inorganic mercury. Recovery and precision data include: water, 70.5 percent (6.8); urine, 81.4 (10.5); serum, 51.0 (9.4). Lower detection limit of inorganic mercury, as the pentafluorophenyl analyte, is 20 ng of mercury per milliliter of sample. Optimal chromatographic results were obtained with 10 percent Dexsil-300 on Anakrom SD, 70-80 mesh, and Durapak Carbowax 400 on Porasil F.

INDEX TERMS: Mercury, Aqueous solutions, Urine, Gas liquid chromatography, Biological samples, Serum, Perhalophenyl mercury, Arylating agents, Aryl mercurials.

1. PHYSICAL AND CHEMICAL METHODS

AMIC-10049

"NITROGEN TRANSFORMATIONS IN SEDIMENTS AS AFFECTED BY CHEMICAL AMENDMENTS", Chen, R. L., Keeney, D. R., Water Resources Bulletin, Vol. 9, No. 6, December 1973, pp 1136-1144.

A study was conducted to elucidate some of the chemical factors affecting the rate and pathways of N transformations in lake sediments. The main emphasis was placed on modifying a noncalcareous sediment with CaCO₃ to approximate the composition of a calcareous sediment. Additionally, the effects of Ca (2 plus), CO₃ (2 minus), Mg (2 plus) and OH (minus) were evaluated by using appropriate chemicals. Further, the effect of aluminum sulfate was evaluated with both sediment types. Sediment pH at 7 days was not affected by CaCO₃, but was decreased by aluminum sulfate. The CaCO₃ treatment increased the rate of ammonification, nitrification, reduction of acetylene to ethylene and methane formation, while with few exceptions the other treatments decreased the rate of the transformations studied. Aluminum sulfate, which has been proposed as a lake restoration treatment, increased ammonification but decreased most of the other transformations.

INDEX TERMS: Nitrogen, Sediments, Lakes, Hydrogen ion concentration, Water quality, Nitrification, Denitrification, Nitrogen fixation, Calcium carbonate, Ammonification, Aluminum sulfate, Mineralization.

AMIC-10051

"METHANE FORMATION BY LAKE SEDIMENTS DURING IN VITRO INCUBATION", Macgregor, A. N., Keeney, D. R., Water Resources Bulletin, Vol. 9, No. 6, December 1973, pp 1153-1158.

The ability of lake sediment samples to store and synthesize methane was tested using samples from Wisconsin lakes. Both hardwater and softwater lakes were investigated. The effects of nitrate, sulfate, and acetylene amendments, as well as temperature, were also investigated. Using a sediment-coated glass bead system as described, sediments showed linear increases in methane synthesis from the moment helium purging ceased for periods up to three weeks. The results indicate that the sediment samples examined have roughly the same capacity to store methane generated in vivo, but depending upon their origin (e.g. softwater or hardwater lakes) differ significantly in their capacity to synthesize methane from sediment precursors. Sediment samples from hardwater lakes produced 10 to 20 times as much methane as sediment from softwater lakes. This difference in methane generating capacity appears to be due to CaCO₃. It is apparent that measurement of standing crop of 'native methane' in sediments may not be a useful indication of the actual rate of methane synthesis. Both nitrate and sulphate were apparently able to inhibit methane synthesis by raising the Eh of the sediment to more positive values. Inhibition, at least by nitrate, may be temporary.

INDEX TERMS: Lake sediments, Methane, Synthesis, Incubation, Nitrates, Sulfates, Water temperature, Sampling, Gas chromatography, Hardness (water), Acetylene, Carbon reduction.

AMIC-10130

"THE CHEMICAL FORM AND BODILY DISTRIBUTION OF MERCURY IN MARINE FISH", Suzuki, T., Miyama, T., Toyama, C., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 6, December 1973, pp 347-355.

One gram of muscle, liver, brain, kidney, and gastric content of fish, or about half of the organ weighing less than 2 g was homogenized in a phosphate-buffer solution (pH 8.6, 1/16 M), and analyzed for inorganic mercury by cold vapor atomic absorption photometry. Weight of fish and the level of total mercury are independent of the inorganic mercury percentage. Comparing the values in the muscle, both inorganic mercury percentages and levels of total mercury are elevated in the liver and kidney. The total mercury content in the liver, excluding the data on fish from the Japan Sea, is also significantly correlated with body weight but this is not seen in the case of the kidney. The data on the brain are difficult to interpret both regarding the level of total mercury and the inorganic mercury percentage. The level of total mercury of the gastric content is markedly higher in greenlings from the Japan Sea than in other fishes from the South China Sea, which means a difference in the mercury level in the habitat, and may contribute to the differing relationships between body weight and the total mercury level in the muscle and liver. The pattern of bodily distribution changes depending on the chemical form of mercury. In the case of inorganic mercury, three significant correlation coefficients are found, that is, 'kidney' vs 'muscle' and 'liver', and 'liver' vs 'brain'. There is a different pattern for organic mercury. The distribution pattern of total mercury is similar to that of organic mercury.

INDEX TERMS: Mercury, Marine fish, Pollutant identification, Distribution patterns, Animal tissues, Cold atomic absorption spectrophotometry, Bioaccumulation.

AMIC-10135

"THE PHOTOCHEMISTRY OF CARBAMATES. 1. THE PHOTODECOMPOSITION OF ZECTRAN: 4-DIMETHYLAMINO-3,5-XYLYL-N-METHYL CARBAMATE", Silk, P. J., Unger, I., International Journal of Environmental Analytical Chemistry, Vol. 2, No. 5, February 1973, pp 213-220.

The photodecomposition of 4-dimethylamino-3,5-xylyl-N-methyl carbamate (Zectran) in aerated and degassed solution has been carried out. Three major photoproducts were detected and characterized to be: 4-dimethylamino-3,5-dimethyl phenol, 4-hydroxy-2,6-dimethyl-N-methyl benzamide and 4-monomethylamino-3,5-xylyl-N-methyl carbamate. The phenol and benzamide products suggest that one of the pathways of photodecomposition of Zectran is via a photo-Fries rearrangement. The ortho-benzamide (5-dimethylamino-4,6-dimethyl-2-hydroxy-N-methyl benzamide) which could also be expected to occur in a photo-Fries reaction, was not observed. The excitation wavelength was greater than 296.7 nm, i.e. radiation available in the solar spectrum. Thus the products observed in this study may be expected to occur in the environment as a result of the action of sunlight on Zectran.

INDEX TERMS: Carbamate pesticides, Pollutant identification, Methodology, Laboratory tests, Zectran, Photodecomposition, Photoproducts, Fate of pollutants, Photochemistry, Infrared spectra, NMR spectra, Mass spectra.

2. BIOLOGICAL METHODS

AMIC-9017
"BYGLANDSFJORDEN. PRIMARY PRODUCTION AND OTHER LIMNOLOGICAL FEATURES IN AN OLIGOTROPHIC NORWEGIAN LAKE", Lande, A., Hydrobiologia, Vol. 42, Nos. 2-3, August 15, 1973, pp 335-344.

Byglandsfjorden is a lake situated in southern Norway, about 80 km north of Kristiansand. The catchment area consists of archaic rocks. The river Otra flows through the lake. Water samples were taken from the lake 4 times during the summer of 1971, and analyzed for DO, pH, specific conductivity, Ca, Mg, Na, K, alkalinity, chloride, and sulfate. Primary productivity was measured three times by the C-14 method. The results show that the lake is acid and poor in electrolytes. pH-values vary between 5.3 and 6.0, and the specific conductivity lies at about 10. Primary production is rather high, and per sq m lake surface the values are found to be about the same as in Svinsjøen, a rather eutrophic lake near Oslo. However, an index used by Rodhe (1965) shows that the lake is of a more oligotrophic type.

INDEX TERMS: Primary productivity, Trophic level, Water quality, Oligotrophy, Dissolved oxygen, Hydrogen ion concentration, Specific conductivity, Calcium, Magnesium, Sodium, Potassium, Chlorides, Alkalinity, Sulfates, Bygladsfjorden.

AMIC-9381
"EFFECTS OF TEMPERATURE ON ACTIVITY AND MORTALITY OF THE SCYPHOZOAN MEDUSA, CHRYSAORA QUINTQUECIRRHA, Gatz, A. J., Jr., Kennedy, V. S., Mihursky, J. A., Chesapeake Science, Vol. 14, No. 3, September 1973, pp 171-180.

Pulsation rate of Chrysaora quinquecirrha medusae was inversely and linearly related to bell diameter over the natural temperature range (15-32 C) of this life history stage of the sea nettle in the upper Chesapeake Bay. At unnatural, elevated temperatures this relationship was disrupted. Pulsation rates generally increased with temperature increase from 15 C to 30 C and then decreased at higher temperatures. The rate-temperature curve for acclimated medusae was similar in shape (increase and decrease in pulsation rate with temperature change) to rate-temperature curves reported for warm water medusae; its shape was different from those reported for cold water medusae. Acclimation of pulsation rate to change temperature was faster than acclimation of upper lethal temperature, although both were measured in hours. Upper lethal temperatures measured over 20-30 C were directly related to acclimation temperature and were similar to those reported for sea nettle polyps (34-35 C). Medusae were more sensitive than polyps to cold, with death occurring at 10 C. Thermal discharges into the upper Chesapeake Bay which raise water temperature above 30 C are probably stressful to sea nettle medusae. Temperatures above 38 C could be lethal in a few minutes.

INDEX TERMS: Water temperature, Mortality, Sea nettles, Laboratory tests, On-site tests, Activity.

AMIC-9193
"HABITAT DISTRIBUTION OF THE SHORE FLIES OF NORTHEASTERN OHIO (DIPTERA: EPHYDRIDAE)", Scheiring, J. F., Foote, B. A., The Ohio Journal of Science, Vol. 73, No. 3, May 1973, pp 152-166.

A study of the habitat distribution of 68 species of shore flies (Ephyridae) was carried out in northern Ohio between April of 1968 and November of 1969. Ten ephyrid habitats were recognized: mud-shore, sand-shore, grass-shore, limnic-wrack, marsh-reed, sedge-meadow, floating-vegetation, floating-algal-mat, rain-pool, and salt-pool habitats. The mud shore contained the greatest diversity of Ephyridae, whereas the salt-pool habitat produced the largest populations. The floating algal mat possessed the fewest number of species, as well as the least number of individuals. Three species were recorded from Ohio for the first time: Atissia litoralis (Cole), Ephydra cinerea Jones, and E. niveiceps Cresson. A listing of all species collected, together with information on habitat from which taken, abundance, and relation of data to other published material, is also included.

INDEX TERMS: Ohio, Aquatic habitats, Ecological distribution, Aquatic insects, Diptera, Shore flies, Species diversity, Limnic wrack, Sedge meadow, Marsh reed, Mud shore, Sand shore, Grass shore, Floating algal, Rain pool, Salt pool.

AMIC-9393
"PSYCHROPHILIC YEASTS ISOLATED FROM MARINE FISH", Bruce, J., Morris, E. O., Antonie van Leeuwenhoek, Vol. 39, No. 2, 1973, pp 331-339.

Yeasts were isolated from marine fish using low incubation temperatures. The isolates were screened for their ability to grow at 4 C and 30 C. Isolates growing at 4 C but not at 30 C were considered to be psychrophilic and were selected for further study. Approximately 25 percent of the isolates were in this category. The isolates comprised the following genera: Candida, Cryptococcus, Debaryomyces, Rhodotorula, Torulopsis and Trichosporon. Rhodotorula infirma-ministata accounted for 50 percent of the isolates and Trichosporon pullulans 10 percent. Other species were present in numbers below the 10 percent level. The distribution of the species between the two sample areas is discussed. The vitamin requirements and optimum growth temperatures of the isolates were assessed.

INDEX TERMS: Yeasts, Marine fish, Pathogenic fungi, Isolation, Nutrient requirements, Psychrophilic fungi, Culture media, Deuteromycetes.

2. BIOLOGICAL METHODS

AMIC-9521

"EFFECT OF RESTRICTED USE OF PHOSPHATE-BASED DETERGENTS ON ONONDAGA LAKE", Murphy, C. B., Jr., Science, Vol. 182, No. 4110, October 26, 1973, pp 379-381.

A marked decrease in the concentration of total inorganic phosphate in the epilimnion and hypolimnion of Onondaga Lake, New York State, has been observed during the 1 1/2 years between July 1971 and January 1973. A monitoring program for Onondaga Lake has been carried out since 1968. Grab samples, collected every 2 weeks at 3-m intervals from the surface to the bottom at a station located in the southern basin, have shown decreases of 85 and 76 percent in the average condensed inorganic phosphate concentrations in the epilimnion and hypolimnion, respectively. The orthophosphate concentrations were found to decline by 47 and 15 percent, respectively, over the same period of time. Standard analytical procedures were used to determine the concentrations of total orthophosphate, total inorganic phosphate, and the derived value for total condensed inorganic phosphate. In the past 5 years, a characteristic seasonal succession of phytoplankton has been observed within the lake. There is little growth of plankton in the winter, when the lake is covered by ice; a diatom population develops in the spring; and the green algae Chlorella, Scenedesmus obliquus, Scenedesmus quadricauda, and Oocystis parva dominate the summer period. Blue-green algae of the genus Aphanizomenon follow the die-off of the greens, and dominate the late summer and early fall. In 1972, Aphanizomenon was absent in the succession. Instead, the green algae blooms continued through the summer and fall with cell counts comparable to those measured in previous years. It appears that the alteration of the phytoplankton seasonal succession is the result of reducing the phosphorus concentrations in the photic zone.

AMIC-9586

"TAXONOMIC POSITION OF TWO LUMBRINERIS SPP.", Knox, G. A., Green, K. M., New Zealand Journal of Marine and Freshwater Research, Vol. 7, No. 3, September 1973, pp 247-252.

Two species with unusual features not typically seen in the Lumbrineridae have recently been found: one, identified as Lumbrineris mucronata, is from the north-east coast of Australia, and the other, identified as L. sulcaticeps, is from the south-east coast of New Zealand. Both species are unusual in that maxilla IV is multidentate. In addition, the entire surface of the plate is covered by small, hard projections, thus forming what appears to be a rasping plate; these projections give the pale-colored palte a speckled appearance. The posterior hooks of both species are simple, and basically bidentate. The hoods of these hooks are almost circular.

INDEX TERMS: Worms, Systematics, Annelids, Speciation, Lumbrineris, Polychaetes, Animal morphology.

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INDEX TERMS: Phosphates, Lakes, Detergents, Legislation, Diatoms, Chlorella, Scenedesmus, Cyanophyta, Chlorophyta, Hydrogen ion concentration, Nitrogen, Biochemical oxygen demand, Dissolved oxygen, Onondaga Lake, Oocycystis, Orthophosphates, Aphanizomenon.

AMIC-9587

"MOINA SP. (CLADOCERA: MOINIDAE) IN A SEWAGE PLANT, WELLINGTON, REFERRED TO MOINA TENUICORNIS SARS, 1896 (NOTE)", Vidal, I. L., New Zealand Journal of Marine and Freshwater Research, Vol. 7, No. 3, September 1973, pp 253-259.

A species of Moina from sewage ponds at Glenside, Wellion, New Zealand, is identifiable with Moina tenuicornis Sars, 1896, and distinguishable from Moina australiensis Sars, 1896 sensu stricto, in having rectangular sculpturing on the ephippium, ungrouped setae on the hind margin of the carapace, and in lacking a permanent supra-ocular depression. Because of wide variation in some diagnostic characters, possibly both taxa are conspecific. Some physical and chemical characteristics of the habitat are tabulated, since little is known of the ecological requirements of these morphologically similar species. Using mean values as a guide, the Glenside population of Moina tenuicornis favors a temperature in the vicinity of 20 C, a very slightly alkaline pH, a dissolved oxygen content in excess of 6 mg/litre, a dissolved solid content of about 270 mg/litre, of which about half is organic and exerts a BOD sub 5 of about 60 mg/litre, and suspended organic solids of about 150 mg/litre.

INDEX TERMS: Systematics, Water quality, Ecology, Waterfleas, Water temperature, Alkalinity, Hydrogen ion concentration, Dissolved solids, Biochemical oxygen demand, Organic matter, Sewage lagoons, Nitrates, Phosphorus, Speciation, Physiological ecology, Moina.

2. BIOLOGICAL METHODS

AMIC-9588

"PRELIMINARY DIAGNOSIS OF A NEW SPECIES OF MARINE ISOPOD FROM STEWART ISLAND", Jansen, K. P., New Zealand Journal of Marine and Freshwater Research, Vol. 7, No. 3, September 1973, pp 261-262.

Four isopod specimens were collected from bottom mud in shallow water in Paterson Inlet, Stewart Island, by Dr A. A. Fincham, Zoology Department, Victoria University of Wellington, in June 1972. The isopods belong to the genus Paravireia Chilton, but morphological differences exclude them from Paravireia typicus Chilton 1926, from the Chatham Islands the only previously described species in the genus. The present paper is to establish a valid specific name for a forthcoming ecological paper by Dr Fincham without the precipitate erection of a new major taxon. This species is distinguished from Paravireia typicus by the smoothly rounded profile of the pleotelson and by the produced apices and setal tufts of the epimers of pereonites 3 and 4. No other records of the species are known.

INDEX TERMS: Isopods, Systematics, Marine animals, Speciation, Paravireia, New Zealand, Animal morphology.

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amounts to make the plants independent of atmospheric N. Less than 10 percent of the kelp production normally enters grazing food chains; the remainder enters detritus food chains, having been released as particulate or dissolved organic matter. It is postulated that human predation on lobsters has allowed sea urchin populations to increase which in turn destroy portions of kelp forests.

INDEX TERMS: Primary productivity, Biomass, Kelps, Water temperature, Predation, Growth strategy.

AMIC-9659

"SEAWEEDS: THEIR PRODUCTIVITY AND STRATEGY FOR GROWTH", Mann, K. H., Science, Vol. 182, No. 4116, December 7, 1973, pp 975-981.

As part of a multidisciplinary study at St. Margaret's Bay, Nova Scotia, a systematic study of the seaweed zone along approximately 50 km of the shoreline was carried out with the aid of a research submarine and scuba gear. It was found that algal zones dominated by Laminaria and Agarum accounted for over 80 percent of the total biomass of seaweeds in the bay. To investigate the rate of biomass turnover, 180 plants (L. longicuris, L. digitata, A. cribrosum) at five sites with different water depths and wave actions were tagged for identification, and holes punched in the blades. The movement of these holes showed that all growth in length occurred at the junction of the stipe and the blade. Over a 2-yr period, all three species completely renewed the tissue between one and five times a year. The biomass of the new tissue was up to 20 times the initial biomass of the blade. Furthermore, peak growth occurred in late winter or early spring when the water temperature was close to 0C. Primary productivity was estimated to be 1750 g C/sq m/yr, and in the Bay, seaweed production was about 3 times that of phytoplankton. Comparison of results from other areas shows that the productivity of seaweeds is as high or higher than that of the most productive terrestrial systems. Study of the growth strategy of seaweeds, especially at low light and temperature levels seems to indicate that kelps are capable of storage, translocation, and mobilization of carbon reserves. However, the theory of energy translocation from an old frond to a new one does not describe the growth of species in eastern Canada since these plants replace old fronds at least once in the winter. It is suggested that the anaerobic mud surrounding the roots provides nitrogen in sufficient

AMIC-9660

"PROBIT TRANSFORMATION: IMPROVED METHOD FOR DEFINING SYNCHRONY OF CELL CULTURES", Hagar, W. G., Punnett, T. R., Science, Vol. 182, No. 4116, December 7, 1973, pp 1028-1030.

Cell numbers can be converted to probits that are used to compare the degree and timing of synchronized cell cultures. The solution follows from the fact that the change in the rate of cell division follows a normal distribution function, with the maximum rate of cell division at the midpoint of the curve. The time curve for the total cell number is the integral of the cell division rates up to that time and, therefore, has the same shape as the integral of a normal probability curve. For this reason, the sigmoidal growth curves from various experiments can be easily compared by converting the cell numbers to probits. In the case of cell division, the plot of probit against time produces a straight line having a midpoint corresponding to the peak of the cell division rate with the reciprocal of the slope equaling the standard deviation of the cell release rate. These two parameters are all that are needed to define degree of synchrony. Data from synchronous cultures of Chlorella pyrenoidosa have been analyzed by this method by means of a readily available computer program. The method can be used with any biological system that generates normal sigmoidal data.

INDEX TERMS: Cultures, Cytological studies, Statistical methods, Synchrony, Chlorella pyrenoidosa.

2. BIOLOGICAL METHODS

AMIC-9669

"MODELLING PRIMARY PRODUCTION IN WATER BODIES: A NUMERICAL APPROACH THAT ALLOWS VERTICAL INHOMOGENEITIES", Fee, E. J., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1469-1473.

A new model for computing integral daily photoplankton primary production is described. The model incorporates vertical variations of algal biomass, complex photosynthesis vs light responses, nonexponential extinction of light vs depth, and any distribution of surface light over a day. The basic approach is to combine measured relations for photosynthetic rate vs light, light vs depth, and light vs time in an interpolative scheme rather than attempting to fit equations to the data and using the resulting equations to obtain a mathematical solution. The model is general and should have wide applicability. Model predictions agreed well with in situ measurements of production.

INDEX TERMS: Algae, Primary productivity, Mathematical models, Photosynthesis, Light.

AMIC-9687

"TEMPERATURES SELECTED SEASONALLY BY FOUR FISHES FROM WESTERN LAKE ERIE", Barans, C. A., Tubb, R. A., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1697-1703.

When four species of fish were taken from western Lake Erie in each of four seasons and held usually for less than 7 days at ambient lake temperatures, the temperatures they selected during 2-3 days in a horizontal temperature gradient differed seasonally. The differences were largely attributable to the conditions at which the fish had been acclimatized in the lake, and were modified by acclimation during 2-3 days in the gradient. The selected temperatures provided insights into the temperatures that might be selected by these species each season if the lake basin or other waters with similar seasonal ambient temperatures were subjected to thermal discharges. Temperatures selected were above ambient lake temperatures except for emerald shiners (*Notropis atherinoides*) in summer and fall. In general, white bass (*Morone chrysops*) and smallmouth bass (*Micropterus dolomieu*) selected a high range in temperatures throughout the year (18-30 C and 18-31 C, respectively), yellow perch (*Perca flavescens*) an intermediate range (10-29 C) and emerald shiners the lowest range (6-23 C). Three of the species were distributed within a relatively precise temperature range in the summer and within a larger range during other seasons; emerald shiners selected a narrow range during all seasons. A fairly stable temperature preference was usually reached within several hours in summer, but the temperatures selected by three species generally increased with time in the gradient during the other seasons; emerald shiners selected constant temperatures in all seasons. Temperatures selected by young and adults differed mainly in yellow perch and emerald shiners in summer and winter, when the lake temperatures fluctuated least.

AMIC-9684

"REDESCRIPTION OF *GAETANUS INTERMEDIUS* CAMPBELL (CALANOIDA: COPEPODA) FROM THE TYPE LOCALITY", Park, T., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 10, October 1973, pp 1597-1600.

Gaetanus intermedius Campbell 1930, is redescribed from specimens taken in the type locality, the Vancouver Island region in the northeastern Pacific. *Gaetanus simplex* Brodsky 1950, is found to be a junior synonym of *G. intermedius*.

INDEX TERMS: Systematics, Copepods, *Gaetanus intermedius*.

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INDEX TERMS: Water temperature, Thermal pollution, Yellow perch, White bass, Temperature selection, Acclimatization, Smallmouth bass, Emerald shiner.

2. BIOLOGICAL METHODS

AMIC-9695

"COMPARATIVE PRODUCTIVITY OF FOUR CAROLINA LAKES", Tilly, L. J., The American Midland Naturalist, Vol. 90, No. 2, October 1973, pp 356-365.

Field data for C-14 uptake in two reservoirs, a Carolina bay and an oxbow in South Carolina indicate that lakes of this region are low in primary productivity compared to lakes elsewhere for which published values are available. Par Pond, a reactor-cooling reservoir, is the only lake studied which shows even moderate productivity. Factors which may be related to productivity in these lakes include nutrient level, water temperature, light penetration as influenced by turbidity and water color, and stratification as influenced by local topography and lake morphometry. Limnological characteristics of the four South Carolina lakes are summarized.

INDEX TERMS: Primary productivity, Limnology, Oxbow lakes, Photosynthesis, Reservoirs, Water quality, South Carolina.

AMIC-9699

"THE CHARACEAE OF SOUTHEASTERN UNITED STATES", Choudhary, M. C., Wood, R. D., The American Midland Naturalist, Vol. 90, No. 2, October 1973, pp 413-446.

A study was made of Characeae of the 10 southeastern states based upon preserved and herbarium specimens assembled by R. D. Wood. The findings are compiled in a floristic report containing a key to species, notes on each species and variety - a brief synonymy, list of published records, sources of illustrations and exsiccatae and remarks on the taxa. The Characeae of the Southeast comprise two genera, *Chara* and *Nitella*, and 17 species which represent a large proportion of the three genera and 22 species treated for North America. The frequency of occurrence of Characeae was 5 percent, far lower than the 19 percent in Fiji and 28 percent in Australia. A new taxon, *N. flexilis* var. *americana*, from Florida, resembles *N. flexilis* but has distinct meius. Taxa newly reported for the region are *C. globularis* var. *virgata*, var. *leptosperma*, *N. clavata* var. *dilatata*, and *N. gracilis* var. *leptosoma* and var. *asagrayana*. Particular attention is paid to the infraspecific variation of *C. zeylanica*, and a number of varieties and forms previously recorded from other areas were found to be represented in the Southeast. Mohr's (1884) unusual collections from Mobile were re-examined, and for the most part the original identifications were confirmed.

INDEX TERMS: Chara, Chlorophyta, Southeast U. S., Speciation, Varieties, Systematics, Aquatic algae, Marine algae, Nitella.

AMIC-9697

"TAXONOMY, DISTRIBUTION AND ECOLOGY OF THE GENUS *SESARMA* (CRUSTACEA, DECAPODA, GRAPSIDAE) IN EASTERN NORTH AMERICA, WITH SPECIAL REFERENCE TO FLORIDA", Abele, L. G., The American Midland Naturalist, Vol. 90, No. 2, October 1973, pp 375-386.

Six species of the grapsid crab genus *Sesarma* are reported from eastern North America. A key for their identification is presented and their diagnostic characters are illustrated. Their distributions in the western Atlantic are reviewed and a map is given of their distributions in Florida, an area where all six species occur. Field observations on the biology and ecology of four species are presented. Character divergence occurs between two closely related, partially sympatric species. Several factors are suggested to account for the observed patterns of distribution.

INDEX TERMS: Systematics, Ecology, Ecological distribution, Habitats, Crustaceans, Speciation, Shore crabs, *Sesarma*, Animal morphology, Macroinvertebrates.

AMIC-9706

"TIDAL STREAM DEVELOPMENT AND ITS EFFECT ON THE DISTRIBUTION OF THE AMERICAN OYSTER", Keck, R., Maurer, D., Watling, L., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 369-379.

This research was undertaken to determine the effect of tidal stream development on the distribution of the American oyster *Crassostrea virginica*. Data are presented on the effect of tidal stream formation on larval setting spat development, and maintenance of a healthy adult population. The four major oyster producing rivers in the state of Delaware are: the Leipsic, Murderkill, Mispillion, and Broadkill. In the majority of rivers the oyster producing sections extend 3500-4000 yards (3150-3600 m) from the river mouths. These sections were staked off in 100 yard (90 m) intervals. An oyster dredge with an approximate one meter mouth was towed over the right, middle, and left portions of each 100 yard (90 m) section. All live oysters (larger than 2 cm in height) were counted and measured to the nearest tenth of a centimeter. The total number of oysters per haul was used to plot the density of the oyster beds, and eventually to estimate the total number of bushels for each river. Dense populations are most often found associated with large meanders. The differential current velocities associated with meander formation result in areas of scour, which are beneficial to development of oyster beds; and areas of deposition, which are detrimental to survival of oysters.

INDEX TERMS: Oysters, Tidal streams, Distribution patterns, Environmental effects, Meanders, Currents (water), Scour, Deposition (sediments), Dredging, Erosion, American oyster, *Crassostrea virginica*, Current velocity, Delaware Bay, Macroinvertebrates.

2. BIOLOGICAL METHODS

AMIC-9709

"REDESCRIPTION OF MAPPATES PLATAXUS RANGNEKAR (COPEPODA: CALIGIDAE)", Hameed, M. S., Pillai, N. K., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 403-411.

A detailed description of Mappates plataxus is presented. In the light of the present study it is suggested that the closely allied genera Anuretes, Pseudanuretes, Henicophilus, Mappates, and Eirgos do not show any valid generic difference. The suggestion that they may be considered as subgenera under the genus Anuretes is put forth.

INDEX TERMS: Copepoda, Systematics, Mappates plataxus, Anuretes, Pseudanuretes, Henicophilus, Eirgos, Animal morphology.

AMIC-9718

"BIOLOGICAL METHODS FOR THE ASSESSMENT OF WATER QUALITY] A SYMPOSIUM PRESENTED AT THE SEVENTY-FIFTH ANNUAL MEETING [JUNE 26-29, 1972", Cairns, J., Jr., Dickson, K. L. (Editors), Virginia Polytechnic Institute and State University, Blacksburg, Virginia, ASTM Special Technical Publication 528, 1972, pp 1-3, 6, 31, 46, 61, 76, 96, 117, 127, 148, 164, 178, 194, 209, 221, 227, and 242.

This volume is intended to be a management tool to apprise the reader of the types of considerations involved in making biological assessments of water quality, developing water pollution monitoring programs, and assessing the effects of potentially deleterious waste discharges in the aquatic environment. Also, it provides information which would enable a nonbiologist to get a state-of-the-art view of the existing techniques available, as well as some historic perspective. Papers by world authorities on the use of fish, algae, aquatic invertebrates, and bacteria in the assessment of pollution, in addition to bioassays for evaluating the toxicity of products or waste effluents, are included. Futuristic methods for continuous biological monitoring of industrial effluents are presented, as well as a possible alternative to the much belabored Biochemical Oxygen Demand. The specific topics are: 'Interaction of Engineers and Biologists in Water Quality Management', W. W. Eckenfelder, Jr.; 'The ABC's of Pollutant Bioassay Using Fish', J. B. Sprague; 'Mixing Zone Concepts', C. M. Fetterolf, Jr.; 'Biological Monitoring of the Aquatic Environment', C. I. Weber; 'Bacteria and the Assessment of Water Quality', T. L. Bott; 'Use of Algae, Especially Diatoms, in the Assessment of Water Quality', R. Patrick; 'Use of Aquatic Invertebrates in the Assessment of Water Quality', A. R. Gauffin; 'Continuous-Flow Bioassays With Aquatic Organisms: Procedures and Applications', W. A. Brungs; 'A Tentative Proposal for a Rapid In-Plant Biological Monitoring System', J. Cairns, Jr.,

AMIC-9711

"PRIMARY PRODUCTION OF THE PERIPHYTON IN THE LITTORAL OF THE DANUBE", Ertl, M., Tomajka, J., Hydrobiologia, Vol. 42, No. 4, September 28, 1973, pp 429-444.

The gross primary production of periphyton, grown on artificial substrata in the littoral of the Danube, was measured by the light and dark bottle method from April, 1970 to March, 1971. The periphyton used for the measurements was sampled from various depths, in order to cover the production of the whole littoral. The highest primary production was always found in the zone just below the water level. Exceptions occurred only when this zone was inundated for a short time as a result of a temporary rise of the water level and the periphyton was insufficiently developed. In order to compare the values of primary production of periphyton obtained from shallower rivers, where the whole bottom is well illuminated, or from rivers that do not exhibit such frequent and extensive level oscillations as the Danube, average value calculated from results obtained from the zone closest to the water level at the time of measurements, were always used. Primary periphytic production in the surface zone was 43.8 mg O₂/sq dm/day. Efficiency of gross photosynthesis in this zone was on the average 1.72 percent. The height of the water level and the water temperature were highly correlated with gross periphytic production. Close relationships between chlorophyll a content, biomass and gross primary production of periphyton were found.

INDEX TERMS: Periphyton, Primary productivity, Littoral, Rivers, Biomass, Growth rates, Cultures, Photosynthesis, Water levels, Danube River, Chlorophyll a, Light and dark bottle method.

AMIC-9718 (Continued)

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R. E. Sparks, and W. T. Waller; 'Rapid Biological Monitoring Systems for Determining Aquatic Community Structure in Receiving Systems', J. Cairns, Jr., K. L. Dickson, and G. Lanza; 'Use of Toxicity Tests With Fish in Water Pollution Control', C. E. Stephan, and D. I. Mount; 'Assessment of Fish Flesh Tainting Substances', N. A. Thomas; 'Use of Histologic and Histochemical Assessments in the Prognosis of the Effects of Aquatic Pollutants', D. E. Hinton, W. M. Kendall, and B. B. Silver; 'Stabilization Oxygen Demand', V. T. Stack, Jr.; 'Microbiological Inhibition Testing Procedure', P. J. Marks; 'Use of Artificial Substrate Samplers to Assess Water Pollution', T. W. Beak, T. C. Griffing, A. G. Appleby; 'Mobile Bioassay Laboratories', R. M. Gerhold.

INDEX TERMS: Bioassay, Pollutant identification, Bioindicators, Methodology, Laboratory tests, Water quality, Assessments, On-site tests, Water pollution, Aquatic life, Data storage and retrieval, Biological communities, Reviews, Aquatic microorganisms, Benthic fauna, Toxicity, Water pollution effects, Environmental sanitation, Instrumentation, Benthic flora, Biological monitoring, Species diversity index.

2. BIOLOGICAL METHODS

AMIC-9724

"RESPIRATION OF A SUBLITTORAL COMMUNITY", Smith, K. L., Jr., Ecology, Vol. 54, No. 5, Late Summer 1973, pp 1065-1075.

Respiration of a sublittoral community was examined off Sapelo Island, Georgia, from July, 1969 through July, 1970. Total community respiration ranged from 53.7 ml O₂/sq m/hr in January to 92.7 ml O₂/sq m/hr in July. A positive correlation was found between community respiration and water temperature. Annual community respiration was estimated to be 676.6 liters O₂/sq m/yr. The macrofauna consisted of 103 species representing ten phyla. Species abundance ranged from 744 individuals/sq m in July to 14,213 individuals/sq m in March. Biomass (ash free dry wt) increased from 7.3 g/sq m in October to 20.2 g/sq m in March. Macrofaunal respiration comprised from 5 to 26 percent of community respiration. Bacteria were the major functional component of the community accounting for 30 percent to 60 percent of the total respiration. Meiofaunal-microfaunal-microfloral respiration contributed from 25 percent to 58 percent of total community respiration. Sediment chemical oxidation was responsible for 2.8 ml O₂/sq m/hr in January to 8.5 ml O₂/sq m/hr in July of the total oxygen uptake.

INDEX TERMS: Respiration, Biological communities, Marine animals, Marine bacteria, Seasonal, Biomass, Benthic fauna, Sediments, Crustaceans, Mollusks, Dominant organisms, Annelids, Oxidation, Sublittoral, Oxygen consumption, Species diversity index, Sapelo Island, Species abundance, Nemertean, Coelenterates, Sipunculids, Echinoderms, Hemichordates, Pogonophorans, Species density.

AMIC-9739

"PRIMARY PRODUCTION AND LIMITING NUTRIENTS IN A SMALL SUBALPINE WYOMING LAKE", Wagner, J. F., Parker, M., Transactions of the American Fisheries Society, Vol. 102, No. 4, October 1973, pp 698-706.

Primary production and limiting nutrients were studied by C-14 techniques in a small, shallow, subalpine lake. There was no relationship between productivity at any depth and light intensity at that depth. Samples taken near the lake bottom always had higher productivity than samples taken near the surface, probably due to more optimal nutrient conditions. Nutrient enrichment experiments support this hypothesis, since sediment extract and ethylenediamine-tetraacetic acid were always effective in enhancing productivity. The effects of other nutrients and nutrient combinations were less consistent and tended to change through the summer. A large number of significant three, four and five factor interactions in midsummer indicated that the nutrient requirements of the algal community were most complex at this time. Although retention time increased through the summer from 10 to 71 hours, productivity tended to more closely parallel water temperature. Studies of currents showed that the western end of the lake had relatively little horizontal water movement compared to that of the eastern end, and that the latter portion had retention times even less than average. Significantly lower productivity in the faster flushing portion of the lake suggests that algal populations in this area were unable to accumulate before being flushed downstream. Because of the lake's low average retention time, it would not be practical to artificially increase the primary productivity of the studied, or similar lakes; the rapid flushing would not allow added nutrients or increased algal populations to accumulate in the lake.

AMIC-9730

"THE EFFECTS OF HURRICANE CAMILLE ON THE MARSHES OF THE MISSISSIPPI RIVER DELTA", Chabreck, R. H., Palmisano, A. W., Ecology, Vol. 54, No. 5, Late Summer 1973, pp 1118-1123.

The active delta of the Mississippi River was sampled in August 1968 to determine plant species composition, plant coverage, and soil and water chemistry. Hurricane Camille struck this area in August 1969, with winds in excess of 200 km/h and tides ranging upward to 5.2 m above MSL. The delta was resampled 2 weeks following the hurricane to evaluate the immediate effects on vegetation, soil, and water, and again 1 year after the hurricane to determine the recovery rate of vegetation. The hurricane resulted in a drastic reduction of vegetation. Regrowth was rapid in the delta marshes and after 1 year plant coverage approached pre-hurricane levels of abundance; however, recovery was slower in ponds and lakes. The loss of vegetation was mainly a result of the sweeping action of wind and water, and plants were either uprooted or ripped apart and carried away by the current. Water salinity increased with the hurricane but declined by the following year and appeared to have only slight effect on marsh vegetation. Plant species varied in their response to the hurricane. Bacopa monnieri showed practically no effect, and Phragmites communis and Spartina alterniflora were reduced only slightly. Myriophyllum spicatum, Panicum repens, and Alternanthera philoxeroides were greatly reduced by the storm; and after 1 year, only Alternanthera philoxeroides showed significant recovery.

INDEX TERMS: Hurricanes, Freshwater marshes, Aquatic plants, Salt marshes, Marine plants, Environmental effects, Soil chemistry, Water chemistry, Mississippi River Delta, Recovery, Macrophytes.

AMIC-9739 (Continued)

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INDEX TERMS: Limiting factors, Primary productivity, Essential nutrients, Water quality, Water temperature, Deficient elements, Biological communities, Standing crops, Subalpine lake.

2. BIOLOGICAL METHODS

AMIC-9765

"SURVIVAL OF BROOK TROUT IN A BOG-DERIVED ACIDITY GRADIENT", Dunson, W. A., Martin, R. K., *Ecology*, Vol. 54, No. 6, Autumn 1973, pp 1370-1376.

Bear Meadows Bog water was analyzed to determine (1) if volatile acids were present, (2) the species of fish present at various pH's in the stream, and (3) the pH tolerance of hatchery brook trout placed in the stream at points where native fish were present or absent. The acidity of the bog water (pH 3.7-4.7) is not due to carbonic acid or to any other volatile acid. The approximate pK of the unknown bog water acid(s) is 6.0-6.5. Fish do not occur in Bear Meadows Bog or in Sinking Creek (the bog's only outlet) over a 4.8-km section below the bog where water pH is too low for their survival. The lowest pH in which brook trout and white suckers were caught in Sinking Creek was 4.25 at area 5 (5.25 km below the bog) after a period of unusually heavy rainfall. At a different time brook trout alone were caught at area 4, 5.2 km below the bog, when the pH was 4.75. The lowest recorded pH at this site was 4.0. Survival times of hatchery brook trout placed in boxes in Sinking Creek were directly related to pH. Individual differences in tolerance to low pH were quite marked, especially at pH's not rapidly lethal. Whether these individual differences are of environmental or genetic origin is not known.

INDEX TERMS: Brook trout, Resistance, Hydrogen ion concentration, Bioassay, On-site tests, Acid streams, Water analysis, Survival, Acidity gradient, Bear Meadows Bog.

AMIC-9768

"ULTIMATE UPPER LETHAL TEMPERATURE OF ATLANTIC SALMON *SALMO SALAR* L.", Garside, E. T., *Canadian Journal of Zoology*, Vol. 51, No. 8, August 1973, pp 898-900.

Thermal bioassays were conducted on parr of Atlantic salmon ranging from 70 to 147 mm total length (2.1-29.4 g) collected from a segment of 400 m immediately above high-tide elevation in Bio Brook, Terra Nova National Park, Newfoundland, during early July, 1969. Temperature of the brook varied from 16 to 20C during the 3-day collecting period. Parr were maintained and acclimated in 75-liter glass aquaria containing water drawn from Big Brook. Acclimation was accomplished through the elevation of water temperature 0.5 degrees (deg) every 10 h from the temperature of collection with sensitive heater-thermostats until the desired level (27.5 C) was achieved. Upper lethal temperature for the highest level of acclimation (27.5C) was calculated from percentage mortality, as a function of test temperature, using probit analysis in the biomedical program *(EMDO35) apted for CDC 6400 computer. The upper lethal temperature for acclimation 27.5 C was determined to be 27.80 C plus or minus 0.41 for 10,000 min exposure. There was no significant correlation (P much greater than 0.05) between size and order of death.

INDEX TERMS: Atlantic salmon, Lethal limit, Water temperature, Bioassay, Thermal stress, Statistical methods, Freshwater, Mortality, Parr, Acclimatization, Big Brook, Probit analysis, *Salmo salar*, Data interpretation.

AMIC-9822

"IMPROVED pH CONTROL OF FUNGAL CULTURE MEDIA", Child, J. J., Knapp, C., Eveleigh, D. E., *Mycologia*, Vol. 65, No. 5, September/October 1973, pp 1078-1086.

A number of fungi grew well in the presence of relatively high concentrations (40 millimoles) of phosphate and MES (2-(N-morpholino) ethane sulfonic acid) buffers at either pH 5.5 or 7.0. In certain instances better growth and sporulation were observed than that found using more conventional growth media (malt, Czapek-Dox) that lack any marked buffering capacity. EMMA (3,6-endomethylene-1,2,3,6-tetrahydro-cisphthalic acid) could be used as a buffer for fungal culture media with certain species only. As good growth and no major change in chemical composition occurred, these buffers are recommended for use in high concentration to eliminate pH variation in comparative physiological studies. Fungal strains used were: *Allomyces arbusculus*, *Aspergillus fonsecaeus*, *Chaetomium funicola*, *Claviceps* sp., *Coprinus comatus*, *Geotrichum candidum*, *Fythium acanthicum*, *Rhizopus sexualis*, *Saccharomyces cerevisiae*, *Sordaria funicola*, *Ustilago maydis*, and *Zygorhynchus* sp.

INDEX TERMS: Fungi, Hydrogen ion concentration, Growth rates, Culture media.

AMIC-9824

"AN APPRAISAL OF IDENTIFICATION METHODS FOR *PENICILLIUM* SPECIES: NOVEL TAXONOMIC CRITERIA BASED ON TEMPERATURE AND WATER RELATIONS", Pitt, J. I., *Mycologia*, Vol. 65, No. 5, September/October 1973, pp 1135-1157.

Examination of media and methods currently used in *Penicillium* taxonomy led to the conclusion that by using only two media, Czapek yeast autolysate agar and malt extract agar, and by incubating cultures at 25 C for 7 days, one could obtain classical taxonomic data with optimal efficiency. The effect of reduced water activity and reduced and elevated temperatures on the growth of *Penicillium* spp. accepted in the Raper and Thom A Manual of the *Penicillia* was studied. On a glycerol-nitrate salts agar of 0.93 water activity, and on Czapek yeast autolysate agar at 5 C and 37 C, extent of growth after 7 days provided taxonomically valuable data; within-species variation was low, while between-species variation was sufficiently marked to assist in determinative classification. Moreover, water relations, as assessed by the above technique, showed a very high correlation with *penicillus* type in some Sections of the genus.

INDEX TERMS: Cultures, Speciation, Fungi, Culture media, Water activity, *Penicillium*, *Eupenicillium*, *Paecilomyces*, *Talaromyces*.

2. BIOLOGICAL METHODS

AMIC-9842

"STEREO-SCANNING ELECTRON MICROSCOPY OF DESMIDS", Pickett-Heaps, J. D., Journal of Microscopy, Vol. 99, No. 1, September 1973, pp 109-116.

Stereo-pairs of scanning electron micrographs are presented of two species of *Staurostrum*, one species of *Cosmarium* and two species of *Micrasterias*, including the trifurcate, diploid variant of *M. thomasi*. Some specimens were treated with a relatively broad range polysaccharidase preparation called 'Glusulase', washed, and allowed to stand at room temperature for 1-1/2 h in culture medium before fixation. Cells were normally fixed in 1 percent glutaraldehyde made up in culture medium, for about 1 h at room temperature; after washing, they were post-fixed for up to 1 h in 1 percent osmium tetroxide, also made up in the culture medium. After post-fixation, the cells were suspended in water and collected on a small 'Millipore' filter. A suitable choice is the 'Solvinert' series of filter pads with pore sizes around 1.5 micrometers. The filter pad served as a mount for the cells. The material and mount were slowly dehydrated in acetone and then passed through the critical point drying (CPD) procedure. The dried specimens were mounted on specimen stubs using transfer or double-sided sticky tape. They were then coated quite heavily and omnidirectionally with 5.0 nm carbon and then 15.0 nm gold. Specimens were examined at 20 kV. For taking stereo-pairs, a difference in tilt of 12 degrees between successive micrographs was found empirically to give good results. Some typical morphological variations encountered in cultures are illustrated; the methods are reasonably quick and reliable and may prove useful in taxonomic studies of desmids.

INDEX TERMS: Systematics, Chlorophyta, Scanning electron microscopy, Sample preparation, *Staurostrum manfeldtii*, *Staurostrum gracile*, *Staurostrum pingue*, *Cosmarium botrytis*, *Micrasterias thomasi*, *Micrasterias sol*.

AMIC-9847

"DETERMINATION OF MEAN CELL SIZE OF TETRAHYMENA IN GROWING CULTURES", Morrison, G. A., Tomkins, A. L., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 383-392.

In the study of the actions of certain inhibitors on the growth of *Tetrahymena pyriformis* in deep culture it was necessary to make concomitant measurements of the number and mean cell size of the living organisms in a culture at intervals. To accomplish this, a Coulter model A was fitted with a 280 micrometer orifice tube to detect decreases in the conductance of a small volume of an aqueous electrolyte. When the setting corresponded to detection of every particle, the total count was obtained. The counts at a number of different threshold settings was used to obtain a distribution of particle volume curve and hence to calculate the mean particle volume (electronic volume). The results show that the diluting solution can have an optimal colligative concentration in which there is initially no change of the measurement; in suboptimal concentrations there is initial increase followed by a decrease to a value somewhat less than that prevailing at the moment of dilution (95 percent), whereas in superoptimal concentrations there is initial decrease followed by an increase. If the initial decrease is severe the subsequent increase restores the value to only 80 percent of the original. The measurements of electronic volume, reflect the corresponding mean cell volume, and changes of it, estimated by photographic methods. The changes can be accounted for by changes of balance between the elasticity of the cell walls and the osmotic pressure across the walls.

INDEX TERMS: Cultures, Population, Particle size, Volume, Coulter counter, Counting.

AMIC-9848

"NUMERICAL ANALYSIS OF HANSENULA, PICHIA AND RELATED YEAST GENERA", Campbell, I., Journal of General Microbiology, Vol. 77, No. 2, August 1973, pp 427-441.

Numerical analysis of published standard descriptions of the eight species of *Debaryomyces*, 48 species of *Pichia*, and the single species of *Wingea* failed to distinguish separate genera. It is proposed that they be combined as a single genus *Pichia* of 41 species, three of which were formerly allocated to the genus *Endomycopsis*. The genus *Hansenula*, of 20 species including *Pachysolen tannophilus* and three former species of *Endomycopsis*, is closely related to the genus *Pichia* and is distinguished only by the ability of *Hansenula* species to assimilate nitrate. In the genus *Schwanniomyces* the number of species is reduced from four to two, and in *Lipomyces*, from three to one.

INDEX TERMS: Systematics, Speciation, Numerical analysis, Yeasts.

AMIC-9852

"THE EFFECT OF LACK OF A CARBON SOURCE ON NITRATE-REDUCTASE ACTIVITY IN *ASPERGILLUS NIDULANS*", Hynes, M. J., Journal of General Microbiology, Vol. 79, No. 1, November 1973, pp 155-157.

Mycelia of *Aspergillus nidulans* were grown under inducing conditions and then transferred to various media and incubated further. Samples were harvested at various intervals and assayed to study the effect of carbon starvation on nitrate-reductase activity. Nitrate-reductase activity rapidly disappeared in medium in which further synthesis of the enzyme was not possible or in medium lacking a carbon source. Absence of inducer and repression by ammonium caused rapid loss of activity. Cycloheximide, at 10 micrograms/ml, only slightly reduced the rate of enzyme loss and, in fact, cycloheximide itself caused loss of nitrate-reductase activity. A lower concentration of cycloheximide (1 microgram/ml) had a similar effect. Methylammonium chloride caused rapid loss of activity in this strain. An even greater rate of enzyme disappearance was found when mycelium was starved for carbon. An attempt to demonstrate in vitro inactivation of nitrate reductase and glutamate dehydrogenase by mixing crude mycelial extracts and incubating was not successful. However, this experiment did show that it was unlikely that accumulation of an inhibitor of the enzymes during carbon starvation could account for the results. Pre-induced beta-galactosidase activity is not rapidly lost from carbon-starved mycelium, nor does the activity of this enzyme increase in medium lacking a carbon source in the absence of an inducer. Therefore it seems that various enzymes show different responses to carbon starvation and different absolute requirements for the presence of inducer. In the case of nitrate reductase there is an absolute requirement for inducer and for the presence of a carbon source.

AMIC-9952 (Continued)

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INDEX TERMS: Cultures, Inhibitors, Carbon, Limiting factors, *Aspergillus nidulans*, Nitrate reductase, Culture media.

AMIC-9950

"RESEARCH ON RED ALGAL PIGMENTS. 5. THE EFFECT OF THE INTENSITY OF WHITE AND GREEN LIGHT ON THE RATE OF PHOTOSYNTHESIS AND ITS RELATIONSHIP TO PIGMENT COMPONENTS IN *GRACILARIA COMPRESSA* (C. AG.) GREV. (RHODOPHYCEAE, GIGARTINALES)", Calabrese, G., Fellicini, G. P., *Phycologia*, Vol. 12, Nos. 3/4, December 1973, pp 195-199.

The effects of green and white light at different intensities upon photosynthetic rates of *Gracilaria compressa* and their relationships to different pigment contents are reported. This is a typical rhodophycean alga, with adaptation to light intensity in the fronds of individual plants. In fact, the green distal portion which is exposed to direct sunlight (within a depth of a few meters), lacks phycoerythrin and shows a great proportion of carotenoids. The red proximal portion, which receives less light as a result of self-shading, synthesizes phycoerythrin and more chlorophyll. The photosynthetic activity in the two portions, assayed under different light conditions, indicates that the abundant oxygen output in the basal red part of the thallus, also at low light intensity, may be due to a high content of photosynthetic pigments. Conversely, the absence of phycoerythrin and lower chlorophyll content in the distal yellow-green part permits a reasonable photosynthetic rate only at higher light intensity. This is especially apparent in green light: at 250 lux no photosynthetic activity is to be seen in the yellow-green thallus, while the red portion reaches the compensation point.

INDEX TERMS: Rhodophyta, Plant pigments, Photosynthesis, Light intensity, Chlorophyll, Respiration, *Gracilaria compressa*, Green light, White light.

AMIC-9948

"THE ULTRASTRUCTURE OF AN ALLOPARASITIC RED ALGA *CHOREOCOLAX POLYSIPHONIAE*", Kugrens, P., West, J. A., *Phycologia*, Vol. 12, Nos. 3/4, December 1973, pp 175-186.

An allopasite, *Choreocolax polysiphoniae*, apparently represents one of the most evolved parasitic red algae. Chloroplasts are highly reduced and consist of double membrane limited organelles lacking any internal thylakoid development. The uninucleate cells have thick walls, an absence of starch in cortical cells and large quantities of starch in medullary cells. Host-parasite concentrations are made by typical red algal pit connections. General effects of the infection on the host include cell hypertrophy, decrease in floridean starch granules, dispersed cytoplasmic matrices, and contorsion of chloroplasts.

INDEX TERMS: Rhodophyta, Parasitism, Ultrastructure, *Choreocolax polysiphoniae*.

AMIC-9992

"SPATIAL VARIABILITY OF THE PRODUCTIVITY: BIOMASS RATIO FOR PHYTOPLANKTON IN A SMALL MARINE BASIN", Platt, T., Fillion, C., *Limnology and Oceanography*, Vol. 18, No. 5, September 1973, pp 743-749.

The productivity:biomass (P:B) ratio for phytoplankton was studied using a replicated sampling design at six stations in a small marine basin. On six out of ten sampling days, statistically significant differences were revealed in the P:B ratios between stations. This result is consistent with the concept of contemporaneous disequilibrium which emphasizes the spatial component of the heterogeneity of the phytoplankton habitat. The measurements were made in the Bedford Basin, Nova Scotia. Six sampling stations were used. On each of 10 sampling days, each station was visited and 15 liters of seawater collected from 5-m depth. The water from each station was stored in a separate carboy. When water had been gathered from all six stations, each carboy was shaken thoroughly and the following samples drawn off: six replicate 1-liter samples for chlorophyll analysis; six replicate light bottles and four replicate dark bottles for C-14-uptake measurement. All of the replicates for C-14-uptake measurement, a total of 60, were incubated at station 1 at 5-m depth. The in situ incubation of the C-14-uptake experiments lasted 4 hr. Chlorophyll was used as an index of phytoplankton biomass. An analysis of variance design permitted calculation of the standard errors of chlorophyll and C-14 uptake in the light and dark. Using these, the standard errors of the P:B ratios were calculated and compared between stations on the same day.

INDEX TERMS: Phytoplankton, Primary productivity, Biomass, On-site tests.

2. BIOLOGICAL METHODS

AMIC-9998

"BREEDING AND GROWTH OF THE CHAETOGNATH *SAGITTA ELEGANS* IN BEDFORD BASIN", Zo, A., Limnology and Oceanography, Vol. 18, No. 5, September 1973, pp 750-756.

This work was an attempt to examine a complete cycle of breeding and growth of *Sagitta elegans* Verrill, the only chaetognath found in Bedford Basin. Bedford Basin is an oval-shaped depression about 7 km long and 4 km wide with a maximum depth of 70 m. It is connected to the coastal water of Nova Scotia through a southeastern channel. A collection was taken every 2 weeks during daylight hours from 6 November 1967 to 21 February 1969 at a single station in the deepest part of Bedford Basin (depth 60 m, tidal range plus or minus 2 m). Samples were preserved immediately in an 8 percent Formalin-seawater solution. In the laboratory, counting, measuring, and stage separation were carried out under the microscope, usually on the day following collection. Within 1 year two generations of *Sagitta elegans* were found. The spring generation, reaching maturity of mid-September, reproduced during the remainder of the year. The autumn generation, consisting of the offspring of the spring generation, appeared to overwinter and established the spring adult population. The temperature-size relationship of *S. elegans* from Bedford Basin is in close agreement with McLaren's curve for this species in the eastern Canadian Arctic. Net carbon production rate, calculated from the spring generation, was highest in mid-September when the majority of the population approached maturity.

INDEX TERMS: Breeding, Growth rates, Worms, Sea water, Water sampling, Water temperature, *Sagitta elegans*, Chaetognaths, Sample preservation.

AMIC-9996

"DAPHNIA DISTRIBUTION WITHIN LANGMUIR CIRCULATIONS", George, D. G., Edwards, R. W., Limnology and Oceanography, Vol. 18, No. 5, September 1973, pp 798-800.

Crustacean zooplankton distribution was studied in Eglwys Nynydd, a eutrophic reservoir near Port Talbot, S. Wales. The reservoir is exposed to the prevailing winds blowing in from the sea and never stratifies thermally. *Daphnia hyalina* var. *lacustris* (Sars) dominates the zooplankton, both numerically and in terms of biomass, throughout the year. Studies of the vertical distribution of the species collected over 2 years have shown that the animals tend to avoid the surface waters in daylight. Continuous horizontal samples of zooplankton were taken with a self-priming pump (30 liters/min capacity) connected to a sectional intake boom installed on a small boat. When used to examine distributions within Langmuir spirals the intake boom was positioned just below the surface (10-30 cm) and run first along, and then midway between, well-defined foamlines. Water was pumped directly into 2-liter containers in the boat for subsequent filtration on shore and all the *Daphnia* in each sample were counted. *Daphnia hyalina* was concentrated near the surface midway between the foamlines of Langmuir circulations that developed in a shallow reservoir at wind speeds above 400 cm/sec. Such concentration was probably caused by the antagonistic factors of upward water transport carrying *D. hyalina* to the surface zone and oriented movements away from this region of high light intensity.

INDEX TERMS: *Daphnia*, Distribution patterns, Light intensity, Winds, Reservoirs, Sampling, Langmuir circulations, *Daphnia hyalina*, Foamlines.

AMIC-9999

"SETTLING PLATES OF COLD-CURE ACRYLIC PLASTIC REPLICATED FROM NATURAL SURFACES", Risk, M. J., Limnology and Oceanography, Vol. 18, No. 5, September 1973, pp 801-802.

Many different substances have been used in the field and in the laboratory as substrates for colonizing communities of plants and animals. 'Formatray', a strong inert, cold-cure dental acrylic, seems to satisfy most of the requirements of an ideal settling plate material. Settling plates were made by pouring mixed Formatray into latex rubber impressions of various surfaces. Latex impressions can successfully be made of almost any natural surface. Formatray was about 40 percent calcium carbonate filler material and chemically approximates a calcareous sandstone or siltstone. A virtually unlimited number of plates can be poured up from one latex impression, thus allowing the operator to place identical plates in different locations or a series of plates, chemically identical and texturally different, in one location. In the field, plates are colonized rapidly and support heavy growths of algae and invertebrates. In a preliminary study in Big Fisherman's Cove, Santa Catalina Island, California, plates set out in shallow water picked up the most common algae settling on rocks in the area. So far, 41 species of algae and at least 11 species of invertebrates have been identified growing on these plates; there seems to be no selective exclusion of groups.

INDEX TERMS: Plastics, Sampling, Algae, Invertebrates, Biological communities, Settling plates, Artificial substrates, Formatray, Acrylics, Colonizing.

AMIC-10000

"PREPARATION OF FILTERED PLANKTON AND DETRITUS FOR STUDY WITH SCANNING ELECTRON MICROSCOPY", Paerl, H. W., Shimp, S. L., Limnology and Oceanography, Vol. 18, No. 5, September 1973, pp 802-805.

A simple, rapid method of fixing plankton and detritus for the scanning electron microscope is described, which can be used in the laboratory or in the field. The sample is fixed with 2 percent glutaraldehyde followed by stepwise dehydration in increasing concentrations of ethyl alcohol. Fixed samples can be stored for up to 2 weeks. Critical point drying of the fixed samples is done in the laboratory. Nucleopore filters proved superior to other filters for most sample preparations.

INDEX TERMS: Detritus, Diatoms, Electron microscopy, Dehydration, Filters, Lakes, Sea water, Sediments, Periphyton, Bacteria, Storage, Sample preparation, Scanning electron microscopy, Sample preservation, Nucleopore filters, Lake Tahoe, Fixation.

2. BIOLOGICAL METHODS

AMIC-10006

"RECENT DEVELOPMENTS IN THE MEASUREMENT OF THE RESPONSE OF PLANKTON AND PERIPHYTON TO CHANGES IN THEIR ENVIRONMENT", Weber, C. I., In: Bioassay Techniques and Environmental Chemistry, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1973, pp 119-138.

The abundance, species composition and condition of aquatic organisms in natural communities are directly related to water quality. Field studies of water quality conducted by state and federal environmental protection agencies generally involved the assessment of the species composition and diversity, numerical density and biomass of four communities of aquatic organisms, namely: plankton, periphyton, macroinvertebrates, and fish. The biomass and condition of the plankton and periphyton may be defined in terms of cell or organism counts, cell volumes, dry and ash-free weight, chlorophyll and adenosine triphosphate content, primary productivity, and rates of respiration and nitrogen fixation. This report discusses some of the more recently developed methods of assessing plankton and periphyton biomass and condition which use chlorophyll and ATP content, and nitrogen fixation rates.

INDEX TERMS: Biomass, Plankton, Periphyton, Chlorophyll, Nitrogen fixation, Spectrophotometry, Fluorometry, Sampling, Pigments, Bioindicators, Adenosine triphosphate, Autotrophic index, Luciferin-luciferase enzyme, Acetylene reduction, Ethylene production.

AMIC-10009

"EFFECTS OF RED MUD ON MARINE ANIMALS", Blackman, R. A. A., Wilson, K. W., Marine Pollution Bulletin, Vol. 4, No. 11, November 1973, pp 169-171.

Red mud, which is a waste product from the reduction of bauxite in the production of aluminum, has been disposed of in Bristol Channel by the UK with no apparent harmful effects. However, in considering the North Sea as a potential dump for red mud, Germany concluded that such disposal would be inadvisable because of detrimental effects on fauna. To determine whether the difference in results occurred from differences in chemical or physical characteristics of the red muds, bioassays were conducted with red muds from the UK and Germany. Red muds contain various quantities of Fe₂O₃, Al₂O₃, SiO₂, Na₂O, CaO, TiO₂, and ash. The experimental solutions were prepared from settled solids; the UK material had about 26 percent solids and the German 55 percent. The experiments were of two types: exposure to red mud settled on a substrate or red mud maintained in suspension. Scrobicularia plana, a deposit-feeding bivalve, Cardium edule, a suspension-feeding bivalve, and Solea solea, a bottom-living flatfish, were exposed to the deposits (5.0-50 mg/sq cm). Mytilus edulis, Crangon crangon (brown shrimp), and Agonus cataphractus (armed bullhead) were exposed to the suspension (up to 33 g/l). All organisms seemed to be unaffected by red mud except the armed bullhead. At 33 g/l, all bullheads died within 72 hr. No mortality occurred in 72 hr with 3.3 g/l red mud. On the evidence of the comparative studies it is concluded that the differences in origin and treatment of bauxite result in red muds of only slightly different toxicities. The physical and chemical characteristics of the waste and its observed effects on plants and animals in the laboratory are important considerations, but they must be related to the hydrographic and biotic features of

AMIC-10008

"IMPACT OF A POWER PLANT ON A SUBTROPICAL ESTUARINE ENVIRONMENT", Thorhaug, A., Segar, D., Roessler, M. A., Marine Pollution Bulletin, Vol. 4, No. 11, November 1973, pp 166-169.

The development of electricity generating stations around Biscayne Bay, Florida, has resulted in a considerable discharge of cooling water into this subtropical sea. The impact of this on the vegetation and animals of the area has been studied for the last four years. Preliminary data show that the fossil fuel burning Turkey Point plant apparently caused increases in concentrations of Cu, Pb, Cd, Zn, V, Ni, and Fe in the sediments of the entire study area. Water temperature increases of 3-5 C caused the Thalassia, Halimeda, and Penicillius communities to decline or disappear. Denuded areas became covered with blue-green algae. Areas where temperature was increased by 2 C were more productive than unaffected areas. Multiple regression analyses of dominant species of molluscs, echinoderms, and sponges indicated that the principle variables related to catch were vegetation and salinity. Animal populations in areas heated 3-5 C above normal also were reduced. No effects were noted at temperature increases of 2 C. At stations elevated less than 2 C, no statistical differences between controls and affected stations could be detected. Preliminary results from studies of the Card Sound effluent canal, opened in February, 1972, indicated the effluent over 2 C above bay ambient and carried a considerable load of suspended matter. In the area where the water contained noticeably more suspended matter, the seagrasses decreased in production of dry weight blade material.

INDEX TERMS: Cooling water, Water pollution effects, Thermal pollution, Heavy metals, Marine algae, Marine plants, Primary productivity, Electric powerplants.

AMIC-10009 (Continued)

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the proposed disposal site, to the quantities involved and to the method of disposal.

INDEX TERMS: Toxicity, Waste disposal, Marine fish, Clams, Shrimp, Oysters, Red mud, Scrobicularia plana, Cardium edule, Solea solea, Mytilus edulis, Crangon crangon, Agonus cataphractus.

2. BIOLOGICAL METHODS

AMIC-10016

"ACETYLENE-REDUCTION ASSAY OF ANAEROBIC NITROGEN FIXATION BY SEDIMENTS OF SELECTED WISCONSIN LAKES", Macgregor, A. N., Keeney, D. R., Journal of Environmental Quality, Vol. 2, No. 4, October-December 1973, pp 438-440.

Sediment samples were collected by Ekman dredge from 2 hardwater and six softwater lakes in Wisconsin for use in acetylene reduction tests to obtain a first approximation of the amounts of combined N added to lake sediments by anaerobic N fixation. To conduct the assay, sediment was transferred by syringe to 160-ml serum bottles containing 4-mm glass beads. The bottles were sealed with neoprene septa held firmly in place with aluminum seals. With the aid of hypodermic needles, each bottle was simultaneously flushed with a continuous flow of pure He and shaken so as to completely mix the beads and sediment. Ethylene, acetylene, and methane in the atmosphere above the sediment were determined after 1 and 2 days of incubation by gas chromatography. Rate of acetylene reduction indicated that, on the average, sediments from hardwater and softwater lakes may fix 37 and 7.7 ng of N, respectively, per gram (dry weight) per day. The rate of acetylene reduction diminished in the presence of nitrogenase inhibitors.

INDEX TERMS: Hardness (water), Nitrogen fixation, Lake sediments, Assay, Acetylene reduction.

AMIC-10016

"ACETYLCHOLINESTERASE TOXICITY OF MALATHION AND ITS METABOLITES", Walker, W. W., Stojanovic, B. J., Journal of Environmental Quality, Vol. 2, No. 4, October-December 1973, pp 474-475.

Malathion, under in vitro laboratory conditions, is readily degraded by an Arthrobacter species to four metabolites - malathion half-ester, malathion dicarboxylic acid, potassium dimethyl phosphorothioate, and potassium dimethyl phosphorodithioate. However, it is not clear whether or not this degradation represents a simultaneous detoxication of the malathion molecule. With this in mind, the relative toxicity of each of the four metabolites to bovine acetylcholinesterase was determined manometrically with the Warburg apparatus. Malathion half-ester retained roughly one-third the enzyme toxicity of unaltered malathion, while the other metabolites showed essentially no enzyme inhibition. It was concluded that while microbial conversion of malathion to malathion half-ester may well represent complete malathion degradation, it does not constitute complete insecticide detoxication.

INDEX TERMS: Pesticide toxicity, Microbial degradation, Malathion, Acetylcholinesterase, Malathion half ester, Malathion dicarboxylic acid, Potassium dimethyl phosphorothioate, Potassium dimethyl phosphorodithioate, Arthrobacter.

AMIC-10047

"ALGAE IN THE SPOON RIVER, ILLINOIS 1971-1972", Lin, S., Evans, R. L., Beuscher, D. B., Water Resources Bulletin, Vol. 9, No. 6, December 1973, pp 1112-1124.

As a part of a water quality survey of the Spoon River, Illinois, algal genera were identified and their densities were enumerated. Weekly samples were collected at five stations starting on June 1, 1971. This report presents the first year's results. Algal densities for each station were found to be distributed geometrically normal. Total algal densities increased as water progressed downstream. Although water temperature has been observed to be an important factor affecting the density and the composition of algae in streams, attempts to correlate algal densities with temperatures for the Spoon River were not fruitful. Correlations of algal densities with dissolved oxygen, flow, and coliform densities also could not be made. The dominant genera observed were Cyclotella, Navicula, Scenedesmus, and Euglena. On the average diatoms accounted for 87 percent of all algae counts. The average diversity indices varied about 1.0 to 1.5 for five stations. There did not appear to be any advantage in the use of diversity index over that of algal density and genera richness in characterizing algae in the Spoon River.

INDEX TERMS: Chrysophyta, Chlorophyta, Euglenophyta, Aquatic algae, Cyanophyta, Temporal distribution, Ecological distribution, Dominant organisms, Water quality, Species density, Species diversity index, Spoon River, Flagellates.

AMIC-10048

"THE EFFECTS OF SELECTED HERBICIDES ON BACTERIAL POPULATIONS IN AN AQUATIC ENVIRONMENT", Ferebee, R. N., Guthrie, R. K., Water Resources Bulletin, Vol. 9, No. 6, December 1973, pp 1125-1135.

Heterotrophic, mesophilic bacteria derived from, and maintained in, a freshwater environment where subjected to three classes of herbicides. Diuron, 2,4,5-trichlorophenoxyacetic acid, and paraquat, used as water soluble solutions, were added (0.7 and 1.4 mg/l) to a laboratory culture of bacteria. Total numbers of the bacteria, representing several genera, were monitored for alteration of numbers and types. Temperature, pH, and dissolved oxygen were monitored and the culture medium was tested for residual herbicide. Trichlorophenoxyacetic acid, 2,4,5-T, did not affect that portion of the bacterial population tested. Increase of bacterial counts as the result of paraquat addition was real, with both direct and indirect effects. Diuron caused a reduction in the total bacterial counts and selective enrichment. The reasons for the observed differences are discussed. The herbicides remained qualitatively measurable for periods up to 3 weeks.

INDEX TERMS: Paraquat, 2,4,5-T, Aquatic bacteria, Population, Bioassay, Water pollution effects, Herbicides, Pesticide residues, Degradation (decomposition), Diuron, Heterotrophic bacteria, Bacterial physiology, Bacterial growth, Mesophilic bacteria.

2. BIOLOGICAL METHODS

AMIC-10050

"EFFECTS OF SEDIMENTATION OF THE ALGAL FLORA OF A SMALL RECREATIONAL IMPOUNDMENT", Samsel, G. L., Jr., Water Resources Bulletin, Vol. 9, No. 6, December 1973, pp 1145-1152.

Investigations were initiated to evaluate the effects of sedimentation on the algal composition, primary productivity rates and chemical nutrient concentrations of a 17-acre recreational impoundment in central Virginia. Comparisons during the winter seasons of 1972-1973 indicated that as a result of sedimentation, from lake front home construction, the total numbers of algal genera in the lake decreased from 24 to 16, productivity as measured by C-1402 and total extractable chlorophyll decreased two-fold, and several important nutrients, i.e. $\text{NH}_4\text{-N}$, SiO_2 and $\text{PO}_4\text{-P}$ increased significantly.

INDEX TERMS: Sedimentation, Environmental effects, Nutrients, Aquatic algae, Standing crops, Primary productivity, Winter, Chemical properties, Physical properties, Phytoplankton, Chlorophyta, Chrysophyta, Cyanophyta, Photosynthetic rates, Chemical concentration.

AMIC-10053

"TREND SURFACE ANALYSIS AND SEASONAL DISTRIBUTION PATTERNS OF PRIMARY NUTRIENTS AND CHLOROPHYLL IN UNSTRATIFIED GULF COAST ESTUARIES", Cechova, I., Davis, E. M., Water Resources Research, Vol. 9, No. 6, December 1973, pp 1543-1554.

The technique of data display, the synographic mapping system (Synap), was applied in ecological studies of unstratified Gulf Coast estuaries. Thirty-four computer maps of spatial distribution of primary nutrients and chlorophyll concentrations in San Antonio and Matagorda (Texas) estuaries were prepared from survey data covering the period 1970-1971. The maps provided a convenient means for detecting the sources of estuarine enrichment by primary nutrients and of seasonal changes in dispersion patterns. Weighted average concentrations of each compound in the entire estuarine water mass were determined from such displays and used in comparison of concentrations for different months of the survey period. The data presented on Synap displays were used in the determination of mixing and exchange efficiency in the estuaries. The results indicated that incoming nutrients often have very short residence times. The efficiency of exchange and residence time of each compound vary significantly within a year, conditioned by variable compound loading, quantity of tributary runoff, range of tidal activity, and variable biological food demand. An attempt was made to relate the chlorophyll a concentrations obtained as weighted averages from Synap displays to concentrations of phosphorus, nitrogen, and carbon, to the amount of tributary runoff, and to yearly seasons by means of coaxial graphical correlation.

INDEX TERMS: Distribution patterns, Nutrients, Estuaries, Water pollution sources, Seasonal, Dispersion, Synap, Chlorophyll a, Data interpretation.

AMIC-10076

"ESTIMATING THE DENSITY OF INDIVIDUAL BACTERIAL POPULATIONS INTRODUCED INTO NATURAL ECOSYSTEMS", Danso, S. K. A., Habte, M., Alexander, M., Canadian Journal of Microbiology, Vol. 19, No. 11, November 1973, pp 1450-1451.

The abundance of individual strains of *Xanthomonas*, *Erwinia*, and *Rhizobium* added to soil was determined by a method that allows for the enumeration of surviving cells on the introduced population in the presence of many other soil microorganisms. The method should be useful for measuring numbers of other bacteria in heterogeneous communities. The method involves using mutants of the species of interest which are resistant to antibacterial agents that prevent the growth of nearly all other populations in the environment. The bacteria used were *Xanthomonas campestris*, *Erwinia carotovora*, *Rhizobium trifolii*, and *Rhizobium meliloti*. Streptomycin was selected as the chemical of choice since *Rhizobium* mutants could be obtained easily by growing the cultures in yeast extract - mannitol broth containing about 50 micrograms streptomycin sulfate/ml and transferring the survivors to the same medium containing higher antibiotic concentrations. By these means, isolates resistant to 1000 micrograms streptomycin sulfate/ml were obtained. Spontaneous mutants of *X. campestris* and *E. carotovora* were obtained by inoculating large numbers of the cells into trypticase soy broth containing 800 micrograms streptomycin sulfate/ml, incubating the broth until growth was observed, and plating the suspension on a solid medium of the same composition. It should not be too difficult to obtain mutants of other species which grow in media containing antibacterial compounds in concentrations sufficiently high to prevent the replication of large percentages of the residents of natural ecosystems.

INDEX TERMS: Bacteria, Soil, Cultures, Ecosystems, Growth rates, *Xanthomonas campestris*.

AMIC-10084

"ISOLATION AND CHARACTERIZATION OF THERMOTOLERANT METHANOL-UTILIZING YEAST", Levine, D. W., Cooney, C. L., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 982-990.

A yeast capable of growth on methanol as its sole carbon-energy source was isolated from soil samples and identified as a strain of *Hansenula polymorpha*. A continuous enrichment culture at 37 C with a simple mineral salts medium was used to select this organism. The isolate, designated DL-1, has a maximal specific growth rate of 0.22 per h, at pH 4.5 to 5.5 and temperatures of 37 to 42 C, in simple mineral salts medium with methanol (0.5 percent), biotin, and thiamine. Growth occurred in a chemostat at temperatures up to 50 C, with strong growth at 45 C. The maximal growth yield of the yeast on methanol was 0.36 g of dry cell weight per g of methanol, and the yield on oxygen was 0.37 g of dry cell weight per g of O_2 . Protein content of the isolate is 46 percent, and total nucleic acid content varies from 5.0 to 7.0 percent with increasing growth rate from 0.08 to 0.20 per h. The amino acid profile of this yeast protein indicated that it could serve as a good source of food protein. Feeding studies with rats show the yeast to have no toxic effects. (Reprinted from Applied Microbiology, Vol. 26, No. 6, December 1973, pp 982-990. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Isolation, Pollutant identification, Cytological studies, Biological properties, Yeasts, Soil fungi, Growth rates, Toxicity, Heat resistance, Methanol, Characterization, *Hansenula polymorpha*, Ascomycetes, Substrate utilization, Growth media, Chemical composition, Continuous cultures.

2. BIOLOGICAL METHODS

AMIC-10091

"CHARACTERISTICS OF PHOSPHORUS DEFICIENCY IN ANABAENA", Healey, F. P., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 383-395.

Several aspects of the metabolism and composition of a strain of Anabaena have been studied during phosphorus deficiency. The effects of medium composition, substrate concentration, temperature, pH, and illumination on alkaline phosphatase activity and phosphate uptake have been examined. Of particular interest among these results was the dependence of maximum alkaline phosphatase activity on Ca and of phosphate uptake on Mg. Depletion of dissolved phosphate from the culture medium was accompanied by a marked increase in alkaline phosphatase activity, initial rate of phosphate uptake, and total amount of phosphate taken up to satisfaction of the phosphorus debt. Readdition of phosphate to a phosphorus-deficient culture resulted in a rapid decline in the ability to take up phosphate but no loss of alkaline phosphatase beyond dilution of activity already present. Entry into phosphorus deficiency was accompanied by a loss of heterocysts, a decline in chlorophyll a, protein, RNA, and cellular phosphorus, and an increase in carbohydrate per unit dry weight. The possible use of these changes as physiological indicators of phosphorus limitation in natural situations is discussed.

INDEX TERMS: Anabaena, Deficient elements, Phosphorus, Cytological studies, Plant physiology, Assay, Cyanophyta, Plant growth, Bioindicators, Enzyme activity, Heterocysts, Alkaline phosphatase.

AMIC-10092

"CHLOROPHYLL, NITROGEN, AND PHOTOSYNTHETIC PATTERNS DURING GROWTH AND SENESCENCE OF TWO BLUE-GREEN ALGAE", Daley, R. J., Brown, S. R., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 395-401.

A standardized, multiflask, batch culture system was developed to study the processes of algal senescence in Anacystis nidulans and Phormidium molle Gom. var. tenuior W. et G. West. Growth data over a 3-year period gave reproducible and comparable time-course curves. Although A. nidulans is unicellular and P. molle filamentous, the patterns of change with age were similar. Mean logarithmic doubling times and carbon yields were, respectively, 6.9 hr and 390 mg C/liter for A. nidulans and 7.2 hr and 710 mg C/liter for P. molle. Chlorophyll concentration and photosynthetic capacity per unit carbon rose rapidly during the logarithmic phase to maximum levels in either late log phase (P. molle) or early linear phase (A. nidulans), then fell throughout the declining growth phase to low levels in the stationary phase. Nitrate was rapidly exhausted from the medium during the period of logarithmic growth and stoichiometrically converted to particulate organic form; very little subsequent fixation of molecular nitrogen occurred. The phycocyanins were rapidly destroyed during the logarithmic phase while the carotenoids remained relatively constant throughout the whole growth period and then slowly declined. Preliminary electron micrographs showed a progressive deterioration in cellular ultrastructure, especially a reduction in the number of photosynthetic thylakoids, commencing in the linear growth phase. Analysis of the results suggests that occurrence of linear growth kinetics and termination of culture growth were caused by exhaustion of nitrate. The observed decreases in chlorophylls, phycocyanins, and photosynthetic capacity during active

AMIC-10092 (Continued)

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culture growth show that senescence effects may not be, as assumed, restricted to the stationary phase of growth.

INDEX TERMS: Aging (biological), Chlorophyll, Nitrogen, Photosynthesis, Plant growth, Plant pigments, Anacystis nidulans, Phormidium molle var. tenuior, Growth kinetics.

AMIC-10093

"SPECIES OF OCEANIC DINOFLAGELLATES IN THE GENERA DISSODINIUM AND PYROCYSTIS: INTERCLONAL AND INTERSPECIFIC COMPARISONS OF THE COLOR AND PHOTON YIELD OF BIOLUMINESCENCE", Swift, E., Biggley, W. H., Seliger, H. H., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 420-426.

The authors have examined aspects of the bioluminescence of 5 clones of Dissodinium, 1 clone of Pyrocystis acuta, 4 clones of Pyrocystis fusiformis, and 5 clones of Pyrocystis noctiluca. All clones produced the same color bioluminescence with an intensity peak near 474 nm. The in vivo emission spectra of these clones agreed with those previously determined for 4 other species of marine dinoflagellates. The amount of light emitted by the dinoflagellates in scotophase when mechanically stimulated to exhaustion was determined for most of the clones. The largest species, P. noctiluca and P. fusiformis, emitted 37-89 billion photons/cell and 23-62 billion photons/cell, respectively, about a thousand times as much light as Gonyaulax species. Pyrocystis acuta emitted 3-6 billion photons/cell. Three of the 5 clones of Dissodinium were bioluminescent. The range for 3 clones was 5-13 billion photons/cell. All 5 clones of Dissodinium are morphologically distinct. Both the clones of Dissodinium and Pyrocystis produced much higher numbers of photons per cell nitrogen (ca. 7-50 times) than Gonyaulax polyedra or Pyrodinium bahamense. The data suggested that enzyme turnover occurred in the reactions producing light during mechanical stimulation of Dissodinium and Pyrocystis species.

INDEX TERMS: Marine algae, Dinoflagellates, Bioluminescence, Protozoa, Biological properties, Color, Speciation, Clones, Bioenergetics, Photon yield.

2. BIOLOGICAL METHODS

AMIC-10094

"THE PRODUCTION OF HYDROGEN PEROXIDE BY BLUE-GREEN ALGAE: A SURVEY", Stevens, S. E., Jr., Patterson, C. O. P., Myers, J., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 427-430.

Thirty-eight axenic isolates of blue-green algae (Cyanophyta) were surveyed for hydrogen peroxide production. In order to avoid complications due to poor growth, three different culture media were used. Cells were grown in liquid culture on the chosen medium at 35 C, with continuous agitation and 1 percent CO₂ in air (v/v) bubbling through the culture. 5-25 w tungsten lamps were positioned 8 cm from the growth tubes in order to enhance peroxide production. Sixteen of the isolates (type I) showed no production of H₂O₂ within the sensitivity of the assay. Type II isolates, showed no H₂O₂ production while in darkness, but at onset of illumination, H₂O₂ production was observed. After a short initial induction period, the rate of peroxide production remained steady until assay ingredients were exhausted or until light was extinguished. Type III isolates produced no H₂O₂ while in darkness, but at onset of illumination, displayed peroxide production with complex kinetics. Salient features included an initial lag, followed by a burst or period of rapid production of H₂O₂; the burst graded into a lower rate which then held steady. Type IV isolates differed markedly from all others assayed in that type IV algae produced H₂O₂ in darkness. Illumination of type IV cells caused an immediate increase in rate of H₂O₂ production. This increased rate continued without variation until light off. At light off, peroxide production dropped back to a rate equal to or sometimes slightly greater than the initial rate observed prior to illumination. The three kinetic profiles observed for peroxide formation are described. The possible site or sites of hydrogen peroxide formation remain unknown.

INDEX TERMS: Aquatic algae, Cyanophyta, Kinetics, Axenic cultures, Hydrogen peroxide.

AMIC-10095

"ULTRASTRUCTURE OF THE GREEN ALGA DICHTOMOSIPHON TUBEROSUS WITH SPECIAL REFERENCE TO THE OCCURRENCE OF STRIATED TUBULES IN THE CHLOROPLAST", Moestrup, O., Hoffman, L. R., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 430-437.

The ultrastructure of the siphonous green alga Dichotomosiphon tuberosus (A. Br.) Ernst is compared with that of other siphonous plants. There is a characteristic association between the Golgi bodies and endoplasmic reticulum, but the mitochondria are not involved in the association as they are in Vaucheria and the phycomycete Saprolegnia. An unusual structure and arrangement of the chloroplasts is described as well as a previously unreported type of 'striated tubule' which occurs in most if not all chloroplasts and amyloplasts. The structure of these tubules is compared with that of other tubules recently found in green algae and higher plants. In addition, cytoplasmic microtubules arranged in the longitudinal direction of the siphon suggest a function in cytoplasmic streaming.

INDEX TERMS: Aquatic algae, Chlorophyta, Cytological studies, Electron microscopy, Plant morphology, Dichotomosiphon tuberosus, Ultrastructure, Chloroplasts.

AMIC-10096

"HYDROGEN SULFIDE PRODUCTION BY SYNECHOCOCCUS LIVIDUS Y52-sl", Sheridan, R. P., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 437-445.

Under anaerobic conditions and in the absence of CO₂, the thermophilic blue-green alga Synechococcus lividus Y52-s evolved hydrogen sulfide in both darkness and light. The mechanism of this process was investigated and compared with photo- and dark reductions in organisms representing several phyla. The photoproduction of H₂S from either sulfate or thiosulfate was inhibited by 3-(3,4-dichlorophenyl)-1,1-dimethyl urea (DCMU) and carbonyl m-chlorophenyl-hydrazone (m-Cl-CCP). The inhibitory effect of DCMU showed the requirement for photosystem II as electron donor. Inhibition by m-Cl-CCP also implicated ATP as an energy source. Monofluoroacetate partially inhibited photoproduction of H₂S. This indicated that oxidative metabolism may act as a source of electrons to reduce the photooxidant under certain conditions. Thiosulfate acts only as electron acceptor and is reductively cleaved to sulfide and sulfite ions. Thiosulfate and sulfate appeared to replace CO₂ in the light and O₂ in darkness as electron acceptors. The phosphorylation uncouplers dinitrophenol and m-Cl-CCP stimulated dark H₂S production.

INDEX TERMS: Anaerobic conditions, Cyanophyta, Hydrogen sulfide, Water pollution sources, Plant growth, Aquatic algae, Algal physiology, Synechococcus lividus, Photoproduction, Thermophilic algae, Photochemistry, Substrate utilization, Biosynthesis.

AMIC-10097

"THE MARINE DIATOM ETHMODISCUS REX: ITS MORPHOLOGY AND OCCURRENCE IN THE PLANKTON OF THE SARGASSO SEA", Swift, E., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 456-460.

Living cells of the diatom Ethmodiscus rex (Rattray) Wiseman and Hendey 1953 were found in the plankton of the southern Sargasso Sea. Apparently, this is the first report of E. rex from the plankton of the Atlantic Ocean. Scanning electron microscopy of peroxide-cleaned frustules revealed some new morphological features for this species. When viewed from inside the frustule, the puncta appear as rimmed pits. From outside the frustule, they appear to be shallow depressions with a small opening at the bottom. The so-called mucous tubules in the center of the valve were seen from the outside to be elongate slits and from the inside as obliquely directed flattened cylinders which cap the tubes.

INDEX TERMS: Diatoms, Marine algae, Plant morphology, Cytological studies, Chrysophyta, Phytoplankton, Ethmodiscus rex, Scanning electron microscopy, Sargasso Sea, Sample preparation.

2. BIOLOGICAL METHODS

AMIC-10100

"EFFECT OF LIGHT INTENSITY AND GLYCEROL ON THE GROWTH, PIGMENT COMPOSITION, AND ULTRASTRUCTURE OF *CHROOMONAS* SP.", Faust, M. A., Gantt, E., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 489-495.

Growth of *Chroomonas* sp. increased with light intensity (100, 1800, and 2700 microwatts/sq cm) with a five-fold increase from the lowest to the highest intensity. Chlorophyll and phycocyanin content per cell were greater in cells grown at low light intensity, but the ratio of chlorophyll a and c did not vary appreciably. Cells grown at low light intensity had 30 percent more phycocyanin than cells grown at high intensities of light. The chloroplast of cells with the higher phycocyanin content had average intrathylakoidal widths of 300 Å, whereas those cells with the lower phycocyanin content had average intrathylakoidal widths of 200 Å. This result is compatible with the hypothesis that phycocyanin is located in the intrathylakoidal space in the cryptophyte algae. Of the various energy sources tested, only glycerol was able to support limited growth under nonphotosynthetic conditions. Under no condition was the chloroplast reduced to an etioplast or proplastid state. Starch accumulation was greatest in cells grown in continuous white light in glycerol. Eyespots were commonest in cells grown in darkness and interrupted every 24 hr by a few seconds of white light. It was concluded that this organism is an obligate phototroph.

INDEX TERMS: Plant growth, Plant pigments, Light intensity, Environmental effects, Solvent extractions, Aquatic algae, *Chroomonas*, Glycerol, Ultrastructure, Algal physiology, Sample preparation, Heterotrophic nutrition, Cryptomonads.

AMIC-10101

"A CONTINUOUS CULTURE STUDY OF PHOSPHATE UPTAKE, GROWTH RATE AND POLYPHOSPHATE IN *SCENEDESMUS* SP.", Rhee, G.-Y., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 495-506.

The kinetics of phosphate uptake and growth in *Scenedesmus* sp. have been studied in continuous culture with particular reference to the shifts in the cellular P compounds as a function of growth rate. Uptake velocity is a function of both internal and external substrate concentrations and can be described by the kinetics of noncompetitive enzyme inhibition. The concentrations of polyphosphates (alkali-extractable or 7-min) can be substituted as inhibitors in the kinetic equation. The apparent half-saturation constant of uptake, $K_{sub m}$, is 0.6 microM growth is less than $K_{sub m}$ by 1 order of magnitude. Growth is a function of cellular P concentrations, and the polyphosphates (alkali-extractable or 7-min) appear to regulate growth rate directly or indirectly. To understand P limitation, therefore, it is necessary to measure both external P and internal polyphosphate levels. Evidence indicates that alkali-extractable polyphosphates, which can be quantitatively determined by a simple method of measuring surplus P, are involved in cell division process and that a maintenance concentration of functional phosphate exists in the form of polyphosphates. Alkaline phosphatase activity has an inversely linear relationship to grow rate and to the reciprocals of both polyphosphates and surplus P. Changes in lipid P, RNA P, and presumably all other forms except DNA are related to changes in growth rate.

INDEX TERMS: Phosphates, Growth rates, *Scenedesmus*, Absorption, Path of pollutants, Kinetics, Polyphosphates, Continuous cultures, Algal physiology, Enzyme activity.

AMIC-10102

"BACTERIA-ASSIMILABLE ORGANIC COMPOUNDS, PHOSPHATE, AND ENHANCED GROWTH OF BACTERIA-ASSOCIATED BLUE-GREEN ALGAE", Lange, W., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 507-509.

The complexities of algal physiology and nutrition make it likely that diverse and often substantial nutrient limitations will be required to control eutrophication in different situations. In defense of a policy exemplified by the generalization 'phosphorus is the primary limiting nutrient in most lakes,' Schindler of the Canadian Freshwater Institute has misquoted the work of Lange. Key points of Lange's conclusions are properly quoted, and the reader is cautioned against an oversimplification of a single approach to algal control.

INDEX TERMS: Aquatic bacteria, Aquatic algae, Eutrophication, Nutrients, Algal control, Water pollution control, Organic compounds, Limiting factors, Plant growth, Algal physiology.

AMIC-10103

"THE EFFECT OF SELENITE ON THE PHYSIOLOGICAL AND MORPHOLOGICAL PROPERTIES OF THE BLUE-GREEN ALGA *PHORMIDIUM LURIDUM* VAR. *OLIVACEA*", Sielicki, M., Burnham, J. C., Journal of Phycology, Vol. 9, No. 4, December 1973, pp 509-514.

Phormidium luridum cultures were treated with sodium selenite in concentrations ranging from 1 microM to 0.01 M. In contrast to the increasing culture turbidity of control and 1 microM selenite cultures, the turbidity of the other selenite cultures declined in proportion to time and selenite concentration. Chlorophyll extraction revealed similar results. Photosynthetic activity was inhibited within 6 hr in all cultures except control and 1 microM selenite. *Phormidium* at concentrations greater than 1 microM selenite showed a gradual loss of the bright green color and turned semitransparent. Cell-associated granules of reduced selenium were observed at higher selenite concentrations. Other structural changes observed were the presence of intracellular and intercellular spaces, spheroplast formation, and gradual cell lysis. Protein analyses of total cell samples and supernatant fractions confirmed cellular breakdown of selenite-treated algal cells.

INDEX TERMS: Plant morphology, Cyanophyta, Bioassay, Photosynthesis, Inhibition, Plant growth, *Phormidium luridum* var. *olivacea*, Selenite, Algal physiology, Pollutant effects.

3. MICROBIOLOGICAL METHODS

AMIC-9392

"INCIDENCE OF RESISTANCE TO TETRACYCLINE, CHLORAMPHENICOL AND AMPICILLIN AMONG *SALMONELLA* SPECIES ISOLATED IN THE NETHERLANDS IN 1969, 1970 AND 1971", Voogd, C. E., Guinee, P. A. M., Manten, A., Valkenburg, J. J., Antonie van Leeuwenhoek, Vol. 39, No. 2, 1973, pp 321-329.

In 1969, 1970 and 1971 respectively, 11761, 13844 and 20053 *Salmonella* strains were screened for resistance to ampicillin, chloramphenicol and tetracycline. Each *Salmonella* strain was transferred to agar slants containing 25 micrograms of tetracycline, 50 micrograms of chloramphenicol, 25 micrograms of ampicillin or 25 micrograms of kanamycin per milliliter at pH 7.4. If growth occurred, the bacteria were identified again in order to exclude any possibility of contamination with drug-resistant bacteria of other species. If the same serotype was found, the degree of resistance was determined by tube-dilution assay on 5 percent sheep-blood agar slants made of nutrient agar pH 7.4 to which citrated sheep blood was added. The tubes were inoculated with one drop of a dilute suspension containing 1 million bacteria per ml in 0.85 percent NaCl solution. After incubation at 37 C for 20 hours any strain growing in tubes containing one of the above antibiotics at a concentration of 50 micrograms/ml was considered to be resistant. This drug level roughly corresponds to 10 times the normal minimal inhibitory concentration. It was found that in these years respectively 23.4 percent, 19.3 percent and 15.1 percent of the isolated strains were resistant to one or more of these antibiotics. Most strains appeared to be only tetracycline-resistant. Resistance to chloramphenicol remained low (0.56 percent and less). During 1971 64 kanamycin-resistant strains (0.32 percent) were isolated. Resistance was largely confined to *S. typhimurium* and *S. panama*.

AMIC-9575

"THE BACTERIAL FLORA OF THE ATLANTIC SALMON (*SALMO SALAR* L.) IN RELATION TO ITS ENVIRONMENT", Horsley, R. W., Journal of Applied Bacteriology, Vol. 36, No. 3, September 1973, pp 377-386.

The aerobic flora of the skin of 56 Atlantic salmon from coastal, estuarine and river waters was analyzed quantitatively; 50 skin and 33 gill samples were analyzed qualitatively. The water at each sampling station was also analyzed. The principal genera on the skin and gills were *Moraxella*, *Flavobacterium*, *Cytophaga* and *Pseudomonas*; members of *Acinetobacter*, *Bacillus*, *Aeromonas*, *Vibrio*, the *Enterobacteriaceae*, *Micrococcaceae* and some coryneforms were also present. The gill flora was similar to that of the skin, which reflected that of the environment.

INDEX TERMS: Aerobic bacteria, Pollutant identification, Methodology, Bioindicators, Water quality, Estuarine environment, Fungi, Aquatic environment, Skin, Heterotrophic bacteria, Gills, Marine environment, Viable count, Swab technique, Sampling technique.

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INDEX TERMS: Antibiotics (pesticides), *Salmonella*, Domestic animals, Enteric bacteria, Aerobic bacteria, Water pollution sources, Tetracycline, Ampicillin, Chloramphenicol, Kanamycin, Drug resistance, Serotypes.

AMIC-9618

"ACETYLENE REDUCTION BY *BEIJERINCKIA* UNDER VARIOUS PARTIAL PRESSURES OF OXYGEN AND ACETYLENE", Spiff, E. D., Odu, C. T. I., Journal of General Microbiology, Vol. 78, No. 2, October 1973, pp 207-209.

Different partial pressures of acetylene and oxygen greatly affect the level of acetylene reduction by *Beijerinckia*, a nitrogen-fixing bacterium found in some acidic tropical soils. Nitrogenase activity was measured by the acetylene reduction technique using three replicate vials for each treatment. A milliliter-sample of *Beijerinckia* culture was usually injected to initiate the reaction and the reaction was usually terminated by injecting 5 N H₂SO₄ into the reaction mixture. The vials were incubated in a 30 C water bath with reciprocal shaking (152 strokes/min). The ethylene produced was measured by flame ionization gas chromatography. Acetylene reduction increased with an increase of pO₂H₂ up to 0.74 atm. Acetylene reduction was linear for at least 40 min. The oxygen partial pressure also affected activity with most acetylene reduction at a pO₂ of 0.15 atm for liquid cultures grown in air.

INDEX TERMS: Oxygen, Nitrogen fixing bacteria, Nitrogen fixation, *Beijerinckia indicum*, Acetylene reduction, Acetylene, Partial pressures, Enzyme activity, Substrate utilization, Fate of pollutants, Bacterial physiology.

3. MICROBIOLOGICAL METHODS

AMIC-9881

"IN VITRO FORMATION OF NITRATE REDUCTASE USING EXTRACTS OF THE NITRATE REDUCTASE MUTANT OF *NEUROSPORA CRASSA*, NIT-1. AND *RHODOSPIRILLUM RUBRUM*", Ketchum, P. A., Sevilla, C. L., Journal of Bacteriology, Vol. 116, No. 2, November 1973, pp 600-609.

In vitro formation of reduced nicotinamide adenine dinucleotide phosphate (NADPH)-nitrate reductase (NADPH: nitrate oxido-reductase, EC 1.6.6.2) has been attained by using extracts of the nitrate reductase mutant of *Neurospora crassa*, nit-1, and extracts of either photosynthetically or heterotrophically grown *Rhodospirillum rubrum*, which contribute the constitutive component. The in vitro formation of NADPH-nitrate reductase is characterized by the conversion of the flavin adenine dinucleotide (FAD) stimulated NADPH-cytochrome c reductase, contributed by the *N. crassa* nit-1 extract from a slower sedimenting form (4.5S) to a faster sedimenting form (7.9S). The 7.9S NADPH-cytochrome c reductase peak coincides in sucrose density gradient profiles with the NADPH-nitrate reductase, FADH2-nitrate reductase and reduced methyl viologen (MVH)-nitrate reductase activities which are also formed in vitro. The constitutive component from *R. rubrum* is soluble (both in heterotrophically and photosynthetically grown cells), is stimulated by the addition of 0.0001 M Na2MoO4 and 0.01 M NaNO3 to cell-free preparations, and has variable activity over the pH range from 3.0 to 9.5. The activity of the constitutive component in some extracts showed a threefold stimulation when the pH was lowered from 6.5 to 4.0. The constitutive activity appears to be associated with a large molecular weight component which sediments as a single peak in sucrose density gradients. However, the constitutive component from *R. rubrum* is dialyzable and is insensitive to trypsin and protease. These results demonstrate that *R. rubrum* contains the constitutive

AMIC-9881 (Continued)

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component and suggests that it is a low molecular weight, trypsin- and protease-insensitive factor which participates in the in vitro formation of NADPH nitrate reductase.

INDEX TERMS: Laboratory tests, Biochemistry, Nitrate reductase, Biosynthesis, Cell extracts, In vitro synthesis, *Neurospora crassa*, *Rhodospirillum rubrum*, Subcellular components.

AMIC-9926

"EFFECTS OF THICKNESS OF BACTERIAL FILM", Hoehn, R. C., Ray, A. D., Journal Water Pollution Control Federation, Vol. 45, No. 11, November 1973, pp 2302-2320.

An investigation was initiated to determine the effects of thickness on the nutrient utilization capacity of bacterial films, that is, whether that rate remains constant or decreases as the film depth increases. Bacterial films were developed in laboratory-scale rotating cylinders. Lyophilized seed and cultures maintained on agar were used to inoculate a drum at the beginning of any particular culturing operation. The isolates were identified as belonging to the genera *Bacillus*, *Micrococcus*, *Pseudomonas*, *Flavobacterium*, and *Microbacterium*. Ten sections of each cylinder could be removed so that film thickness could be measured periodically. A shallow stream of synthetic media flowed continuously through the cylinders during the culturing operations, and the differences in influent and effluent concentrations of organic matter were used to calculate nutrient uptake rates. These rates were examined as functions of thickness. In one series of studies, film solids were measured and examined as functions of thickness. Nutrient uptake rates attained a maximum at thickness between 100 and 150 microns and, if all data were composited, appeared to stabilize. When data from individual experiments were examined separately, however, nutrient utilization began decreasing between 100 and 150 microns, continuing until the films were approximately 400 microns thick. Beyond that thickness, the rates increased again to their former levels.

INDEX TERMS: Nutrients, Absorption, Cultures, Organic matter, Metabolism, Chemical oxygen demand, *Pseudomonas*, Bacterial films, Substrate utilization, Thickness, Oxygen diffusion, Film density, *Flavobacterium*, *Bacillus*, *Micrococcus*.

AMIC-9927

"MODEL FOR COLIFORM BACTERIA IN GRAND TRAVERSE BAY", Canale, R. P., Journal Water Pollution Control Federation, Vol. 45, No. 11, November 1973, pp 2358-2371.

A predictive model for total coliform bacteria in Grand Traverse Bay, Michigan, has been developed using continuity equations with a simple fluid transport model and temperature-dependent first order kinetics. The model has been verified over a wide range of loadings during a period of several years with data obtained during numerous field surveys. The model has been applied to a number of water quality control problems of interest to local planners and others, such as defining the role of storm sewer discharges to the bay, the effects of additional areas for development, and the discharge of wastes from private watercraft.

INDEX TERMS: Coliforms, Mathematical models, Michigan, Distribution patterns, Water temperature, Industrial wastes, Sewage, Flow, Water quality, Bays, Grand Traverse Bay, Boardman River.

3. MICROBIOLOGICAL METHODS

AMIC-10004

"FISH VIRUSES: ISOLATION AND IDENTIFICATION OF INFECTIOUS HEMATOPOIETIC NECROSIS IN EASTERN NORTH AMERICA", Wolf, K., Quimby, M. C., Pettijohn, L. L., et al., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1625-1627.

Infectious hematopoietic necrosis virus (IHN) was isolated from diseased fingerling rainbow trout (*Salmo gairdneri*) from a hatchery in West Virginia. Clinical signs, histopathologic findings, and origin of eggs provided a basis for diagnosis, and virus was isolated and presumptively identified by plaque characteristics. Serum neutralization tests provided positive identification of the agent as IHN, and electron microscopy showed its rhabdovirus morphology. Experimental infections resulted in signs of IHN and death; test fish had characteristic histopathologic alterations and appropriate virus titers. This is the first completely documented occurrence of IHN beyond the Pacific Northwest.

INDEX TERMS: Isolation, Pollutant identification, Fish diseases, Methodology, Testing procedures, Rainbow trout, Viruses, Electron microscopy, Fish eggs, Fry, IHN virus, Infectious hematopoietic necrosis, Histopathology, *Salmo gairdneri*, Plaque counts, Rhabdoviruses, Sample preparation.

AMIC-10055

"DYNAMIC BEHAVIOR OF A COMPLETE-MIXING ACTIVATED SLUDGE SYSTEM", Chu, G. C. Y., Erickson, L. E., Fan, L. T., Biotechnology and Bioengineering, Vol. 15, November 1973, pp 1101-1121.

The dynamic behavior of a laboratory-scale activated sludge biological waste treatment process with recycle and wasting of sludge was investigated by subjecting the system to step changes in the influent waste concentration, the recycle flow rate, or the sludge wasting rate. The dynamic behavior of the system was examined by measuring adenosine triphosphate (ATP) in addition to dissolved chemical oxygen demand (COD) and cell dry weight in the aeration tank. Cell dry weight of the recycle flow and effluent COD were also measured. System performance changed appreciably when the system was subjected to step changes in the influent waste concentration, the recycle flow rate, or the sludge wasting rate. Generally, the responses to a step increase and a step decrease of the same input variable were not symmetrical, especially in the response of the ATP concentration. The ATP/MLSS ratio was found to depend on the food-to-organism ratio in the aeration tank. When this ratio was small, the ATP/MLSS was large. The time constant analysis showed that the dry weight time constants were directly related to the sludge mean residence time; as the sludge wasting rate increased, the value of the time constant decreased. The time constants of the dissolved COD variation in the aeration tank were much smaller than those of the sludge dynamics. The dissolved COD time constants were found to be closely related to the fluid mean residence time in the aeration tank.

INDEX TERMS: Activated sludge, Biological treatment, Flow rates, Wasting rates, Continuous cultures, Chemical oxygen demand, Aeration, Organic matter, Cultures.

AMIC-10005

"MICROCULTURES OF BROWN BULLHEAD (*ICTALURUS NEBULOSUS*) CELLS: THEIR USE IN QUANTITATION OF CHANNEL CATFISH (*ICTALURUS PUNCTATUS*) VIRUS AND ANTIBODY", Gratzek, J. B., McGlamery, M. H., Dawe, D. L., et al., Journal of the Fisheries Research Board of Canada, Vol. 30, No. 11, November 1973, pp 1641-1645.

A microculture system was applied to the culture of brown bullhead (*Ictalurus nebulosus*) cells and used for the titration of channel catfish (*Ictalurus punctatus*) virus and corresponding antibody. As few as 17,000 cells/well could be used for routine titrations. Simultaneous inoculation of virus with cells at the time of planting resulted in clearer endpoints as opposed to inoculation of performed monolayers. When channel catfish virus antibodies were measured using plaque reduction and microculture titration assays as indicator systems, no significant differences in antibody titers were noted.

INDEX TERMS: Cytological studies, Assay, Pollutant identification, Microculture methods, Channel catfish virus, Quantitative analysis, Brown bullhead, Cell cultures.

AMIC-10060

"EFFECT OF HELIUM GAS AT ELEVATED PRESSURE ON IRON TRANSPORT AND GROWTH OF *ESCHERICHIA COLI*", Schlamm, N. A., Perry, J. E., Wild, J. R., Journal of Bacteriology, Vol. 117, No. 1, January 1973, pp 170-174.

Helium at an ambient pressure of 68 atm with 0.2 atm of O₂ shortened by 1 to 1.5 h the lag phase for growth of *Escherichia coli* in minimal medium supplemented with 2 microliters of cell-free culture filtrate (CFF) per ml or with 1 micromM 2,3-dihydroxybenzoylserine (DHBS), an iron chelator. The lag phase of cultures not exposed to helium could be shortened by use of supplements, but higher concentrations were required - 10 to 30 microliters of CFF per ml or 10 to 50 micromM DHBS. Strain AN 193 of *E. coli*, which requires the DHBS precursor 2,3-dihydroxybenzoic acid (DHBA), grew well in media with 10 micromM DHBA when exposed to helium at 68 atm, whereas 100 micromM DHBA was required for growth in unexposed cultures. In the presence of 100 micromM DHBA plus 1.0 micromM ethylenediaminetetraacetic acid, growth was inhibited at 1 and 68 atm. Growth was restored, however, by the addition of 0.1 micromM FeSO₄ at 68 atm and 1.0 micromM FeSO₄ at 1 atm, but lag times were invariably shorter in the pressurized cultures. Hydrostatic pressures of 68 atm did not reduce the lag phase in the presence of CFF, DHBS, or DHBA. Our results suggest that 68 atm of helium pressure, but not hydrostatic pressure, elicited a more rapid transport of iron into the cells.

INDEX TERMS: *E. coli*, Helium, Environmental effects, High pressure, Iron, Growth rates, Bacterial physiology, Transport.

3. MICROBIOLOGICAL METHODS

AMIC-10063

"LIPOPOLYSACCHARIDE FROM A GRAM-NEGATIVE MARINE BACTERIUM", Mongillo, A., Deloge, K., Pereira, D., et al., Journal of Bacteriology, Vol. 117, No. 1, January 1974, pp 327-328.

To investigate the occurrence of marine lipopolysaccharides, a number of marine microorganisms were isolated from sand and seawater collected from Narragansett Bay, Rhode Island. Upon initial screening, one organism was chosen for analysis. Cultural and biochemical characteristics indicated that the organism was a nonmotile pseudomonad. The organism was routinely cultivated at room temperature with constant shaking in a medium containing 5.0 g of nutrient broth, 8.0 g of yeast extract, and the complete salts solution per liter of distilled water. The organism was grown for 24 hr, harvested by centrifugation, washed in complete salt solution, and extracted by the phenol-salts method. The material isolated from this marine pseudomonad as lipid A showed many of the characteristics of other lipid A molecules: it contained glucosamine, and phosphate; its solubility in lipid solvents such as chloroform indicated the presence of fatty acids; and the two hexoses present, glucose and galactose, are also commonly found in the polysaccharide portion of the LPS molecule. Absent from the preparation was the heptose monosaccharide. The absence of the core could indicate that this pseudomonad may only produce an incomplete LPS. Another possibility is that the proper concentration of cations were not present during the extraction to hold the core portion intact. The organism does, however, possess a type of lipopolysaccharide molecule.

INDEX TERMS: Marine bacteria, Lipids, Sands, Lipopolysaccharides, Lipid A, Pseudomonads.

AMIC-10068

"METHOD FOR ROUTINE CULTURING OF STRICT ANAEROBIC BACTERIA", van Wyk, L., Laboratory Practice, Vol. 22, No. 11, November 1973, p 681.

Routine culturing of marine anaerobes is accomplished by adding 4 ml anaerobic medium to McCartney bottles previously gassed with a CO₂, N₂, and H₂ mixture. The tightly stoppered bottles are sterilized at 121 C for 15 minutes and cooled in a slanted position. The bottles are then filled with a sterile semisolid agar containing 0.15 g washed agar, 0.0001 g reazurin, 2.5 ml reducing solution, and 100 ml distilled water. This agar together with rubber-lined metal caps, protects the slant culture from air, and the indicator shows if the medium becomes too oxidized to permit growth of the anaerobes. Inoculation of the slants can be carried out with a platinum loop in a stream of sterile CO₂ without air ever coming into direct contact with the grown medium. By this method cultures of anaerobic bacteria from sheep rumen were effortlessly maintained. After initial incubation at 38 C for 48 hr, cultures were stored at 4 C for 60 d, whereupon transfers were successfully made to fresh anaerobic slants. Slides for gram stains were easily prepared from these slant cultures. Since the preparation of media is time consuming, a large number of McCartney bottles may be simultaneously prepared as described and stored at 4 C until required without marked changes in the medium taking place.

INDEX TERMS: Anaerobic bacteria, Cultures, Incubation, Agars, Reazurin, Inoculation, Slant cultures, Sample preservation, Culture media, Sample preparation,

AMIC-10075

"THE EFFECT OF THYROXINE AND TRIIODOTHYRONINE ON BACTERIAL GROWTH", Garber, N., Lupowitz-Donenfeld, B., Canadian Journal of Microbiology, Vol. 19, No. 11, November 1973, pp 1401-1405.

The effects of L-thyroxine, D-thyroxine, and 3,5,3'-triiodothyronine on the growth of several Gram-positive and Gram-negative bacteria was examined. The first two compounds, at a concentration of 0.000077 M, were found to have a considerable inhibitory effect while 3,5,3'-triiodothyronine had a very weak effect on the growth of the Gram-positive bacteria examined. The growth of the Gram-negative bacteria was not inhibited under the same conditions. Potassium iodide, at the same concentration, was not inhibitory. Release of free iodine from the thyroxine preparation was also excluded as contributing to the thyroxine effect because it was shown to be less toxic than thyroxine for *Bacillus cereus* 569 and to exhibit a similar inhibitory effect on Gram-positive and Gram-negative bacteria. The inhibition of Gram-positive bacteria by L-thyroxine was reduced by cations such as Mn(2 plus), Fe(2 plus), and Ca(2 plus). However, the hormones were more potent in their effect compared to EDTA in the same molar concentration and the inhibition exerted by them was not so easily abolished by the divalent cations as it was in the case of EDTA. Although chelation could contribute to the inhibition of the bacteria by the iodinated hormones, it seems that it is not the only factor involved.

INDEX TERMS: E. coli, Growth rates, Pseudomonas, Salmonella, Streptococcus, Cultures, Bioindicators, Iron, Calcium, Chelation, Thyroxine, Triiodothyronine, EDTA, Hormones, Gram-negative bacteria, Gram-positive bacteria, Bacterial physiology.

AMIC-10077

"DEGRADATION OF PARATHION BY BACTERIA ISOLATED FROM FLOODED SOIL", Siddaramappa, R., Rajaram, K. P., Sethunathan, N., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 846-849.

Bacillus sp. and *Pseudomonas* sp. were isolated from parathion-amended flooded alluvial soil which had demonstrated parathion-hydrolyzing ability. When *Pseudomonas* was incubated with 50 micrograms of parathion, 19 micrograms of p-nitrophenol was recovered within 4 h of incubation as the hydrolysis product. After 20 h parathion was completely destroyed and no p-nitrophenol could be detected. When *Pseudomonas* was grown in a N₂-free medium with p-nitrophenol as the sole carbon source, nitrite-nitrogen was released in proportion to the amount of p-nitrophenol degraded. *Bacillus* sp. was incubated as above with 166 micrograms of p-nitrophenol being metabolized, releasing 43 micrograms of nitrite. The bacterium failed to metabolize intact parathion to yield either nitrite or p-nitrophenol.

INDEX TERMS: Alluvium, Microbial degradation, Pseudomonas, Soil bacteria, Metabolism, Phosphothioate pesticides, Nitrites, Isolation, Parathion, *Bacillus*, Fate of pollutants, Chemical recovery, p-Nitrophenol, Metabolites, Degradation products.

3. MICROBIOLOGICAL METHODS

AMIC-10078

"UREASE ACTIVITY OF ENTEROBACTERIACEAE: WHICH MEDIUM TO CHOOSE", Vuze, A., Pilick, J., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 850-854.

Detection and intensity of urease activity in enterobacteriaceae greatly varies as a function of the media or techniques used, or both. A comparative investigation on several solid and liquid media led to the following conclusions. (1) Detection of *Proteus* spp. can be adequately performed with the highly selective solid medium described by Cook (1948), as well as with the different liquid media described (Stuart standard and rapid media; Elek medium). (2) Detection of *Klebsiella* should be based upon urease production on solid media with low buffer capacity (Christensen, 1964). (3) For the identification of *Yersinia*, either the solid Christensen urea agar or the rapid Elek technique gives optimal results. (Reprinted from Applied Microbiology, Vol. 26, No. 6, December 1973, pp 850-854. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Pollutant identification, Enteric bacteria, Culture media, Urease, Biosynthesis, Selective media, Biochemical characteristics, Enzyme activity, Solid media, Liquid media.

AMIC-10081

"RECOVERY AND IDENTIFICATION OF ANAEROBES: A SYSTEM SUITABLE FOR THE ROUTINE CLINICAL LABORATORY", Ellner, P. D., Granato, P. A., May, C. B., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 904-913.

A system is described in which clinical specimens to be cultured for anaerobes are plated on reducible media and incubated in Gas Pak jars for 24 h. Clinical specimens were carefully selected for culture using this system. Generally those specimens originating from body sites harboring normal commensal flora were not cultured. Several experimental formulations of the prerduced anaerobically sterilized (PRAS) transport media were compared with Amies transport medium without charcoal. Using *Clostridium novyi* B, no significant advantage was observed with the experimental media over Amies medium. Selective and nonselective formulations of reducible media were used for primary isolation. The isolates were identified according to the Gram stain of the pure chopped meat glucose (CMG) culture in combination with gas-liquid chromatography. Pure, undiluted 24-h CMG culture was used to inoculate anaerobic blood agar (anBAP) for antibiotic susceptibility testing. Antibiotic disks of penicillin, ampicillin, carbenicillin, chloramphenicol, tetracycline, erythromycin and clindamycin were used. The methods have been tested in a high-volume routine microbiology laboratory (more than 700 specimens per day), but are also suitable for smaller laboratories. The system permits improved recovery and identification of the majority of anaerobes within a time period commensurate with clinical practice. Preliminary reports with presumptive identification are often available within 48 h, and the final report with complete identification and antibiogram is usually available within 4 days.

AMIC-10079

"METHOD FOR RADIORESPIROMETRIC DETECTION OF BACTERIA IN PURE CULTURE AND IN BLOOD", Schrot, J. R., Hess, W. C., Levin, G. V., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 867-873.

Methods are described for the detection of low numbers of bacteria by monitoring C-14O₂ evolved from C-14-labeled substrates. Cell suspensions are filtered with membrane filters, and the filter is then moistened with 0.1 ml of labeled medium in a small, closed apparatus. Evolved C-14O₂ is collected with Ba(OH)₂-moistened filter pads and assayed with conventional radioactivity counting equipment. The kinetics of C-14O₂ evolution are shown for several species of bacteria. Fewer than 100 colony-forming units of most species tested were detected in 2 h or less. Bacteria were inoculated into blood and the mixture was treated to lyse the blood cells. The suspension was filtered and the filter was placed in a small volume of labeled medium. The evolved C-14O₂ was trapped and counted. A key development in the methodology was finding that an aqueous solution of Rhozyme and Triton X-100 produced lysis of blood but was not detrimental to bacteria. (Reprinted from Applied Microbiology, Vol. 26, No. 6, December 1973, pp 867-873. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Methodology, Bacteria, Pollutant identification, Radioactivity techniques, Testing procedures, Laboratory tests, Laboratory equipment, Carbon radioisotopes, Pure cultures, Blood, Radiorespirometry, Trace levels, Carbon dioxide evolution, Culture media.

AMIC-10081 (Continued)

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INDEX TERMS: Anaerobic bacteria, Pathogenic bacteria, Pollutant identification, Isolation, Methodology, Laboratory tests, Antibiotics (pesticides), Culture media, Culturing techniques, Recovery, Selective media, Gas liquid chromatography, Gram-negative bacteria.

3. MICROBIOLOGICAL METHODS

AMIC-10082

"SCANNING ELECTRON MICROSCOPY OF BACTERIAL COLONIES", Afrikian, E. G., St. Julian, G., Bulla, L. A., Jr., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 934-937.

A technique is described for observing bacterial colony growth. *Bacillus cereus*, *B. subtilis*, and *B. cereus* var. *mycoides* were grown on strips of dialysis membrane layered on nutrient agar. Microcolonies of the organisms on strips were fixed in Formalin vapor in situ; the strips then were removed from the agar and secured to scanning microscope specimen stubs without markedly disturbing the cellular arrangement. Scanning electron micrographs clearly depict morphology of individual cells, as well as the spatial orientation of cells within the colony. This technique is reproducible, adaptable, and simple. (Reprinted from Applied Microbiology, Vol. 26, No. 6, December 1973, pp 934-937. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Pollutant identification, Cytological studies, Methodology, Scanning electron microscopy, Bacterial colonies, Reproducibility, Sample preparation, Culturing techniques.

AMIC-10083 (Continued)

Card 2/2

INDEX TERMS: Enteric bacteria, Farm wastes, Hogs, Aerobic conditions, Temperature, hydrogen ion concentration, Oxidation-reduction potential, Environmental effects, Survival, Windrow composting, Bacterial populations, Thermophilic conditions, Fecal streptococci, Cellulolytic microorganisms, Fecal coliforms, Mesophilic microorganisms, Enterococci.

AMIC-10083

"POPULATION CHANGES IN ENTERIC BACTERIA AND OTHER MICROORGANISMS DURING AEROBIC THERMOPHILIC WINDROW COMPOSTING", Savage, J., Chase, T., Jr., Macmillan, J. D., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 969-974.

Composting of wastes from swine feeding operations was studied. The effects of the frequency of turning the wastes and addition of straw to improve the physical structure was studied to determine the most effective technique to rapidly increase the temperature and, consequently, destroy coliforms and *Salmonella*. Four different treatments were studied; the results showed that, with addition of 5 percent (wt-wt) straw and mechanical turning of the compost 20 times per week, the temperature reached 60 C within 3 days and enteric bacteria were destroyed within 14 days. The possibility of survival of pathogens at the cool surface of a windrow operation, however, has not been disproven. The results obtained indicate clearly a marked decrease in coliforms, salmonellae, and enterococci during the thermophilic stage of composting. For maximal sanitary safety, the thermophilic stage of composting should be reached as soon as possible. A succession of microbial populations was observed during the composting process. The bacteria increased in number before the temperature of the windrows rose and then declined, whereas cellulolytic organisms and actinomycetes in general increased in the thermophilic stage. Presumably, the mesophilic bacteria rapidly attack the more readily available organic constituents, resulting in a temperature increase. The increased temperature favors the cellulolytic organisms, and the mesophilic bacteria largely disappear. The actinomycetes appeared in the final stage to such an extent that the surfaces of the compost piles were white or gray. These organisms are known to play a role in the humification of organic matter, which results in a stabilized product.

AMIC-10085

"MULTIPURPOSE MEDIUM FOR USE WITH PSEUDOMONAS SPECIES", Rosenthal, S. L., Applied Microbiology, Vol. 26, No. 6, December 1973, pp 1013-1014.

A medium consisting of the following can be used to detect starch hydrolysis, gelatinase production, and denitrification by pseudomonads: yeast extract (Difco) 5 g; KNO₃, 5 g; K₂HPO₄, 1 g; gelatin, 4 g; soluble starch, 2 g; agar (Difco), 15 g water, 1,000 ml. Fifty-eight *Pseudomonas* strains were grown on the medium. The identity of *P. aeruginosa* was confirmed by the presence of the characteristic odor and pigments and by the possession of acetamide deaminase. The requirement for methionine as a growth factor served as a confirmatory test for *P. maltophilia*. The remaining species were identified by a battery of 14 single carbon source assimilation tests. All strains grew rapidly and well on the medium. Forty-nine *Acinetobacter* strains were also tried. All grew well aerobically and had either positive or negative tests for gelatinase. None grew anaerobically.

INDEX TERMS: *Pseudomonas*, Pollutant identification, Testing procedures, Denitrification, Hydrolysis, Culture media, Biochemical characteristics, Chemical composition, Substrate utilization, Gelatinase, Starch.

4. METHODS AND PERFORMANCE EVALUATION

AMIC-10056

"THE ESTIMATION OF RELATIVE POTENCY FROM TWO PARABOLAS IN SYMMETRIC BIOASSAYS", Williams, D. A., Biometrics, Vol. 29, No. 4, December 1973, pp 695-700.

Three estimators of relative potency from two parabolas in symmetric bioassays, the estimator proposed by Elston (1965), the maximum likelihood (ML) estimator, and the usual estimator assuming linearity, are compared. The results of a simulation study indicate that in well designed assays Elston's estimator performs at least as well as the other two estimators, whether or not the log-dose response regression is linear.

INDEX TERMS: Estimating, Statistical methods, Equations, Symmetric bioassay, Relative potency, Mean square error, Parabolas.

AMIC-10071

"BAYESIAN ANALYSIS OF A BIVARIATE NORMAL DISTRIBUTION WITH INCOMPLETE OBSERVATIONS", Mehta, J. S., Swamy, P. A. V. B., Journal of the American Statistical Association, Vol. 68, No. 344, December 1973, pp 922-927.

A specific problem of making inferences about the difference of the means in a bivariate normal population is considered when the sample has some missing values corresponding to one or both variables. The purpose of the study was to evaluate the effects of extra observations from the populations of $x_{\text{sub } 1}$ and $x_{\text{sub } 2}$ on the overall inferences about the difference of the means. A Bayesian solution to the problem is offered. One advantage of the Bayesian approach is that the nuisance parameters can be eliminated by straightforward integration. The effects of extra observations from the populations of $x_{\text{sub } 1}$ and $x_{\text{sub } 2}$ on the overall inferences about the difference of the means can be evaluated by analyzing the marginal posterior distribution of the difference of the means which incorporates a proper allowance for the roles of the nuisance parameters in the model.

INDEX TERMS: Statistical methods, Average, Distribution, Bayesian analysis, Bivariate normal population, Inferences.

AMIC-10058

"MAXIMUM LIKELIHOOD ESTIMATION FOR MIXTURES OF TWO NORMAL DISTRIBUTIONS", Dick, N. P., Bowden, D. C., Biometrics, Vol. 28, No. 4, December 1973, pp 781-790.

This paper is primarily concerned with estimation of the parameters μ_1 , ρ_1 , μ_2 , ρ_2 , and p in the mixture of two normal distributions when independent sample information is available from one of the populations. The solution to the maximum likelihood (ML) equations was obtained using Newton's iterative method. Some interesting results for the moment estimates were obtained for the case when independent sample observations are available from one population. Extensive Monte Carlo simulation was employed to obtain the sample variances of the estimates as well as the estimated asymptotic variances. The variances of the estimates are influenced by the separation of the two means with respect to the variances, the mixture proportion (p), and, of course, the size of the sample. When the number of observations is small and the means are not well separated, the sample variance of the estimates can be as much as three times greater than the estimated asymptotic variances. The problem motivating this research originated in fisheries where it was necessary to estimate the average lengths of the two separate plants of fish after one year, the population variances of the lengths, and the mixture proportion using the entire sample.

INDEX TERMS: Distribution, Probability, Monte Carlo method, Average, Fisheries, Variance, Hessian matrix, Normal distribution.

AMIC-10073

"APPROXIMATING DISCRETE DISTRIBUTIONS, WITH APPLICATIONS", Gokhale, D. V., Journal of the American Statistical Association, Vol. 68, No. 344, December 1973, pp 1009-1012.

This article presents a generalized procedure of finding the discrete distribution which minimizes, subject to a set of linear constraints on the probabilities, the 'discrimination information' with respect to a given probability distribution. A convergent iterative algorithm is modified to serve this purpose. Many applications are discussed including analyses of contingency tables and some discrete analogues of the one-sample and several-samples problem. A test for the validity of the imposed constraints is provided by a test-statistic distributed asymptotically like a chi square.

INDEX TERMS: Statistical methods, Probability, Analog models, Algorithms, Discrimination information, Probability distribution, Contingency tables.

5. INSTRUMENT DEVELOPMENT

AMIC-8667

"SPECIAL REPORT: SEMICONDUCTOR MEMORIES ARE TAKING OVER DATA-STORAGE APPLICATIONS", Riley, W. B., Electronics, Vol. 46, No. 16, August 2, 1973, pp 75-90.

Semiconductor memories are finding wide application in computer, controller, and calculator design. This paper provides a general review of the current status of semiconductors discussing what is available, who is using the equipment, some criteria for selecting equipment, some problems that have been encountered, and some of the benefits from the new semiconductor technology. There are 16 different types of semiconductors, divided into two classes in any of four different and independent ways. The divisions are dynamic and static circuits, bipolar and MOS technology, read-write and read-only memories and random-access and serial-access memories. Not all 16 types are, however, purchasable or even practical.

INDEX TERMS: Data storage and retrieval, Computers, Semiconductors, Controllers, Calculators, Memory (computers).

AMIC-9245

"MASS AND CHARGE TRANSFER KINETICS AND COULOMETRIC CURRENT EFFICIENCIES. PART VII. CONDITIONAL POTENTIALS, AND SINGLE-SCAN VOLTAMMETRY OF PURE VANADIUM(V) - VANADIUM(IV) SYSTEMS IN VARIOUS MEDIA AT PLATINUM ELECTRODES PRE-TREATED BY FIVE METHODS", Bishop, E., Hitchcock, P. H., Analyst, Vol. 98, No. 1169, August 1973, pp 553-562.

The limited previous work on vanadium is reviewed. Five methods of electrode pre-treatment have been selected and are described. The variation of the conditional potential of the vanadium(V) - vanadium(IV) system with hydrogen-ion concentration is reported. The experimental work is complicated by isopolymerization reactions, of which at least one is kinetically slow. The voltammetric reduction of vanadium(V) in saturated potassium sulphate - acetate buffer at pH 4.0 is examined: the benefit of shifting solvent reaction potentials to more negative potentials is nullified by the direct reduction of un-ionized acetic acid. A similar examination is made in a medium of 0.00001 M sulphuric acid and in one of 2.0 M sulphuric acid. Possible adsorption effects are canvassed. The complex behaviour at intermediate hydrogen-ion concentrations is discussed, with illustrations drawn from a sulphuric acid medium of pH 2.0. The anodic oxidation of vanadium(IV) is briefly examined. It is concluded that the electrochemical behaviour of the vanadium system is strongly dependent on hydrogen-ion concentration and on the electrode pre-treatment. The electrode can be chemically oxidized in vanadium(V) solutions. The mechanism is a one-step one-electron process. No evidence could be found for reduction below the plus 4 oxidation state at platinum. Vanadium(IV) cannot be oxidized without severe loss of current efficiency, nor reduced to vanadium(III) at platinum electrodes.

AMIC-9072

"ROTATING RING-DISK ELECTRODE STUDY OF THE ADSORPTION OF LEAD ON GOLD IN 0.5M POTASSIUM CHLORIDE", Vicente, V. A., Bruckenstein, S., Analytical Chemistry, Vol. 45, No. 12, October 1973, pp 2036-2043.

The underpotential deposition of Pb(0) on gold occurred at 0 V greater than $E_{\text{sub D}}$ greater than minus 0.6 V (SCE) using cyclic voltammetry at a rotating gold ring-disk electrode. A complete monolayer of Pb atoms on gold is equivalent at 420 microC/geometric sq cm or about 247 microC/real sq cm. Bulk Pb(0) deposition does not occur until this amount of charge has been consumed. The monolayer of underpotential Pb(0) yields three peaks upon anodic stripping. Further, adsorption of Pb(II) on gold occurs during the cathodic disk potential scan and begins at about plus 0.6 V. From ring collection data, about 20 percent of a monolayer equivalent remains adsorbed at the disk as a lead(II) species during the anodic disk potential scan. Complete desorption occurs just before the potential for the dissolution of gold ($E_{\text{sub D}}$ equivalent or equal to plus 0.7 V) in the chloride medium. (Reprinted from Analytical Chemistry, Vol. 45, No. 12, October 1973, pp 2036-2043. Copyright 1974 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Adsorption, Lead, Electrochemistry, Zeta potential, Rotating ring-disk electrodes, Gold electrodes, Cyclic voltammetry, Anodic stripping voltammetry, Chemical concentration, Chemical interference.

AMIC-9245 (Continued)

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INDEX TERMS: Kinetics, Chemical reactions, Hydrogen ion concentration, Electrochemistry, Electrolytes, Vanadium, Mass transfer, Charge transfer, Single scan voltammetry, Platinum electrodes, Coulometric currents, Pretreatment methods, Electrochemical reactions.

5. INSTRUMENT DEVELOPMENT

AMIC-9246

"MASS AND CHARGE TRANSFER KINETICS AND COULOMETRIC CURRENT EFFICIENCIES. PART VIII. SINGLE-SCAN VOLTAMMETRY OF VANADIUM(V) - VANADIUM(IV) IN THE PRESENCE OF CHROMIUM, MANGANESE AND IRON, AND THE KINETIC PARAMETERS OF THE VANADIUM SYSTEM, AT PLATINUM ELECTRODES PRE-TREATED BY FIVE METHODS", Bishop, E., Hitchcock, P. H., Analyst, Vol. 98, No. 1169, August 1973, pp 563-571.

Continuing the earlier examination of the vanadium system alone, under various conditions and with various electrode pre-treatments, the effect of neighbouring steel-forming d-block elements has been investigated. Chromium(VI) at pH 4.0 suppresses the vanadium(V) reduction wave, and the degree of suppression is quantitatively proportional to the chromium(VI) concentration. Activated electrodes are deactivated by dipping them in a chromium(VI) solution, and remain so even when well washed thereafter, so that chromium(VI) as well as chromium(III) is absorbed strongly on platinum. In 2.0 M sulphuric acid, chromium(VI) and vanadium(V) are reduced at the same rate. Manganese(VII) in acetate buffer gives a fast, well separated wave, but the separation is not as good in 2.0 M sulphuric acid; slowing the vanadium(V) reduction by using an oxidized electrode effects no improvement: the manganese wave is similarly affected. Addition of chromium(VI) to the manganese - vanadium mixture at pH 4 suppresses the manganese wave only slightly, even when the vanadium wave is completely suppressed. In 2.0 M sulphuric acid, the manganese wave is undistorted and chromium and vanadium are simultaneously reduced. Iron(III) in 2.0 M sulphuric acid does not interfere, but the separation of the vanadium and iron waves is not good. Iron(II) can, however, act as a potentiostatic intermediate. The kinetic parameters of the vanadium system are reproducible in acetate buffer, but only when the electrode is fouled in 2.0 M sulphuric acid. Pattern theory and

AMIC-9246 (Continued)

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diffusion-corrected Lewartowicz methods give results that agree. The charge-transfer kinetic parameters are shown to be potential dependent in acidic media. The results are compared with those in earlier reports. The generation current efficiency for vanadium(IV) in acetate buffer was computed.

INDEX TERMS: Kinetics, Heavy metals, Cations, Electrolytes, Platinum electrodes, Single scan voltammetry, Charge transfer, Mass transfer, Vanadium, Ionic interference, Pretreatment methods, Coulometric currents.

AMIC-9808

"UTILIZATION OF REMOTE SENSING IN RIVER BASIN STUDIES", Link, L. E., Shindala, A., Water Resources Bulletin, Vol. 9, No. 5, October 1973, pp 901-907.

Remote sensing techniques have the potential for significantly reducing the level of effort in a river basin water quality study. An immediate requirement exists, however, for the formulation of the proper methodology for the application of remote sensing to this problem area. A general methodology is proposed for conduct of river basin water quality studies. The primary advantage offered by the proposed methodology is a technique for rapid evaluation of the water quality conditions of a river basin. Remote sensing techniques are a fundamental part of the methodology. The proposed methodology consists of two phases. Phase I deals with the study of the water resource characteristics of the basin as a system and identification of 'critical areas.' Phase II of the methodology involves the detailed study of the critical areas by means of computerized water quality simulation models.

INDEX TERMS: Remote sensing, Water quality, Methodology, Model studies, River basins, Telemetry, Hydrologic data, Properties, Aerial photography, On-site data collections, Stream channels, Site selection.

AMIC-9890

"A DIRECT COMPARISON OF SATELLITE AND AIRCRAFT INFRARED (10 MICROMETERS-12 MICROMETERS) REMOTE MEASUREMENTS OF SURFACE TEMPERATURE", Platt, C. M. R., Troup, A. J., Remote Sensing of Environment, Vol. 2, No. 4, 1973, pp 243-247.

Nimbus IV Satellite THIR (10 micrometers-12 micrometers) sea surface temperature data for a region off the NE coast of Australia were compared with data taken over the same region and period with a radiometer detecting in the same spectral interval flown aboard a DC 3 aircraft at altitudes ranging from the surface to 3 km. When the aircraft ascended from the surface to above the tradewind inversion, the apparent sea surface temperature decreased by 2.6 C, on average. An empirical formula for the water vapour absorption coefficient, which included a component proportional to the water vapour pressure, was used successfully to account for the apparent temperature decrease. From above the inversion, the aircraft radiometer sea surface temperatures were slightly greater than the Nimbus IV Thir sea surface temperatures. This discrepancy was accounted for by residual water vapour between the inversion and the tropopause, nadir angles of viewing from Nimbus IV, and the slight mismatch between the spectral filters of the two instruments.

INDEX TERMS: Remote sensing, Measurement, Water temperature, Sea water, Satellites (artificial), Aircraft, Surface waters, Comparative data.

5. INSTRUMENT DEVELOPMENT

AMIC-9940

"MINICOMPUTERS' ROLE IN MONITORING", Epler, R. J., Environmental Science and Technology, Vol. 8, No. 1, January 1974, pp 28-30.

Many analytical techniques suitable for use in pollutant monitoring lend themselves to use with computers: X-ray fluorescence, microwave spectroscopy, and nuclear magnetic resonance (nmr). Other instrumentation, too, can be used effectively in conjunction with computers. Much of the instrumentation used to monitor pollution can be tied to a computer through appropriate interfacing. Suppose a system is needed to monitor the following parameters in surface water, temperature, pH, electrical conductivity, dissolved oxygen, oxidation-reduction potential, and chloride content. To analyze these parameters in detail, and particularly to interrelate them, would be a difficult task liable to human error. A computer system could be developed that would perform all of these operations easily, and at the same time, present a total picture. The minicomputer is a key to such a system because it is small, inexpensive, and tolerant of a wide variety of environmental conditions. As an example, the PDP-8/F minicomputer is used as the central element of the system. Each instrument used in the system, such as a pH meter or a conductivity meter, produces an electrical signal that is proportional to the parameter being measured. For the computer to use these signals, two things are necessary: First, the hardware must convert the signals into a form that the computer can use, and second, correct programming must be used. To convert analog signals into digital form, a converter (ADC) is used, aided by instrumentation-grade analog amplifiers, if necessary. Such a system in a laboratory lends itself to other types of instrumentation, such as gas chromatography, spectrophotometry, and infrared and ultraviolet spectrometry.

AMIC-9940 (Continued)

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INDEX TERMS: Digital computers, Data processing, Monitoring, Water pollution, Water quality, Pollutant identification, Automation, X-ray fluorescence, Nuclear magnetic resonance, Instrumentation, Thermal pollution, Radioactive wastes, Minicomputers.

AMIC-9942

"POTENTIOMETER RECORDERS", Measurements and Data, Vol. 7, No. 6, November/December 1973, pp 62-71.

Null-balance recorders are servo-operated devices generally referred to as 'potentiometers.' The advantages of the null-balance potentiometer are (1) high sensitivity, down to microvolt signals, and (2) independence of lead length. Nearly all process and test variables can be measured in terms of microvolt or millivolt electric signals, and often must be measured at large distance from the point of recording. The potentiometer recorder meets these needs. Further, the potentiometer can be used with minor modifications as a null-balancing bridge-input recorder, which is basically a resistance (or inductance or capacitance) measuring device. A departure from standard servo recorder design is the 'Speed Servo' with a response speed faster than potentiometer recorders which use servomotors, geartrains and cable or cord pen drive. In the 'Speed Servo' strings, pulleys, belts, gears and rotary servomotor are replaced by a servomotor whose armature operates back and forth like a shuttle. This armature features drive coil allowed to slide freely along the pole piece in a magnetic field (produced by the permanent magnet). Current in the drive coil horizontally. Specifications (channels, FS response, comments, and prices) are given for potentiometers from 69 different suppliers.

INDEX TERMS: Potentiometers, Resistivity, Specifications, Electronic equipment, Recorders, Servomotors.

AMIC-9958

"INVESTIGATION OF THE FACTORS AFFECTING THE RESPONSE TIME OF A CALCIUM SELECTIVE LIQUID MEMBRANE ELECTRODE", Fleet, B., Ryan, T. H., Brand, M. J. D., Analytical Chemistry, Vol. 46, No. 1, January 1974, pp 12-15.

Measurements on the response time of a Calcium Selective Liquid Membrane Electrode are reported and a new parameter $t_{sub 95}$ is proposed as being a more representative measure of electrode performance than the more widely used $t_{sub 1/2}$. The former value is of more importance in assessing the performance of an electrode in real analytical situations. The effect of various interfering ionic species on the response time of the electrode is investigated and ions tested have been divided into three groups according to their effect on the response time. An interpretation of this division is proposed on the basis of the kinetics of the reaction of the interferent ion with the membrane site species and conventional selectivity ratios. It has been shown that a calcium liquid membrane electrode responds rapidly and reproducibly to step changes in calcium ion activity, with response time of the order of a few seconds. Also interfering ions can have a marked effect on the electrode response time and this cannot always be predicted from a knowledge of the selectivity constant. Where the selectivity constant is very small, it may be assumed that no effect on response time will be observed. For interfering ions with moderate to large selectivity constants, an increase in electrode response time will be observed when the kinetics of the interferent ion reactions become rate limiting.

INDEX TERMS: Effects, Calcium, Cations, Selectivity, Liquid membrane electrodes, Calcium electrodes, Ionic interference, Response time, Data interpretation.

5. INSTRUMENT DEVELOPMENT

AMIC-10034

"SURFACTANT-SELECTIVE ELECTRODES. PART I. AN IMPROVED LIQUID ION-EXCHANGER", Birch, B. J., Clarke, D. E., Analytica Chimica Acta, Vol. 67, No 2, December 1973, pp 387-393.

An improved electrode selective to the dodecylsulphate anion is described, which has no apparent effect on micellar properties. Electrodes selective to a variety of surfactant types have been prepared and the manufacture of electrodes specific to single alkyl chain length surfactants is discussed. An example is given of their use in the study of the precipitation of commercial surfactants.

INDEX TERMS: Fabrication, Solubility, Dodecylsulfate electrodes, Anionic surfactants, Surfactant selective electrodes, Liquid ion exchanger, Ionic interference, n-Alkyl sulfates.

AMIC-10065

"DIGITAL CONTROL ALGORITHMS. PART III. TUNING PI AND PID CONTROLLERS", Chiu, K.-C., Corripio, A. B., Smith, C. L., Instruments and Control Systems, Vol. 46, No. 12, December 1973, pp 41-43.

Common practice in the process industries is to use the discrete equivalent of the three-mode proportional-plus-integral-plus-derivative (PID) controller for digital feedback loops. A number of unique discrete algorithms have also been developed, but little industrial acceptance has been found except in cases such as basis weight and moisture control on paper machines where dead time renders PID systems ineffective. This article is the third in a series comparing the performance of several discrete algorithms with three mode control, for processes in which time constants rather than dead time dominate. Complete generalization is not possible. However, comparisons will be based on a model of a jacketed backmix reactor, which is representative of many real processes.

INDEX TERMS: Automatic control, Process control, Digital control, PID controllers, PI controllers.

AMIC-10035

"GOLD TWIN-ELECTRODES IN THIN-LAYER ELECTROCHEMISTRY", MacKay, J. W., Allen, A. S., Analytica Chimica Acta, Vol. 67, No. 2, December 1973, pp 395-402.

The characteristics of a gold twin-electrode system in a thin-layer cell containing 0.1 M perchloric acid, and varying amounts of sodium chloride, were investigated by triangular sweep voltammetry. The 'adsorbed oxygen' layer starts to form above 1 V, and the peak from reduction of this layer shifts from 0.88 V to 0.65 V on changing the turn-around potential from 1.02 to 2.0 V. A distinct adsorption peak appears at 0.5 V, with cathodic peaks at 0.4 V and -0.1 V. Chloride adsorption is observed at 0.6 V, with desorption at 0.4 V. The dissolution of the gold electrode to gold(III) chloride occurs at 1.1 V; but this reaction is blocked above 1.2 V by the formation of the 'adsorbed oxygen' layer. The peak from the reduction of the gold(III) chloride is located at 0.7 V and is separable from the 'adsorbed oxygen' reduction peak. The electrode surface obtained from the reduction of gold(III) chloride shows characteristics different from those obtained by the reduction of the 'adsorbed oxygen' layer.

INDEX TERMS: Electrochemistry, Aqueous solutions, Chlorides, Ion selective electrodes, Twin electrode system, Triangular sweep voltammetry.

AMIC-10066

"PULSED D.C. MOTOR SPEED CONTROL FOR PORTABLE INSTRUMENTATION", Schnopp, W. W., Richardson, H. C., Instruments and Control Systems, Vol. 46, No. 12, December 1973, p 45.

Many environmental testing instruments require that air be moved at a given rate through a filter for a specific time. This filter is then removed, and the pollutants that have been collected are measured. Most of these instruments use a blower powered by a small DC motor whose speed must be adjustable in order to calibrate the instrument. Many units are designed for portable field use, operate on batteries and use a power consuming series dropping resistor to alter the speed of blower motor. An effective speed control can be implemented by generating a square wave at a constant frequency and varying the duty cycle of the square wave. Additionally, removal of the series resistor increases the motor torque at the slower speed. The design uses a 24-volt DC motor. The pulsed DC speed control is designed around an inexpensive integrated circuit (IC) timing module with a base frequency of 250 kHz. The output pulse train is fed to the base of the Darlington connected transistors. Motor requirements up to 1 A may be handled. A resistor reduces the 24-V motor supply to 12 V for use with the IC, and may be removed if a 12-V supply is available. This control may be used for DC motors with current requirements up to 400 mA.

INDEX TERMS: Instrumentation, Monitoring, Pulsed DC speed control, Motors.