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NOTICE

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

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

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REVIEWS OF CURRENT LITERATURE ON

ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 22

By

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NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM
ANALYTICAL QUALITY CONTROL LABORATORY

REVIEWS OF CURRENT LITERATURE ON ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 22 November, 1973

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

CONTENTS

AMIC-8298
"DETERMINATION OF TRACE FLUORINE IN BIOLOGICAL MATERIALS BY PHOTONUCLEAR ACTIVATION ANALYSIS", Ohno, S., Suzuki, M., Kadota, M., Yatazawa, M., Mikrochimica Acta, No. 1, 1973, pp 61-68.

Spinach leaves and rice were prepared for photonuclear activation analysis of fluorine by freeze drying, pulverizing, evaporating with NaOH, fusing the residue with sodium peroxide, dissolving the fused cake in distilled water, centrifuging, and adjusting the supernatant to pH 6-7. Powdered soil was prepared by fusing with sodium peroxide and following the procedures used for the plant samples. Sample solutions were then passed through an ion exchange resin (Dowex 1X8 and 50WX8) which was dried and sealed in a polyethylene bag for irradiation. Fluorine-18 was separated by adding a fluorine carrier solution and HCl to the sample, filtering, transferring the filtrate to a separator funnel and extracting with dimethyldichlorosilane in xylene. Activity was then measured on a TMC 100-channel pulse height analyzer and the results compared with those from standard solutions. Recoveries ranged from 85 to 91 percent, the detection limit was about 0.01 microgram, and precision was about plus or minus 11 percent. The extraction procedure apparently eliminated interference from iodine, bromine, and chlorine. The method is applicable to air, water, and other environmental materials in addition to biological and geological materials.

INDEX TERMS: Fluorine, Soil analysis, Separation techniques, Water analysis, Air, Sample preparation, Photonuclear activation analysis, Rice, Spinach, Chemical interference, Precision, Recovery, Detection limits.

AMIC-8302
"ANIONIC EXCHANGE SEPARATIONS OF THE ELEMENTS THAT CAN BE EXTRACTED WITH TRIBUTYL PHOSPHATE. II", Koch, W., Korkisch, J., Mikrochimica Acta, No. 1, 1973, pp 101-112.

A very sensitive and selective method for the spectrophotometric determination of germanium has been described employing pyrocatechol violet. Prior to the determination, the germanium is first accumulated by extraction with tributyl phosphate (TBP) and kerosene and then separated from the co-extracted elements, that interfere with the determination, by means of the strongly basic anion-exchanger Dowex 1,X8 in a mixture consisting of 30 vol. percent TBP, 60 vol. percent methylglycol and 10 vol. percent 12 N hydrochloric acid. In addition it was shown that this mixture is well suited to separate uranium quantitatively from germanium. The spectrophotometric determination of germanium is interfered with by V(V), Mo(VI), Ga(III), Tl(III), Sb(III), Sn(II) and Fe(III). The interference by iron can be averted by adding sodium-potassium tartrate.

INDEX TERMS: Chemical analysis, Separation techniques, Spectrophotometry, Germanium, Chemical interference.

AMIC-8304
"DETERMINATION OF SMALL AMOUNTS OF URANIUM AFTER CONCENTRATING THROUGH EXTRACTION AND ANIONIC EXCHANGE IN A SOLVENT AGENT SYSTEM CONTAINING TRI-N-OCTYLPHOSPHINE OXIDE", Korkisch, J., Koch, W., Mikrochimica Acta, No. 1, 1973, pp 157-168.

A method has been developed for the separation of uranium that is based on systematic studies of the behavior of uranium in various water-organic solvent systems containing tri-n-octylphosphine oxide (TOPO) towards various anion forms of the strongly basic anion exchanger Dowex 1,X8. In this procedure, the uranium is extracted from a 1 N hydrochloric acid solution containing ascorbic acid into diethyl ether and adsorbed from a mixture consisting of 50 vol. percent ether (0.1 N in TOPO), 45 vol. percent methylglycol and 5 vol. percent 12 N hydrochloric acid on the ion exchanger (chlorid form). Following elution with 1 M hydrochloric acid, the uranium is determined either fluorimetrically or spectrophotometrically by the thiocyanate method. By means of this anion exchange procedure, it is possible above all to separate the uranium from all ions interfering with its fluorimetric or spectrophotometric determination and also from TOPO itself. In particular, consideration is given to the spectrophotometric determination of the uranium in the presence of larger amounts of molybdenum, and a method was worked out for the removal of this element. (In German)

INDEX TERMS: Separation techniques, Pollutant identification, Uranium, Tri-n-octylphosphine oxide, Solvent systems, Preconcentration.

AMIC-8306
"SEPARATION AND IDENTIFICATION OF METAL DITHIZONATES BY THIN-LAYER CHROMATOGRAPHY AND ITS APPLICATION IN TOXICOLOGICAL ANALYSIS", Tewari, S. N., Bhatt, N., Mikrochimica Acta, No. 3, 1973, pp 337-340.

A quick and reliable method has been developed for the detection of toxic metals present in autopsy tissues and other biological materials, by complex formation and thin-layer chromatography. The study was restricted to the metal ions which form complexes with dithizone and are extractable at (1) pH 1-4 (i.e. Cu, Hg, Cd) and (2) pH 6-8 (i.e. Pb, Zn, Mn, Ni, Co). The thin-layer chromatographic investigation was carried out on Silica Gel-G plates. Autopsy tissues suspected of containing Cu were treated with a chloroform solution of dithizone with the pH of the medium being maintained between 1 and 4. Four developing agents were tested: carbon tetrachloride: chloroform (10:4), toluene, xylene, and benzene. No spray reagents were required as the spots of the metal complexes on the plates were colored. The R sub f values of the common metal complexes in the 4 solvents and the color of their respective spots on the TLC plates are given.

INDEX TERMS: Separation techniques, Pollutant identification, Heavy metals, Methodology, Solvent extractions, Chemical analysis, Toxins, Thin layer chromatography, Biological materials, Organic solvents, Metal dithizonates, Complexation, Toxicology.

AMIC-8311
"PYRIDINE KETOXIMES AS ANALYTICAL REAGENTS: THE SPECTROPHOTOMETRIC DETERMINATION OF COBALT WITH 2-PYRIDYL-2-THIENYL-BETA-KETOXIME", Notenboom, H. R., Holland, W. J., Billinghurst, R. G., Mikrochimica Acta, No. 3, 1973, pp 467-473.

The synthesis and characterization of 2-pyridyl-2-thienyl-beta-ketoxime (I) and its application to the spectrophotometric determination of trace amounts of cobalt by extraction of the resulting chelate from strong hydrochloric acid solution into chloroform are described. Under the conditions of analysis the chelate has a maximum absorbance of 412 nm with a molar absorptivity of 20,000 and a Sandell sensitivity of 0.0029 microgram/sq cm. The optimal pH range for chelate formation was 7.0-10.8; the addition of sufficient HCl to make the sample solution 1.2-3.4 M gave reproducible results. The Co chelate in 3 M HCl was stable for at least one week and the chloroform extracts for at least 2 hours. As little as 0.5 ml of reagent solution gave reproducible results. The chelate was completely extractable into chloroform and dichloromethane, partially extractable into methyl isobutyl ketone and benzene and non-extractable into hexane and carbon tetrachloride. A large number of ions did not interfere with the analysis; however, permanganate, chromate, disodium EDTA, fluoride, palladium, and platinum (2 and 4 plus) ions seriously interfered and must be absent from all determinations.

INDEX TERMS: Spectrophotometry, Cobalt, Pollutant identification, Aqueous solutions, Chemical analysis, Chromogenic reagents, 2-Pyridyl-2-thienyl-beta-ketoxime, Trace levels, Chemical concentration, Ionic interference, Metal chelates, Sample preparation, Precision, Accuracy, Chemical concentration.

AMIC-8561
"SOME CHEMICAL AND BIOLOGICAL CHARACTERISTICS OF THE MISSISSIPPI RIVER BORDERING IOWA", McDonald, D. B., In: Water 1972, AIChE Symposium No. 129, Vol. 69, 1973, p 280-372.

The portion of the Mississippi River which borders Iowa contains a variety of habitats, such as main channel, off-channel, lake, and slough areas, which support a wide variety of fish of sport and commercial significance. Over 50 species were identified in pool 14 alone. Studies of the water chemistry indicate that the water quality is good compared to streams within the state although there are limited stretches of river where deteriorated water quality conditions occur. Pollutants may also be introduced into the river as a result of runoff from agricultural land. Oxygen concentrations are usually adequate for fish life; however, low dissolved oxygen levels have been observed in slough areas accompanying the death and decay of large algal masses.

INDEX TERMS: Mississippi River, Water quality, Freshwater fish, Aquatic habitats, Water pollution effects.

AMIC-8721
"ORGANIC POLLUTANT IDENTIFICATION UTILIZING MASS SPECTROMETRY", McGuire, J. M., Alford, A. L., Carter, M. H., U. S. Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, Georgia, Report No. EPA-R2-73234, July 1973, 54 pp.

A system has been developed for the rapid identification of volatile organic water pollutants. It involves gas chromatography/mass spectrometry with computerized matching of mass spectra. Application of this system to the analysis of waste effluents revealed a significant number of pollutants that were not previously known to be present.

INDEX TERMS: Pollutant identification, Organic compounds, Polychlorinated biphenyls, Industrial wastes, Effluents, Organic pesticides, Computer programs, Data processing, Synthetic rubber, Organic wastes, Chemical analysis, GC-Mass spectrometry, Coal gasification, Data interpretation.

AMIC-8964
"EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM AS A MIXED LIGAND COMPLEX OF OXINE AND AZIDE", Rao, V. P. R., Anjaneyulu, Y., Mikrochimica Acta, No. 4, 1973, pp 481-490.

Vanadium, oxine and azide react at pH 3.5-4.5 to give a dark green solid which extracts into benzene giving dark green solution. The extract has absorption maxima at 415 nm and 620 nm with molar absorptivities 8650 and 6040 respectively. Spectrophotometric investigations reveal that the extracting species has V, HOx, and N3(-) in the ratio 1 to 2 to 2. Beer's law is obeyed up to 8.10 micrograms and 10.50 micrograms of vanadium per ml at 415 nm and 620 nm, respectively. The sensitivity of the color reaction is 0.0065 microgram per sq cm at 415 nm and 0.009 microgram per sq cm at 620 nm. The percent extraction of V was found to be 90. The formation constant and the free energy of formation are 8.3 to 8.7 times 10 to the 6th power and -9.91 to -9.31 Cal respectively at 30 C. The interference of various foreign ions was studied and methods are proposed for the elimination of the interference of some of those substances. Infrared and magnetic data of the solid complex are given.

INDEX TERMS: Separation techniques, Spectrophotometry, Aqueous solutions, Vanadium, Complexation, Sensitivity.

AMIC-9137
"NITROGEN SOURCES AND CYCLING IN NATURAL WATERS", Brezonik, P. L., University of Florida, Department of Environmental Engineering, Gainesville, Florida, Report No. EPA-660/3-73-002, July 1973, 177 pp.

Sources of nitrogen were reviewed to determine their significance in lacustrine budgets. Nutrients in rainfall were found significant although their variability obviates precise conclusions. Using literature values for nutrient export from various land uses, nutrient budgets were calculated for 55 Florida lakes. Critical N and P loading rates (above which eutrophication is likely) were estimated from the calculated budgets and lake trophic conditions. Algal fixation in two eutrophic Florida lakes was studied in detail; the total annual N fixed and factors affecting the occurrence of fixation were evaluated. A survey of fixation in 55 Florida lakes showed significant fixation only in eutrophic lakes. Bacterial fixation in the anoxic hypolimnion of a small lake contributed substantial nitrogen to the lake, and N fixing activity was found in both estuarine and lacustrine sediments. The acetylene reduction assay for N fixation was evaluated; short incubations were found essential. Reduction was light dependent and N2 acted as a competitive inhibitor. A preliminary experiment suggested that lacustrine sediments act as ammonia buffers; estuarine sediment sorbed ammonia strongly with little tendency to release ammonia to the water. Interferences from high organic color were evaluated for automated inorganic N and P analytical methods. Various amino acids were also shown to interfere with the indophenol ammonia procedure.

INDEX TERMS: Nitrogen, Cycling nutrients, Eutrophication, Nitrogen fixation, Lakes, Water pollution sources, Limnology, Water quality, Natural waters, Nutrient sources, Nutrient budget, Acetylene reduction, Nitrogen cycle, Organic nitrogen.

AMIC-9140
"DISTRIBUTION OF CAESIUM-137 IN BRITISH COASTAL WATERS", Jefferies, D. F., Preston, A., Steele, A. K., Marine Pollution Bulletin, Vol. 4, No. 4, August 1973, pp 118-122.

Water samples were collected from the Irish Sea, the northeast Atlantic, Scottish coastal waters, and the North Sea for analysis of Cs-137 emanating from the Windscale nuclear fuel reprocessing plant for the purpose of determining distribution patterns and dilution of this effluent. Cs-137 was determined by filtering seawater through a 0.22-millimicron membrane filter using one-step separation with either ammonium dodeca-molybdophosphate or potassium cobaltihexacyanoferrate followed by gamma spectrometry. More than 90 percent of the total cesium was retained in the filtrate. The data suggest that water leaving the Irish Sea through the North Channel moves round the coastline in a clockwise direction closely confined to the coastal margins of Scotland and then enters the northern North Sea, where its southern penetration may be detected as far south as the northern coast of England. This type of distribution has far-reaching implications for the fate of materials introduced to coastal waters since even Cs-137, which is relatively conservative in seawater, is largely confined in its distribution to inshore waters. Those materials which are less conservative and thus more rapidly removed from the water mass will be even more restricted in their distribution as a consequence. These general conclusions confirm once more the need to concentrate monitoring and surveillance operations in coastal waters, since the majority of pollutants are introduced regularly and in largest quantity at or near the shoreline.

INDEX TERMS: Distribution patterns, Radioactive wastes, Coasts, Water analysis, Sea water, Waste dilution, Separation techniques, Cesium-137, Gamma spectrometry.

AMIC-9188
"ANALYTICAL APPLICATIONS OF GAS CHROMATOGRAPHY OF METAL CHELATES", Barratt, R. S., Proceedings of the Society for Analytical Chemistry, Vol. 10, No. 7, July 1973, pp 167-170.

A general summary is given of methods of chelating metals, namely Be, Cr, Ni, Cu, and Co for analysis by gas chromatography. Chelating agents, recovery, detection limits, interferences, and chemical structures of several chelates are discussed. The use of gas chromatography for determination of chloride ions is also described.

INDEX TERMS: Heavy metals, Beryllium, Gas chromatography, Chlorides, Chelation, Chromium, Nickel, Copper, Cobalt, Detection limits, Recovery, Chemical interference.

AMIC-9195
"DETERMINATION OF TRACE AMOUNTS OF CHROMIUM BY ATOMIC ABSORPTION SPECTROMETRY WITH A TANTALUM FILAMENT ATOMIZER", Maruta, T., Takeuchi, T., Analytica Chimica Acta, Vol. 66, No. 1, August 1973, pp 5-11.

The effect of various foreign ions on chromium absorption in atomic absorption spectrometry was examined with a modified tantalum filament atomizer. The sample solution containing Cr was vaporized and atomized from a tantalum filament by electrical heating into an argon stream within an absorption chamber. All atomic absorption signals were recorded with the height of the absorption signal being used to determine the concentration of Cr. The highest absorption signal was obtained when the filament temperature level (1650 degrees) was the lowest. The detection limit of this method was found to be 0.94 pg and the sensitivity was 0.52 pg. Ten determinations using 6 ppm Cr solution gave a coefficient of variation of 2.8 percent. The effects of 100-, 50- or 10-fold weights of 12 different metal ions on the absorption signal in a 6 ppm Cr solution were measured at various temperatures. No interferences of Fe, Cu, Mn, Al or Na were observed irrespective both of concentrations and filament temperature levels; Fe did not interfere even at a 300-fold amount. No interference was observed at the 10-fold level with the exception of alkaline earth elements and V. The proposed technique is very rapid as a complete single analysis of the aqueous sample requires only 2 min. There are no memory effects between determinations. The most prominent advantages of the proposed method of atomization are its high sensitivity, simplicity and rapidity.

INDEX TERMS: Chromium, Aqueous solutions, Pollutant identification, Heavy metals, Chemical analysis, Alkaline earth metals, Temperature, Atomic absorption spectrophotometry, Ionic interference, Tantalum filament atomizer, Precision, Detection limits, Sensitivity.

AMIC-9211
"EXTRACTION OF BORIC ACID WITH ALIPHATIC 1,3-DIOLS AND OTHER CHELATING AGENTS", Egneus, B., Uppstrom, L., Analytica Chimica Acta, Vol. 66, No. 2, September 1973, pp 211-229.

Some 40 compounds have been investigated with reference to their boric acid extraction properties. Preliminary tests showed that aliphatic 1,3-diols with at least 6 carbon atoms possess superior extraction qualities compared to diketones, hydroxyketones, hydroxyamines and other species investigated. The 1,3-diols were then further studied with attention to size and steric configuration. The extraction equilibria involved were thoroughly investigated for 2,2-diphenylpropanediol-1,3 (DPPD). The constants derived showed that this diol, in spite of its large hydrophobic groups, has a smaller reaction constant than the previously investigated 2,2-diethylpropanediol-1,3 (DEPD) and 2-ethylhexanediol-1,3 (TMPD), which seems to form a very stable ester with boric acid in chloroform at room temperature. The ester formation is supported by n.m.r. and i.r. spectra. The effect of geminal substituents in the 2-position is discussed.

INDEX TERM: Separation techniques, Solvent extractions, Methodology, Aqueous solutions, Chelation, Boron, Chemical properties, Boric acid, Chelating agents, Chemical recovery, Aliphatic 1 3-diols, Infrared spectra, NMR spectra, Ultraviolet spectra, Aliphatic hydrocarbons, Reagents, Organic solvents, Esterification, Ketones, Amines.

AMIC-9221
"DETERMINATION OF ZINC BY FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY", Kurz, D., Roach, J., Eyring, E. J., Analytical Biochemistry, Vol. 53, No. 2, June 1973, pp 586-593.

The flameless atomic absorption method described is a simple, rapid, accurate microtechnique for determining zinc in aqueous solutions, serum, or urine. It requires no sample pretreatment, only 1.0 microliter of sample per determination, no correction for viscosity differences between sample and standard solutions, and is not subject to ionic or organic interference. The average recovery of added zinc in serum is 97.5 percent and in urine is 97.6 percent. The values obtained for serum (mean plus or minus SD: 94.6 plus or minus 11.0 micrograms/100 ml; N equals 25) and urine (range: 600-1000 micrograms/24 hr; N equals 4) are comparable to the values reported in the literature. The coefficient of variation was less than 5.0 percent in all cases. The qualitative concentration limit was 0.009 microgram/100 ml. The techniques and instrumentation described are also applicable to a number of trace minerals of common interest.

INDEX TERMS: Zinc, Aqueous solutions, Chemical analysis, Urine, Instrumentation, Pollutant identification, Anions, Cations, Biological samples, Flameless atomic absorption spectrophotometry, Serum, Ionic interference, Chemical recovery, Sample preparation.

AMIC-9215
"ATOMIC ABSORPTION AND FLUORESCENCE SPECTROMETRY WITH A CARBON FILAMENT ATOM RESERVOIR. PART XIV. THE DETERMINATION OF VANADIUM IN FUEL OILS", Everett, G. L., West, T. S., Williams, R. W., Analytica Chimica Acta, Vol. 66, No. 2, September 1973, pp 301-303.

The carbon filament atom reservoir technique for determining vanadium in aqueous media and Cu, Ag, and Ni in lubricating oils has been extended to include vanadium in petroleum products. A 10-ml sample solution was shaken with 2 M HCl for 5 min and separated. 0.1 percent 1-(2-pyridyl-azo-2-naphthol) (PAN) in ethanol was added to the acid layer and the pH adjusted to 4.0 with concentrated ammonia. The vanadium-PAN complex was then extracted with chloroform and analyzed. This method has an overall extraction efficiency of greater than 95 percent; the detection limit of V in the original sample is 0.007 ppm (w/w). The sensitivity of the method (1 percent abs.) was 0.013 pg and the detection limit (S:N equals 2) was 0.03 pg; the reproducibility for 15 replicates at the 10-ng level was plus or minus 4 percent.

INDEX TERMS: Chemical analysis, Pollutant identification, Instrumentation, Solvent extractions, Petroleum products, Fuel oil, Atomic absorption spectrophotometry, Fluorescence spectrophotometry, Carbon filament atom reservoir, Vanadium, Reproducibility, Precision, Detection limits, Sensitivity, Acid stripping.

AMIC-9226
"ION-EXCHANGE SEPARATIONS ON MIXED COLUMNS", Yamabe, T., Journal of Chromatography, Vol. 83, August 29, 1973, pp 59-65.

The separation of metal ions by elution with a solution containing a chelate-forming agent, namely an organic hydroxy acid (lactic acid or tartaric acid) was investigated by changing the mixing ratio (gamma) of the cation- and anion-exchange resins and by changing the pH of the eluent. When the concentration of lactic acid was 0.5 M at pH 2.8 and gamma equals 1/2, a mixed sample of Lu, Tm, Er, Ho, Dy, Tb and Gd was completely separated within 100 min. When the concentration of tartaric acid was 0.25 M at pH 3.0 and gamma equals 2, a mixed sample of Cu, Zn, Pb, Co and Cd was completely separated within 90 min.

INDEX TERMS: Separation techniques, Cations, Heavy metals, Anion exchange, Cation exchange, Hydrogen ion concentration, Mixed columns, Ion exchange chromatography, Ion exchange resins, Elution, Organic hydroxy acids, Rare earth elements, Lactic acid, Tartaric acid, Chelating agents.

AMIC-9231
"POTENTIALITY OF THE COUPLING OF COLUMN LIQUID CHROMATOGRAPHY AND FIELD DESORPTION MASS SPECTROMETRY", Schulten, H.-R., Beckey, H. D., Journal of Chromatography, Vol. 83, August 29, 1973, pp 315-320.

The first use of column liquid chromatography in combination with field desorption mass spectrometry is exemplified by the separation and identification of the components of a steroid mixture extracted from rat serum. There are two main reasons for the high-molecular-ion intensities obtained: (1) the smaller transferred energy in the field ionization process compared with other ionization modes increases the chance of detecting the intact molecular ions; and (2) the samples are not introduced via the commonly used direct introduction system for evaporation, but are applied to the field ion emitter from a solution using the emitter dipping technique. Hence ionization and desorption of the adsorbed molecules can be performed with minimum thermal stress. Potential applications for the coupling of liquid chromatography and field desorption mass spectrometry are discussed, especially in relation to the handling of the sample and the limits of detection.

INDEX TERMS: Separation techniques, Organic compounds, Pollutant identification, Column liquid chromatography, Field desorption mass spectrometry, Sample preparation, FD mass spectra, Detection limits, Steroids, Molecular ions.

AMIC-9235
"A HIGH-SPEED LIQUID CHROMATOGRAPH WITH A FLOW-SPECTROFLUORIMETRIC DETECTOR AND THE ULTRAMICRO-DETERMINATION OF AROMATIC COMPOUNDS", Hatano, H., Yamamoto, Y., Saito, M., et al., Journal of Chromatography, Vol. 83, August 29, 1973, pp 373-380.

A high-speed liquid chromatograph has been used with a new spectrofluorimetric detector, which is more sensitive than a normal ultraviolet absorption or spectrophotometric detector for fluorescent compounds. The spectrofluorimeter is equipped with double-beam optics and with a flow-cell, 3 microliters in volume, and is used to record the emission and excitation spectra of the separated components during the chromatographic separation by stopping the elution at peak maxima. This technique enables both qualitative identification and quantitative determination of the separated components. Selective recording of chromatograms is possible by varying the wavelengths for emission and excitation. The technique is demonstrated using mixtures of vitamins B2, B3, and B6, and of naphthalene, anthracene, pyrene, benz(a)anthracene, benz(a)pyrene and benz(e)pyrene have been separated and identified.

INDEX TERMS: Instrumentation, Chemical analysis, Aromatic compounds, Pollutant identification, Organic compounds, Laboratory equipment, Separation techniques, High speed liquid chromatography, Flow spectrofluorimetric detector, Quantitative analysis, Spectrofluorimetry, Trace levels, Sensitivity.

AMIC-9240
"MICRODETERMINATION OF ARSENIC(III) AND OSMIUM(VIII) THROUGH OSMIUM-THIOUREA REACTION", Naidu, P. P., Rao, G. G., Microchemical Journal, Vol. 18, No. 4, August 1973, pp 422-427.

The osmium-thiourea reaction described in previous methods for the determination osmium and arsenic was slow under the conditions utilized. A new method has been proposed for the rapid determination of osmium without waiting 30 minutes for the attainment of full color intensity. With this procedure only 1 ml of 1 percent thiourea is necessary. It was observed that arsenic(III) catalyzed the reaction. Based on this, qualitative and quantitative methods are described for the determination of both osmium and arsenic. Interference study of 30 ions showed they do not interfere.

INDEX TERMS: Chemical analysis, Aqueous solutions, Pollutant identification, Chemical reactions, Color reactions, Spectrophotometry, Cations, Anions, Alkali metals, Alkaline earth metals, Heavy metals, Arsenic, Osmium, Trace levels, Quantitative analysis, Ionic interference, Accuracy.

AMIC-9242
"APPLICATIONS, INVOLVING THE IODIDE ION. VIII. DIRECT AND INDIRECT DETERMINATION OF MERCURY(I) AND ANALYSIS OF MIXTURES. ANALYSIS OF CHROMIUM(VI)-CHROMIUM(III) MIXTURES. DETERMINATION OF HYPOCHLORITE", Khalifa, H., Issa, Y. M., Microchemical Journal, Vol. 18, No. 4, August 1973, pp 436-444.

Mercury(I), down to 3 ppm, has been accurately determined by direct titration with iodide or by back-titrating excess of iodide with mercury(II) using silver amalgam as the indicator electrode. The direct method and additional volumetric ones were applied to the rapid analysis of various mixtures involving mercury(I) with fair accuracy and precision. Analysis of Cr(VI)-Cr(III) mixtures involved potentiometric back-titration of excess iodide and of excess EDTA separately with mercury(II). Back-titration of excess iodide was successfully applied to the determination of hypochlorite.

INDEX TERMS: Mercury, Volumetric analysis, Chromium, Methodology, Iodides, Heavy metals, Aqueous solutions, Chemical analysis, Pollutant identification, Potentiometric titration, Hypochlorites, Mixtures, Accuracy, Precision, Detection limits.

AMIC-9268
"CURRENT STATUS OF THE ENVIRONMENTAL AND HUMAN SAFETY ASPECTS OF NITRILOTRIACETIC ACID (NTA)", Thayer, P. S., Kensler, C. J., CRC Critical Reviews in Environmental Control, Vol. 3, No. 4, September 1973, pp 375-404.

A review of the available experimental and field information on nitrilotriacetic acid (NTA) indicates a very low probability of environmental or human hazard at the maximally proposed levels of use in detergents. The probable average concentrations will be low, less than 25 parts per billion (ppb), in the domestic water supply and the high concentrations, 1,500 to 20,000 parts per million (ppm), required to produce adverse effects in animals appear to provide a more than adequate margin for safety. The probable effects on the environment, including contribution towards eutrophication of estuarine bodies of water, also appear to be minimal. The use of NTA in detergents should, however, be accompanied (1) by an environmental surveillance program to ensure that the probable low concentrations of NTA are the actual concentrations, and (2) a continuing research program to further assure environmental and human safety.

INDEX TERMS: Nitrilotriacetic acid, Environmental effects, Pollutant identification, Reviews, Public health, Biodegradation, Toxicity, Water pollution effects, Soil contamination effects, Surface waters, Water pollution sources, Fate of pollutants, Sensitivity, NTA chelates, Degradation products, Substrate utilization, Degradation pathways, Mobilization, Enzymatic inhibitors, Teratogenicity, Mutagenicity, Carcinogenicity, Metabolism, Animal physiology, Water pollution, Measurement, Path of pollutants, Sewage effluents, Sewage treatment, Rivers, Streams, Organic loading, Eutrophication, Plant growth.

AMIC-9270
"THE USE AND EFFECT OF MIXED STANDARDS OF THE QUANTITATION OF POLYCHLORINATED BIPHENYLS", Beezhold, F. L., Stout, V. F., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 1, July 1973, pp 10-15.

A study was made of the problems encountered when the chromatogram of a sample being analyzed for PCB's via GLC cannot readily be compared to a particular Aroclor standard. The use of mixed Aroclor standards was proposed and a study made of the effect of mixed standards on the analytical results. It was found that the choice of a standard could alter the values by more than a factor of 2. In addition, the particular mixture used as a standard should be reported along with resulting values.

INDEX TERMS: Polychlorinated biphenyls, Pollutant identification, Separation techniques, Aroclors, Chemical analysis, Quantitative analysis, Mixed standards, Animal tissues.

AMIC-9273
"POLYCHLORINATED TERPHENYLS IN PAPERBOARD SAMPLES", Thomas, G. H., Reynolds, L. M., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 1, July 1973, pp 38-41.

The detection, estimation, and confirmation of the identity of polychloroterphenyls (PCTs) as well as polychlorobiphenyls (PCBs) are described for paperboard and food packaging material. The sample is blended, and an aliquot Soxhlet extracted, concentrated, cleaned-up on Florisil, and subjected to a 'PCB split' on Florisil. For waxy samples, the residue from extraction is dissolved in 5 percent benzene in acetone with slight warming; the solution chilled in a dry ice/methanol bath for 3 min; the flocculent precipitate filtered; and the filtrate concentrated and treated as above. The PCT content of cleaned-up sample extracts is screened and quantified using gas chromatography. Approximately 100 paperboard samples have been analyzed with PCT levels of 0-163 ppm and PCB levels of 0-20 ppm. Two satisfactory gas chromatography systems have been developed for the estimation of PCTs.

INDEX TERMS: Chemical analysis, Pollutant identification, Polychlorinated biphenyls, Gas chromatography, Methodology, Estimating, Polychlorinated terphenyls, Paperboard, Packaging materials, Sample preparation.

AMIC-9275
"THE DETERMINATION OF PENTACHLOROPHENOL AND HEXACHLOROPHENE IN HUMAN ADIPOSE TISSUE", Shafik, T. M., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 1, July 1973, pp 57-63.

A method was developed for determining low levels of pentachlorophenol (PCP) and hexachlorophene (HCP) in human adipose tissue. 200 mg of adipose tissue were accurately weighed into a Duall tissue grinder to which hexane was added. The sample was mixed on a Vortex mixer and allowed to stand for about 30 min. The sample was then ground, washed with hexane, and combined with 10 percent NaOH. This mixture was then mixed on the Vortex mixer for 1 min and centrifuged to separate the 2 layers. Several extractions with hexane and diethyl ether were carried with the final hexane extract containing ethylated PCP and HCP being transferred to a silica gel microcolumn for separation. Identification was made by electron capture gas chromatography. Confirmation of the diethyl ether of hexachlorophene and the ethyl ether of pentachlorophenol was accomplished by mass spectral direct probe analysis. The limits of detectability for PCP and HCP in adipose tissue are 5 and 10 ppb, respectively. Samples from the pooled human fat weighing 100-300 mg were analyzed for both PCP and HCP using the procedure described in the analysis of adipose tissue. An average of 5 ppb PCP was found in six replicates and 30 ppb HCP in 10 replicates of human adipose tissue. Replicate samples of the pooled fat (100-300 mg) were spiked with 4.6 ng PCP and 10 ng HCP. The average recoveries of PCP and HCP from the replicates analyzed were 75 percent and 96 percent, respectively.

INDEX TERMS: Chemical analysis, Pollutant identification, Mass spectrometry, Electron capture gas chromatography, Adipose tissue, Pentachlorophenol, Trace levels, Quantitative analysis, Hexachlorophene.

AMIC-9276
"INTERCALIBRATION OF ANALYSES OF RECENTLY BIOSYNTHESIZED HYDROCARBONS AND PETROLEUM HYDROCARBONS IN MARINE LIPIDS", Farrington, J. W., Teal, J. M., Quinn, J. G., et al., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 129-136.

An intercalibration exercise has been conducted to determine the accuracy and precision of hydrocarbon analyses. Column chromatography or thin layer chromatography was used to isolate the hydrocarbons from other lipids. Gas chromatography was then used as a screening method to select hydrocarbon extracts which would be further analyzed by GC-mass spectrometry and other combinations of spectrophotometric and wet chemistry methods to determine the concentration of petroleum hydrocarbons in the samples. The presence or absence of the unresolved complex mixture signal in the hydrocarbon gas chromatograms served as the initial criterion for determining petroleum contamination. A homologous series of peaks in the chromatograms provided supplemental evidence of petroleum contamination which was then confirmed analytically. Three laboratories analyzed a reference sample (IDOE-5) consisting of cod liver lipids spiked with 371.8 ppm of a distillate cut (n-C16 to n-C28) of South Louisiana crude oil. The results were fairly accurate and agreed very well for the concentrations of both petroleum and recently biosynthesized pristane and squalene. Using GC as the initial screening method is fairly accurate and precise for hydrocarbons in the boiling range 287-450 C with a polarity suitable for column or thin layer chromatographic isolations. The methods as employed here would not detect asphaltenes; O, N, S containing aliphatic and cyclic compounds; nor concentrations of hydrocarbons much above or below the boiling range specified above.

AMIC-9276 (Continued) Card 2/2

INDEX TERMS: Lipids, Methodology, Calibrations, Pollutant identification, Isolation, Natural organics, Marine environment, Interlaboratory studies, Flame ionization gas chromatography, Petroleum hydrocarbons, Chemical composition, Chemical concentration, Column chromatography, Thin layer chromatography, Accuracy, Precision, Sample preparation.

AMIC-9281
"VOLTAMMETRIC IDENTIFICATION OF ORGANOCHLORINE INSECTICIDES, POLYCHLORINATED BIPHENYLS, POLYCHLORINATED NAPHTHALENES AND POLYCHLORINATED BENZENES", Farwell, S. O., Beland, F. A., Geer, R. D., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 157-165.

The need for an analytical method which would provide for the exact identification or 'fingerprinting' of chlorinated hydrocarbons in the environment prompted the study of the possibility of using a voltammetric detector. This detector could provide both gross classification, such as distinguishing between polychlorinated biphenyls (PCB) and polychlorinated naphthalenes (PCN), and identification of the specific isomer in each class of compound. This research represents the first in the voltammetric reduction of PCB's and PCN's and provides a preliminary description of the analytical methodology applicable to the rapid identification of these compounds. The apparatus used employed three-electrode potentiostatic control circuitry with interruptable linear voltage sweep control. All solutions were 0.5 mM in the electroactive species with dimethyl sulfoxide as the solvent and 0.1 M tetraethylammonium bromide as the supporting electrolyte. Nitrogen gas was used for deaeration. The voltage values for the compounds analyzed are tabulated.

INDEX TERMS: Pollutant identification, Polychlorinated biphenyls, Chlorinated hydrocarbon pesticides, Chemical analysis, Pollutants, Fingerprinting, Polychlorinated naphthalenes, Voltammetry, Voltammetric detector, Polychlorinated benzenes, Characterization, Chlorinated hydrocarbons, Isomers, Reduction potentials.

AMIC-9283
"A MODIFIED EXTRACTION METHOD FOR DETERMINATION OF MINERAL OIL IN SEA WATER", Hughes, D. R., Belcher, R. S., O'Brien, E. J., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 170-171.

Synthetic seawater samples for evalution of three oil-extraction procedures were prepared by adding sodium chloride to distilled water and spiking with 3.8 to 188 ppm Bass Strait Crude Oil. The three extraction techniques were (1) reciprocal shaking with carbon tetrachloride, (2) stirring with a stainless steel impeller with carbon tetrachloride, and (3) same procedure as (2) in an ultrasonic cleaning bath. Extractions were for 15 minutes, after which samples were allowed to stand overnight. Further separation was carried out in a separatory funnel. The third procedure required centrifuging to separate phases. Extracts were added to a Florisil column, eluted with carbon tetrachloride, and the summed infrared absorption determined for the eluate. Recoveries which were determined from calibration curves were best (mean value 102 percent) using the stirring-ultrasonic dispersion method.

INDEX TERMS: Water analysis, Sea water, Separation techniques, Oil, Recovery, Infrared absorption.

AMIC-9286
"THE DETERMINATION OF METHYL MERCURY IN URINE", Ross, R. T., Gonzalez, J. G., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 187-192.

Described is a modification of the above procedure for the determination of methyl mercury in urine employing a cysteine acetate cleanup procedure and analysis using the GLC-EC technique. A urine sample is pipetted into a stoppered centrifuge tube and acidified to pH 1 with concentrated HCl. Benzene is added to the mixture and shaken vigorously for 5 min. The emulsion was broken by centrifugation, and the organic layer removed by a disposable pipette. The urine is extracted again as described above. The organic layers were combined, and an aliquot was removed and extracted with cysteine acetate solution. The mixture was shaken vigorously, the layers separated, and an aliquot acidified to pH 1 with HCl and extracted with two portions of benzene. The benzene layers were combined, dried over anhydrous sodium sulfate and stored in a glass stoppered test tube until GLC analysis. This method is capable of detecting ppb of MMC and combines high recoveries and rapid analysis time in a single procedure. Since binding of MMC to urine constituents is fast and complete, acidification of the urine to pH 1-2 is absolutely necessary prior to benzene extraction. The cleanup procedure using cysteine acetate solution is also essential for the elimination of interfering GLC peaks.

INDEX TERMS: Urine, Methodology, Pollutant identification, Chemical analysis, Electron capture gas chromatography, Methylmercury, Sample preparation, Cleanup, Chemical recovery.

AMIC-9287
"TITRATION OF SULPHATE IN MINERAL WATERS AND SEA WATER BY USING THE SOLID-STATE LEAD ELECTRODE", Mascini, M., Analyst, Vol. 98, No. 1166, May 1973, pp 325-328.

A procedure is described for the determination of sulfate in the range 20 to 3000 p.p.m. in mineral and seawaters by using a lead-selective electrode. Chloride and hydrogen carbonate are separated from the sample by passing it firstly through a cation-exchange resin in the silver form, and secondly through a cation-exchange resin in the acid form. The solution recovered is titrated with standard lead nitrate solution. Phosphates, occasionally present in mineral waters, interfere with the sulfate determination. Based on several titrations carried out on standard solutions of sulfate and on seawater and mineral waters, the extent of error shows that the procedure is acceptable for routine analysis. The limit of sensitivity is about 10 ppm and the titration time is about 10 minutes.

INDEX TERMS: Mineral water, Sea water, Sulfates, Chemical analysis, Pollutant identification, Separation techniques, Lead electrodes, Potentiometric titration, Sample preparation, Chemical recovery, Sensitivity, Chemical interference, Precision.

AMIC-9288
"ANALYSIS OF HIGH-PURITY WATER BY FLAMELESS ATOMIC-ABSORPTION SPECTROSCOPY. PART II. SIGNAL INTEGRATION WITH A NON-RESONANCE LINE CORRECTION SYSTEM FOR SPURIOUS ABSORPTION PHENOMENA", Pickford, C. J., Rossi, G., Analyst, Vol. 98, No. 1166, May 1973, pp 329-334.

A polychromator has been used in conjunction with a multi-channel integration system and an automatic sample injection unit in graphite-tube flameless atomic-absorption spectroscopy. The precision of the system has been evaluated at high and low absorbances, and its ability to compensate for spurious absorption and variable volatility effects examined. The use of a non-resonance line correction system and integration of the absorption signal improves the precision of graphite-tube flameless atomic-absorption spectroscopy, particularly at low concentration levels. Some variations in signal intensity caused by changes in the volatility of the sample can be eliminated, and the compensation for spurious absorption phenomena is satisfactory up to 95 percent absorption, provided that the reference line is close to the resonance line of the main element. With the automatic sampler the system does represent a first approach to a fully automatic scheme for multi-element determinations by flameless atomic-absorption spectroscopy. The results achieved indicate the feasibility and the applicability of such a system, particularly when a limited number of elements have to be determined on a routine basis or when the limited size and the nature of the sample (toxicity and activity) could make cumbersome or impossible the determination of more elements.

INDEX TERMS: Chemical analysis, Heavy metals, Automatic control, High purity water, Flameless atomic absorption spectrophotometry, Multielemental analysis, Graphite tube.

AMIC-9292
"GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF CHLORFENVINPHOS IN MILK, EGGS, AND BODY TISSUES OF CATTLE AND CHICKENS", Ivey, M. C., Oehler, D. D., Claborn, V. H., Journal of Agricultural and Food Chemistry, Vol. 21, No. 5, September/October 1973, pp 822-824.

A reliable and sensitive gas liquid chromatographic method is described in which a flame photometric detector is used to determine micro amounts of chlorfenvinphos in the milk and body tissues of cattle and in the body tissues, eggs, and manure of chickens. With extraction and cleanup, 0.002 ppm of the insecticide could be detected in milk and 0.001 ppm in body tissues and eggs. Recoveries of 83-100 percent were obtained from the fat, muscle, kidney, liver, and heart of cattle and from the fat, muscle, liver, skin, and manure of chickens. Recoveries of 93 percent were obtained from milk and 81 percent was obtained from eggs.

INDEX TERMS: Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Milk, Poultry, Cattle, Pollutant identification, Pesticide residues, Flame photometric gas chromatography, Animal tissues, Chlorfenvinphos, Chemical recovery, Sample preparation, Cleanup, Detection limits, Sensitivity.

AMIC-9293
"PICLORAM PHOTOLYTIC DECOMPOSITION", Mosier, A. R., Guenzi, W. D., Journal of Agricultural and Food Chemistry, Vol. 21, No. 5, September/October 1973, pp 835-837.

Irradiation of a 0.00208 M aqueous solution of the picloram sodium salt with 300-380 nm ultraviolet light resulted in 99 percent degradation of the parent compound within 72 hr. After 5, 15, 25, 34, and 48 hr of irradiation, the amounts of picloram degradation were 15, 27, 31, 61, and 90 percent, respectively (all picloram solutions were analyzed as the methyl ester, solutions were methylated by diazomethane). After 34 hr of irradiation, 11 visually observable degradation products, excluding the spot of origin (spot no. 1) and parent compound (spot no. 13), were separated by tlc. Eight of these spots had radioactivity above background, which indicated that the carboxyl carbon (C-14) was still intact. No radioactivity was detected in the other three compounds, spots 5, 6, and 8, indicating decarboxylation. During photolysis, two chloride ions were produced per molecule of picloram photolyzed. Evidence was obtained to suggest that both a free radical and an ionic mechanism are involved in the photolysis of picloram. The overall reaction proceeds by a nonchain mechanism.

INDEX TERMS: Aqueous solutions, Chemical analysis, Radioactivity techniques, Pollutant identification, Chlorinated hydrocarbon pesticides, Path of pollutants, Fate of pollutants, Picloram, Photodecomposition, Quantitative analysis, Electron capture gas chromatography, Thin layer chromatography, Degradation products, Degradation pathway.

AMIC-9294
-rates and products of decomposition of 2,2-DIBROMO-3-NITRILOPROPIONAMIDE", Exner, J. H., Burk, G. A., Kyriacou, D., Journal of Agricultural and Food Chemistry, Vol. 21, No. 5, September/October 1973, pp 838-842.

Rates and products of decomposition of 2,2-dibromo-3-nitrilopropionamide (DBNPA), an antimicrobial compound for industrial water treatment, were determined over a range of conditions. Rates of hydrolytic decomposition, determined polarographically at various pH's and temperatures, are consistent with acid- and base-catalyzed amide hydrolysis. Hydrolysis of DBNPA ultimately forms carbon dioxide, ammonia, and bromide ions via the following sequence of degradation products: dibromoacetonitrile, dibromoacetamide, dibromoacetic acid, glyoxylic acid, and oxalic acid. DBNPA reacts rapidly with various ions such as bisulfite to form cyanoacetamide. Decomposition under the influence of sunlight also leads to cyanoacetamide. Contact with soil and soil organisms degrades DBNPA. Decomposition of DBNPA by several chemical and biological pathways ensures that the compound will not persist in the environment.

INDEX TERMS: Microbial degradation, Hydrolysis, Pesticide kinetics, Environmental effects, Hydrogen ion concentration, Temperature, Chemical analysis, Pollutant identification, Soil contamination, Water pollution, Degradation rates, Degradation products, Biocides, Nucleophiles, Photodecomposition, 2 2-Dibromo-3-nitrilopropionamide, Fate of pollutants.

AMIC-9295
"PERSISTENCE OF ENDOTHALL IN AQUATIC ENVIRONMENT AS DETERMINED BY GAS-LIQUID CHROMATOGRAPHY", Sikka, H. C., Rice, C. P., Journal of Agricultural and Food Chemistry, Vol. 21, No. 5, September/October 1973, pp 842-846.

A gas chromatographic method was used to determine the residues of endothall in both the water and hydrosoil of a farm pond and of laboratory aquaria. The bulk of endothall added to the aquaria remained in the water during the course of the experiment. Both in the pond and in the aquaria, the herbicide persisted in the hydrosoil for a longer period than in the water. In the pond treated with approximately 2 ppm of endothall, the herbicide could not be detected in the water and top 1 in. of the hydrosoil 36 and 44 days after treatment, respectively. In the aquaria treated with 2 and 4 ppm, endothall was reduced to nondetectable levels in the water within 7 days after treatment. It took 2 and 4 weeks for the herbicide in the hydrosoil to reach a level of less than 0.1 ppm in the aquaria treated with 2 and 4 ppm, respectively. The rate of endothall dissipation in the aquaria was similar at both application rates.

INDEX TERMS: Persistence, Pesticide kinetics, Aquatic environment, Pesticide residues, Radioactivity techniques, Herbicides, Water analysis, Hydrosols (soils), Soil analysis, Aquaria, Pollutant identification, Endothall, Gas liquid chromatography, Fate of pollutants, Chemical recovery, Detection limits, Sample preparation, Farm ponds.

AMIC-9296
"PHOTOLYSIS OF PARATHION (O,O-DIETHYL-O-(4-NITROPHENYL)THIOPHOSPHATE). NEW PRODUCTS", Grunwell, J. R., Erickson, R. H., Journal of Agricultural and Food Chemistry, Vol. 21, No. 5, September/October 1973, pp 929-931.

Solutions of parathion and paraoxon were irradiated at 2537 A for varying amounts of time and for 6 hr, respectively, in order to identify the photolytic products. Photoproducts were identified by gas liquid chromatographic retention time, mass spectra, and infrared spectrum and by comparison with an authentic sample. O,O,S-Triethylthiophosphate was identified as the major product of the photolysis of parathion in aqueous THF or ethanol. Minor products were O,O,O-triethylthiophosphate, paraoxon, and triethylphosphate, which was formed by secondary photolysis of paraoxon.

INDEX TERMS: Aqueous solutions, Pollutant identification, Phosphothioate pesticides, Degradation (decomposition), Irradiation, Photolysis, Parathion, Degradation products, Paraoxon.

AMIC-9299
"CHARACTERIZATION OF WASTE EFFLUENTS FROM A COMMERCIAL PIMIENTO CANNING OPERATION", Bough, W. A., Journal of Milk and Food Technology, Vol. 36, No. 7, July 1973, pp 371-374.

Composite samples of liquid effluents taken at each unit operation in pimiento processing every 30 min over a 2-hr period were passed through a 20-mesh screen to remove particulate material and analyzed in duplicate for the following characteristics: total, fixed, volatile, suspended, dissolved, and settleable solids; pH; total acidity; COD; and 5-day BOD. Flow rates were determined with a trapezoidal weir which was placed in the rectangular gutters carrying the effluents. Characterization of the unit effluents revealed significant patterns of difference in composition and flow rates. The most concentrated effluent occurred in the first stage of the processing operation where the roasted peel was removed by washing. The suspended solids load of this effluent accounted for 69 percent of the total suspended solids load and 37 percent of the COD load, but only 18 percent of the total flow. Segregation and separate treatment of this concentrated effluent is suggested to reduce the total waste load. Another concentrated effluent resulted from the citric acid dip before the packing and closing area. The flow of the effluent was only 10 percent of the total, but accounted for 32 percent of the total dissolved solids and 37 percent of the total BOD. Two effluents from the grading area accounted for 50 percent of the total flow and only 10 percent of the total COD load. Recycling of these dilute effluents to the peel removal operation is suggested. Based on the rate of processing, the total wastes produced from pimiento canning contained 3.2, 60.2, and 35.4 lb. of suspended solids, COD, and BOD, respectively, per ton of raw pimientos. The total waste flow was 4,840 gal. per ton.

AMIC-9299 (Continued) Card 2/2

INDEX TERMS: Effluents, Flow rates, Waste identification, Industrial wastes, Food processing industry, Chemical analysis, Sampling, Pollutant identification, Pimiento cannery, Characterization, Sample preparation.

AMIC-9304
"ANALYZING HEAVY ENDS OF CRUDE", Thompson, C. J., Dooley, J. E., Hirsch, D. E., Ward, C. C., Hydrocarbon Processing, Vol. 52, No. 9, September 1973, pp 123-130.

A systematic procedure which utilizes isothermal and molecular distillation, chemical treatment, silica-alumina gel chromatography, gel permeation chromatography and spectrometry has been developed by the Bureau of Mines for the separation and characterization of heavy ends of petroleum. Some aspects of the procedure are described and applied to a 370-535 C (700-1000 F) distillate from Gach Saran, Iran, crude oil. In this application chromatography is utilized through anion and cation exchange resins to separate acids and bases, followed by chemical treatment with FeCl3 to remove neutral nitrogen compounds. The distillate, then essentially free of acids, bases and neutral nitrogen compounds, is passed through a dual silica-alumina gel adsorption column, using gradient elution, to produce four well-defined concentrates; namely, saturates, monoaromatics, diaromatics and polyaromatic-polar compounds. Mass spectra were used to identify the general composition of each concentrate. A combination of gel permeation, mass spectrometric and nuclear magnetic resonance data were then used to further evaluate the adsorption concentrates of the distillate. The entire procedure reported in this study is schematically outlined.

INDEX TERMS: Chemical analysis, Methodology, Separation techniques, Pollutant identification, Crude oil, Heavy distillates, Oil characterization, Gach Saran crude oil, Chemical composition, Petroleum distillates, Saturates, Monoaromatics, Diaromatics, Polyaromatic-polar compounds.

AMIC-9308
"THE FORMATION OF WATER-IN-OIL EMULSIONS SUBSEQUENT TO AN OIL SPILL", MacKay, G. D. M., McLean, A. Y., Betancourt, O. J., Johnson, B. D., Journal of the Institute of Petroleum, Vol. 59, No. 568, July 1973, pp 164-172.

A series of experiments were carried out to obtain more information on the extremely stable water-in-oil emulsions formed when some hydrocarbon products are spilled at sea. It was established that the agent responsible for the stability was not a discrete chemical entity but was an asphaltenic type substance. The mechanism resulting in the stabilizing effect does not involve electrical double layer interaction, but is due to the mechanical strength of the asphaltenic layer encapsulating each water droplet.

INDEX TERMS: Oil spills, Chemical properties, Oil-water interfaces, Stability, Emulsifie Emulsifiers, Chemical analysis, Mass spectrometry, Isolation, Water-in-oil emulsions, Emulsification, Asphaltenes, Crude oil, Stabilizing agent, Gas oil, Naphtha, Asphalt.

AMIC-9310
"COMPLEX BEHAVIOUR OF COBALT IN THE DANUBE RIVER", Radosavljevic, R., Tasovac, T., Draskovic, R., et al., Archiv fur Hydrobiologie, Suppl. 44, No. 2, March 1973, pp 241-248.

As a part of a program for investigating the pollution of the Danube and studying the behaviour of different pollutants introduced in the river, systematic investigations of the content of Cobalt-60 and inactive isotope have been carried out and their concentrations in water, suspended material, bed sediments, plankton and other components determined. The capture of cobalt by suspended particles and bed sediments has been studied. The behaviour of cobalt in the Danube River is complex and depends on many parameters. The interdependences between the content of cobalt in water and dispersed components in the river, biomaterials, macro-and-microchemical elements indicate that biogeochemical transport in the river is very heterogenous and depends on hydrodynamical conditions. The empirical curves of cumulative frequency distributions of particular levels of cobalt in the cross-section of the river at the kilometer 1144 and 1137 have log-normal distributions and confirm that hydrodynamical conditions in the river plays an important role in transport of cobalt. Results of field and laboratory experiments are presented.

INDEX TERMS: Cobalt, Bottom sediments, Plankton, Suspended solids, Path of pollutants, Hydrobiology, Aquatic animals, Water pollution, Chemical analysis, Danube River, Transport, Chemical concentration, Bioaccumulation, Animal tissues.

AMIC-9312
"A COMPARISON OF THE CONTENT OF MICROELEMENTS IN THE WATER OF THE RIVER DANUBE NEAR VIENNA AND BELGRADE FOR 1961-1970", Frantz, Von A., Draskovic, R. J., Tasovac, T., et al., Archiv fur Hydrobiologie, Suppl. 44, No. 2, March 1973, pp 258-262.

The Federal Institute of Hydrobiology and Waste Water Research in Vienna, Austria, and the Boris Kidric Institute of Nuclear Sciences in Belgrade, Yugoslavia, started systematic investigations of the River Danube to determine the amount of microelements by means of neutron activation analysis in dependence of place and time. Results of 1961-1970 are presented. (In German)

INDEX TERMS: Water analysis, Chemical analysis, Neutron activation analysis, Pollutant identification, Heavy metals, Time, Chromium, Iron, Cobalt, Sodium, Spatial distribution, Temporal distribution, Alkali metals, Danube River, Scandium, Antimony, Lanthanum, Rare earth elements.

AMIC-9335
"INTERPRETATION OF INFRARED SPECTRA USING PATTERN RECOGNITION TECHNIQUES", Liddell, R. W., III, Jurs, P. C., Applied Spectroscopy, Vol. 27, No. 5, September/October 1973, pp 371-376.

The pattern recognition technique utilizing adaptive binary pattern classifiers has been applied to the interpretation of infrared spectra for carbonyls, cyclohexanes, alcohols, ketones, esters, benzene, and ethers. The binary pattern classifiers were trained to determine the chemical classes of x-y digitized infrared spectra. High predictive abilities were obtained in classifying unknown spectra. A new training procedure for binary pattern classifiers was developed and used to classify ir spectra into chemical classes. Pattern classifiers trained in the conventional way and by the new procedure were used in conjunction with feature selection, and it is shown that a small fraction of the data is necessary to classify these infrared spectra successfully into chemical classes.

INDEX TERMS: Computer programs, Data processing, Pollutant identification, Organic compounds, Infrared spectra, Pattern recognition, Carbonyls, Cyclohexanes, Ketones, Esters, Benzene, Ethers.

AMIC-9346
"THE SPREADING OF HEAVY METALS IN FLOWING WATERS IN THE REGION OF OCCURRENCE OF NATURAL DEPOSITS AND OF THE ZINC AND LEAD INDUSTRY", Pasternak, K., Acta Hydrobiologica. Cracow, Vol. 15, No. 2, 1973, pp 145-166.

Waters from channels, streams, and rivers in the area of lead and zinc mining (Boleslaw) were analyzed for Cu, Zn, Pb, Cd, Mn, Cr, Co, Mo, Sr, and Ba to investigate the contribution of these industries to metal concentrations in the water. Samples were collected in polyethylene bags and prepared for determination of microelements (except Sr) by evaporating and dissolving the residue in nitric acid. Determinations were made by atomic absorption spectroscopy. It was found that these industries contribute significant amounts of Zn, Pb, and Cd to the receiving waters, and these metals may be transported considerable distances. Lead content decreases the fastest and zinc content the slowest as the distance from the pollution source increases. The natural occurrence of lead and zinc ores in the deeper rock layers does not to any extent influence the surface waters with pH about 8.1 and with high total hardness. The increase in the content of zinc, lead, and cadmium in the water of the investigated water courses is mainly connected with the industrial pollution. The quantitative level of these three heavy metals shows a distinct tendency to increase in the autumn-winter season. The occurrence of calcium-dolomite rocks in the catchment basin of the investigated water courses is revealed in the chemism of the water by an exceptionally high content of magnesium and a low content of manganese and copper.

INDEX TERMS: Distribution, Heavy metals, Mine wastes, Water pollution sources, Copper, Zinc, Lead, Cadmium, Manganese, Chromium, Cobalt, Molybdenum, Strontium, Barium.

AMIC-9350
"ACCUMULATION OF FOSSIL CO2 IN THE ATMOSPHERE AND THE SEA", Fairhall, A. W., Nature, Vol. 245, No. 5419, Xeptember 7, 1973, pp 20-23.

A model showing the relationship between the accumulation of CO2 in the atmosphere from fossil fuels and the levels in the sea predicts that the rapid increase in atmospheric CO2 will cause the sea to become undersaturated in CaCO3. The possible result of this undersaturation is that coral reefs and shells of organisms would tend to dissolve. The model is based on the premise that the long lived terrestrial biosphere and humus are not significant sinks for fossil CO2 emissions. The author cautions that the predictions of the model remain to be validated and the effect of undersaturation of CaCO3 on calcareous organisms is not presently known.

INDEX TERMS: Mathematical models, Carbon dioxide, Water pollution effects, Mollusks, Calcium carbonate, Sea water, Fossil fuels.

AMIC-9352
"PRINTOUT COLORIMETER FOR AUTOANALYSIS OF WATER POLLUTION", Snaddon, X. V. M., Mayo, S. A., Cope, J., Process Biochemistry, Vol. 8, No. 9, September 1973, pp 15-17.

A dual-beam colorimeter was developed to perform routine and continuous monitoring for the Upper Tame Mine Drainage Authority. The criteria for the system were that it be reliable, automatic correction of electronic drift be provided, discrimination between channels be provided with a means of detecting plateaus and peaks and converting these maxima into concentration units, results be displayed in digital form, and sample identification be included with results. The system consists of four basic sections: the input amplifiers, linearizer, and subtractor; the analog to digital converter and maximum memory system; the digital output stage; and the power supplies. The optical system is designed to withstand dropping without damage. Results of determinations of COD agreed closely with those obtained by other methods. Use of the system to determine ammonia-nitrogen and nitrite revealed that temperature variations and oxidation of reagents affected results. Suggestions are given for coupling alarms, automatic shutoff, and data accumulation systems to the colorimeter.

INDEX TERMS: Colorimetry, Water analysis, Instrumentation, Automatic control, Design criteria, Chemical oxygen demand, Ammonia, Nitrites.

AMIC-9355
"SAMPLING TECHNIQUES IN CHROMATOGRAPHY", Karasek, F. W., Research/Development, Vol. 24, No. 9, September 1973, pp 54-57.

Methods and problems associated with sample introduction in gas chromatography are discussed. The most widely used method employs a syringe to inject the sample through a septum. Reproducibility is plus or minus 1 percent. However, problems such as septum leakage, sample blow-back in the syringe, and nonlinear volatilization of sample may destroy the accuracy of results. Valves have also been developed for sample injection. These can perform many thousands of sample injections (versus 50-80 for a septum) and can be used for backflushing, column or sample selection; detector switching, and concentration techniques. Valves also are frequently used in process chromatographs under automatic control and provide reproducibility of better than plus or minus 1 percent. Many of the procedures used with GC are useful for liquid chromatography.

INDEX TERMS: Gas chromatography, Sample injection, Syringes.

AMIC-9359
"CHLORODIOXINS IN PESTICIDES, SOILS, AND PLANTS", Helling, C. S., Isensee, A. R., Woolson, E. A., et al., Journal of Environmental Quality, Vol. 2, No. 2, April/June 1973, pp 171-178.

Chlorodioxins, such as 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (TCDD), are highly toxic impurities found in certain pesticides. A review is made of (1) the sources and toxicology of TCDD and its relationship to the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), and (2) pesticide analyses and soil-related environmental studies of TCDD conducted by the U. S. Department of Agriculture. TCDD was persistent and immobile in soils. The dioxin was not detected, however, 6 years after abnormally high applications of 2,4,5-T to Lakeland sand. TCDD was not photodegraded on soil and only slightly, in aqueous suspension. Plants grown in soil containing 0.06 ppm TCDD had no detectable quantity (less than or equal to 1 ppb) at maturity. It was not translocated when applied to leaves, but washoff or volatilization occurred. TCDD was undetected (less than 50 ppb) in 19 bald eagle (Haliaeetus leucocephalus) carcasses.

INDEX TERMS: Soil contamination, Vegetation, 2 4 5-T, Pesticide kinetics, Toxicity, Water pollution sources, Persistence, Volatility, Absorption, Translocation, Chlorodioxins, Toxicology, Pesticide formulations, Impurities, Chlorodibenzo-p-dioxins, Teratogenicity, Photodecomposition.

AMIC-9366
"DISSIPATION AND PHYTOTOXICITY OF DICAMBA RESIDUES IN WATER", Scifres, C. J., Allen, T. J., Leinweber, C. L., Pearson, K. H., Journal of Environmental Quality, Vol. 2, No. 2, April/June 1973, pp 306-309.

A study was conducted to evaluate (1) the influence of several environmental factors on dicamba dissipation from water, and (2) the biological significance of dicamba residues in water relative to growth and development of several crop species. Two south-central Texas ponds (only one was vegetated) were surface-sprayed with the dimethylamine salt of dicamba, and samples were taken and analyzed at 1, 3, 5, 7, 12, 15 and 20 days after treatment and thereafter at about 7-day intervals for an additional 70 days. Dicamba dissipation was studied under controlled greenhouse conditions using polyethylene containers under fluorescent lights. Dicamba concentrations in field samples were estimated using mustard seedling bioassay, spectrophotometric, and GLC techniques. Three greenhouse studies were conducted to evaluate seedling response of several crops to preemergence irrigation with water containing the herbicide. The herbicide dissipated most rapidly from water under non-sterile, lighted conditions. Pond sediment evidently contained microbial populations capable of decomposing the herbicide. Temperature was crucial in dicamba dissipation, especially in the presence of sediment. Influence of sediment on dissipation rate of dicamba was apparently augmented by light in some cases. Under summer conditions, dicamba at 4.4 kg/ha per surface area of ponds dissipated at about 1.3 ppm/day. Dicamba dissipated as a logarithmic function of concentration with time. Reaction of seedling crops to irrigation water containing dicamba varied among species and cultivars. Relative tolerance from these studies was ranked from most to least tolerant as follows: sorghum greater than cotton greater than cucumbers.

AMIC-9366 (Continued) Card 2/2

INDEX TERMS: Pesticide kinetics, Pesticide toxicity, Phytotoxicity, Water pollution effects, Pesticide residues, Environmental effects, Chlorinated hydrocarbon pesticides, Water analysis, Pollutant identification, Water pollution sources, Laboratory tests, Resistance, Plant growth, Bioassay, Dicamba, Seedling crops, Dissipation, Fate of pollutants, Data interpretation.

AMIC-9369
"SEASONAL CHANGES IN THE ORGANIC FORMS OF CARBON, NITROGEN AND PHOSPHORUS IN SEA WATER AT E1 IN THE ENGLISH CHANNEL DURING 1968", Banoub, M. W., Williams, P. J. leB., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 3, August 1973, pp 695-703.

Water samples were collected at monthly intervals during 1968 at Station E1 in the English Channel for analysis of organic C, N, and P to determine seasonal variations. Two aliquots from each sample were filtered for particulate N and C analysis through two glass fiber filters, one for analysis of organic C and one for organic N. The filtrate was frozen in clean bottles until analysis. The filters were washed with K_2SO_4 and H_2SO_4 to remove inorganic carbonates and stored in solid CO_2. Particulate organic C was measured by infrared analysis of CO_2 formed by combustion. Particulate N was measured by Kjeldahl combustion followed by colorimetric determination of ammonia by conversion to indophenol blue. Dissolved organic C was analyzed by the method of Menzel and Vaccaro (1964), total N and P were determined by uv irradiation; and chlorophylls were determined according to the recommendations of the SCOR/UVESCO report (1966). The average integral mean values were: dissolved organic carbon, 780 micrograms C/l; dissolved organic nitrogen, 64 micrograms N/l; dissolved organic phosphorus, 3.8 micrograms N/l. Dissolved organic carbon and the particulate organic carbon and nitrogen showed increases subsequent to the spring bloom; such increases were less evident in the dissolved organic nitrogen results and not apparent in those of dissolved organic phosphorus.

INDEX TERMS: Water analysis, Seasonal, Carbon, Nitrogen, Phosphorus, English Channel.

AMIC-9371
"THE DISTRIBUTION OF TRACE METALS AND FAUNA IN THE FIRTH OF CLYDE IN RELATION TO THE DISPOSAL OF SEWAGE SLUDGE", Halcrow, W., MacKay, D. W., Thornton, I., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 3, August 1973, pp 721-739.

Sediment, water, and fauna were collected from the Firth of Clyde during September, 1971 to January, 1972 for analysis of heavy metals resulting from disposal of sewage sludge. Procedures for sample preparation are given. Ca, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn in sediments was determined by atomic absorption. Ag was determined by optical emission spectroscopy, and As, Mo, Sn, and V by colorimetry. Fauna were homogenized, and water was solvent extracted and preconcentrated for AA analysis. Only liver and muscle were analyzed from fish. Mercury in sediments was determined by cold-vapor AA after drying and acid digestion. Results show maximum ranges of Cu, Pb, and Zn to be confined to a relatively small area within 2 km of the center of the dumping area. Hg showed a similar pattern with peak concentrations of 1820 ng/g at the center of the dumping site. Pb and Zn contents were also high at sites further up the Clyde; however, no evidence of large-scale transport was found. Organic carbon contents were 3-8 percent compared with background levels of 0.3-2.2 percent. Epifaunal species showed rather erratic variation in trace metal content, unrelated to total or readily extractable trace metals in the underlying sediment. The trace-metal content of demersal fish species was not significantly different from figures reported for elsewhere in the United Kingdom. The distributions of some in-faunal and epifaunal species in the area are described. It is concluded that the effects of sewage sludge disposal in this area are local, gross changes being limited to an area of about 20 sq km of sea-bed. However, little is known of the overall effects of toxic wastes particularly at threshold levels, and further monitoring is required.

AMIC-9371 (Continued) Card 2/2

INDEX TERMS: Water analysis, Heavy metals, Sediments, Sludge disposal, Benthic fauna, Marine fish, Calcium, Cadmium, Chromium, Copper, Iron, Manganese, Nickel, Lead, Zinc, Mercury, Carbon, Atomic absorption spectrophotometry, Sample preparation, Silver.

AMIC-9372
"AN IMPROVED BOTTOM-WATER SAMPLER", Joyce, J. R., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 3, August 1973, pp 741-744.

A sampler for collecting water at predetermined points above the sediment-water interface consists of a frame containing six inverted PVC bottles. The bottom of each bottle has a hole drilled in it which is fitted with a simple prespex flap valve. Silico-rubber tubing is attached to the neck of each bottle and passes through a trigger bar which is connected to an actuating weight and two support bars. The tubes pass through holes in the side plating at different (interchangeable) levels to collect samples at predetermined points above the sediment. The sampler can be actuated at any depth. This device has been successfully used in a study of the Tawe estuary, where a bottom layer of high-turbidity, low-salinity water has been discovered.

INDEX TERMS: Sampling, Mechanical equipment, Water, Design criteria, Bottom water sampler.

AMIC-9379
"IRON, ZINC, MAGNESIUM, AND COPPER CONCENTRATIONS IN BODY MEAT OF THE BLUE CRAB, CALLINECTES SAPIDUS", Boon, D. D., Chesapeake Science, Vol. 14, No. 2, June 1973, pp 143-144.

Body meat of the blue crab, Callinectes sapidus, was analyzed by atomic absorption for iron, zinc, magnesium, and copper. Samples were taken biweekly from May 6, 1971 to April 19, 1972, a total of twenty-six determinations over a one-year period. For each determination, a one pound can of unpasteurized 'regular' or 'special' crab body meat was purchased locally. One hundred grams of this meat were homogenized with 100 g of distilled water in a high speed blender and acid digested. Concentrations found were as follows: iron, 7-66 ppm; zinc, 36-68 ppm; magnesium, 384-527 ppm; and copper, 5-97 ppm. Concentrations of copper were high during May, 1971, but no seasonal trend was found. Iron and copper values were near those found by other investigators in 1939; magnesium contents were higher.

INDEX TERMS: Copper, Iron, Zinc, Magnesium, Blue crab, Sample preparation, Atomic absorption spectrophotometry.

AMIC-9394
"ANALYSIS OF ALKYL ETHOXYLATES BY NMR", Cross, C. K., MacKay, A. C., Journal of the American Oil Chemists' Society, Vol. 50, No. 7, July 1973, pp 249-250.

A new, fast, simple technique is presented, which allows complete characterization of alkyl ethoxylates in terms of average chain length of the alkyl portion and degree of polymerization. The method uses trimethylsilylation of the terminal-OH of alkyl ethoxylate to obtain a sharp distinct internal standard of nine hydrogens per molecule. The number of hydrogens responsible for the NMR at 0.7-1.5 and 3.0-3.9 ppm can be calculated and, consequently, the average chain length and average number of ethylene oxide units. Water and ethanol do not interfere since they are removed in the reaction. Results for several commercial alkyl ethoxylates were in good agreement with compositions stated by the manufacturers.

INDEX TERMS: Nuclear magnetic resonance, Alkyl ethoxylates, Characterization, Nonionic surfactants.

AMIC-9403
"A PNEUMATIC SAMPLE CHANGER FOR GAMMA-RAY SPECTROSCOPY", Massoni, C. J., Fones, R. V., Simon, F. O., Review of Scientific Instruments, Vol. 44, No. 9, September 1973, pp 1350-1352.

The capacity of gamma-ray spectroscopy equipment was increased by the addition of a gravity-fed, pneumatic-ejection sample changer. The changer is designed for solid samples which are placed in polyethylene rabbits 1.65 cm in diam and 5.50 cm long. These are made by cutting off the hinge and opening tab from a 7.4 ml polyethylene vial. Operation of the changer and the associated electronics are described. The electronic circuitry has a fail-safe feature which stops the operation of the changer if a malfunction occurs. The system has proved to be more than 99 percent reliable.

INDEX TERMS: Instrumentation, Automatic control, Gamma ray spectroscopy, Sample changers.

AMIC-9405
"ANALYSIS BY MEANS OF GAS BUBBLE ELECTRIFICATION", Pantony, D. A., Stagg, D. C., Zeitschrift fur Analytische Chemie, Vol. 264, No. 5, June 13, 1973, pp 348-353.

A simple theory is proposed to account for the reciprocal relationship between concentration of solute and the charge on a droplet ejected as a rising bubble bursts at a solution's surface. Reasonable agreement is found between theoretical predictions of charge in multivalent electrolytes and the experimental values. Application to continuous analysis of flowing systems and to end-point detection is demonstrated for acid-base and complexometric titrations.

INDEX TERMS: Chemical analysis, Solutes, Aqueous solutions, Volumetric analysis, Electrolytes, Gas bubble electrification, Acid-base titration, Complexometric titration, Acetic acid, Nickel chloride, Trisodium trimetaphosphate, Trisodium orthophosphate, Tetrasodium pyrophosphate, Pentasodium triphosphate, Titrimetry.

AMIC-9406
"AMPEROMETRIC TITRATION OF MERCURY(II) WITH EDTA, DTPA AND TRIEN IN THE PPM-RANGE", van der Linden, W. E., Dieker, J., Zeitschrift fur Analytische Chemie, Vol. 264, No. 5, June 13, 1973, pp 353-355.

Mercury(II) can be titrated at pH 2.5-3 with EDTA, DTPA and TRIEN. The titration is followed amperometrically making use of a rotating gold-electrode at a potential of plus 0.25 V vs. S.C.E. Especially the use of DTPA allows the determination of small amounts of mercury(II) (down to 1 microgram). The standard deviation is 2-3 percent. A correction for the systematic negative error of approximately 4 percent in the case of EDTA and 8 percent in the case of DTPA, mainly caused by the faradaic reaction at the electrode, can easily be made. Bismuth, iron and thorium will interfere, but on addition of fluoride the interference of thorium and iron can be masked. TRIEN showing a better selectivity of mercury towards iron has the lowest conditional stability constant and will not be suited to the titration of very low concentrations. Copper may be present in a thousand fold concentration. About equivalent amounts of iron(III) can be titrated in one run with mercury. In that case two end-points are obtained, the first one for iron, the second one for mercury. The ratio of the conditional constants of mercury to those for copper and iron is more favourable for DTPA and especially TRIEN.

INDEX TERMS: Volumetric analysis, Mercury, Electrochemistry, Amperometric titration, EDTA, DTPA, TRIEN, Metal complexes, Trace levels, Rotating gold electrodes, Chemical interference, Precision, Stability constants.

AMIC-9407
"SELECTION OF EXPERIMENTAL CONDITIONS FOR THE PHOTOMETRIC COMPLEX FORMATION TITRATIONS OF METALS IN THE PPM-RANGE", Kragten, J., Zeitschrift fur Analytische Chemie, Vol. 264, No. 5, June 13, 1973, pp 356-361.

Metals can be complexometrically titrated in the ppm-range in the presence of equivalent amounts of indicator. When (2:2) metal-indicator complexes predominate in solution, the end-points found from the 'L'-shaped absorbance-volume curves by extrapolation, are generally systematically shifted. This can be avoided by a proper choice of the indicator. Mathematical conditions previously derived are transformed to practical titration conditions, which, applied to diagrams for Bi and Zn, lead to the selection of optimum experimental conditions for these metals. The procedure is generally applicable and remains suitable even when a lack of data requires some preliminary investigations.

INDEX TERMS: Metals, Pollutant identification, Complexometric titration, Chemical indicators, Metal complexes, Trace levels, Chromogenic reagents.

AMIC-9411
"APPLICATION OF ACTIVATED CARBON FOR THE ENRICHMENT OF TRACE ELEMENTS AND THEIR DETERMINATION BY ATOMIC ABSORPTION SPECTROMETRY", Jackwerth, E., Lohmar, J., Wittler, G., Zeitschrift fur Analytische Chemie, Vol. 266, No. 1, July 3, 1973, pp 1-8.

Activated carbon can be used as collector material in trace analysis. Due to the special character of activated carbon, not only insoluble compounds can be enriched, but also many soluble chelate complexes of trace elements. For that purpose the buffered aqueous solution of the analytical sample containing complexing or precipitating reagents is filtered through a small filter paper covered with 50 mg of activated carbon. The trace compounds, and in many cases also the surplus reagent are adsorbed by the collector. By treating the carbon collector with acid after the process of trace enrichment, a trace concentrate free of unwanted substances is obtained. Thus it is possible to use sensitive electrochemical and optical methods for the determination. For the determination of the enriched elements by atomic absorption spectrometry, the activated carbon suspended in diluted nitric acid can be dispersed directly into the atomizer. The carbon particles do not cause any interferences. The application and the advantages of activated carbon for enrichment of trace elements in high-purity materials is demonstrated by some analytical examples. (In German)

INDEX TERMS: Trace elements, Activated carbon, Aqueous solutions, Chemical analysis, Heavy metals, Separation techniques, Solubility, Pollutant identification, Methodology, Atomic absorption spectrophotometry, Enrichment, Sample preparation, Metal chelates.

AMIC-9412
"SEPARATION AND GAS-CHROMATOGRAPHIC DETERMINATION OF TRACES OF FLUORIDE", Bock, R., Strecker, S., Zeitschrift fur Analytische Chemie, Vol. 266, No. 2, July 23, 1973, pp 110-116.

Traces of fluoride can be separated from aqueous solution by extraction with $(C_2H_5)_3SiCl$ in m-xylene or with $(C_6H_5)_4SbOH$ in CH_2Cl_2. Furthermore, several coprecipitation reactions were tested; absorption on hydroxyl apatite is most suitable. Determination of 0.05 microgram fluoride/ml can be performed by gas chromatography of $(C_2H_5)_3SiF$ in m-xylene using flame ionisation detectors; but variable blanks of 0.5-1.5 micrograms fluoride normally prevent the determination of less than ca. 3 micrograms fluoride. (In German)

INDEX TERMS: Fluorides, Aqueous solutions, Chemical analysis, Separation techniques, Pollutant identification, Solvent extractions, Trace levels, Flame ionization gas chromatography, Detection limits.

AMIC-9413
"ISOLATION AND CLEANUP OF ORGANOPHOSPHORUS INSECTICIDES AND THEIR OXONES FROM ANIMAL TISSUES", Hladka, A., Kovac, J., Zeitschrift fur Analytische Chemie, Vol. 265, No. 5, July 30, 1973, pp 339-342.

A simple isolation and cleanup procedure has been developed for the determination of organophosphorus insecticides and their oxones in animal tissues. This procedure partly unites extraction of organophosphorus pesticides and their oxones with cleanup by column chromatography. Most polar coextracts remain on the column and in its further processing the eluate does not tend to form emulsion. The process has been studied on model mixtures of P-32- and C-14-labelled pesticides with tissues as well as after application of pesticides to white rats. The average recovery of the method is 90.5 percent, with a standard deviation of plus or minus 5.1 percent.

INDEX TERMS: Isolation, Pollutant identification, Radiochemical analysis, Phosphothioate pesticides, Pesticide residues, Solvent extractions, Oxones, Animal tissues, Radiochromatography, Isomers, Chemical recovery, Precision, Sample preparation, Metabolites.

AMIC-9414
"NUCLEAR MAGNETIC RESONANCE RELAXATION TITRATION", Schluter, A., Weiss, A., Zeitschrift fur Analytische Chemie, Vol. 266, No. 3, August 30, 1973, pp 177-186.

Quantitative determination of the concentration of paramagnetic ions in aqueous solutions is performed by NMR relaxation titration. By measurement of the nuclear spin-lattice relaxation time T sub 1 or the nuclear spin-spin relaxation time T sub 2 redox titrations and complexometric determinations of the concentration of paramagnetic ions are possible. Also the precipitation of ions from the solution can be followed by this method. The use of a magnetic indicator in this analytical method is shown. The sensitivity of the method goes down to concentrations as low as 0.001 M. The accuracy of NMR relaxation titration is better than 1 percent. A number of applications of the method are given.

INDEX TERMS: Methodology, Aqueous solutions, Chemical precipitation, Chemical analysis, Chemical reactions, Quantitative analysis, NMR relaxation titration, Paramagnetic ions, Metal complexes, Accuracy, Detection limits, Chemical concentration.

AMIC-9434
"OXYGEN UPTAKE OF BOTTOM SEDIMENTS STUDIED IN SITU AND IN THE LABORATORY", Edberg, N., Hofsten, B. V., Water Research, Vol. 7, No. 9, September 1973, pp 1285-1294.

Oxygen uptake by soft bottom sediments was measured in situ with a temperature-compensated oxygen electrode in a Plexiglas cylinder. Comparative measurements were made in the laboratory on sediments cores taken with a modified Kajak bottom sampler from near the site of the in situ measurements. Values obtained from in situ measurements at 19 localities in fresh and brackish waters were in the range 0.3-3.0 g O2/sq m/d. Laboratory measurements yielded consistently lower values and showed that the oxygen uptake depended on the oxygen concentration and that the temperature coefficient decreased with increasing temperature. There was no simple correlation between oxygen uptake and content organic matter in sediments.

INDEX TERMS: Bottom sediments, On-site tests, Laboratory tests, Measurement, Freshwater, Organic matter, Brackish water, Water temperature, Running waters, Oxygen consumption, Natural waters, Oxygen electrodes, Concentration.

AMIC-9437
"ORGANIC DESORPTION FROM CARBON-II. THE EFFECT OF SOLVENT IN THE DESORPTION OF PHENOL FROM WET CARBON", Pahl, R. H., Mayhan, K. G., Bertrand, G. L., Water Research, Vol. 7, No. 9, September 1973, pp 1309-1322.

e The desorption of phenol from active carbon was studied using cyclic and continuous flow desorbers. The absorptivity index of phenol in each of 10 solvents was determined by spectrophotometry using a set of standard solutions of phenol in each solvent. Phenol was adsorbed onto the carbon in a polyethylene container and the carbon was separated from solution by filtration. The damp carbon was placed in flasks, frozen, and vacuum-dried. After 36-48 h the flasks were removed, weighed, and the 'dry' carbon stored. Final drying was done by freeze drying and confirmed by thermogravimetric analysis. A Soxhlet extraction apparatus was used to desorb phenol from carbon using methanol, acetonitrile and cyclohexane. A continuous flow desorber constructed from a modified Soxhlet extractor was used so that all the solvents could be used under identical flow and temperature conditions. The heat of solution of phenol in methanol, dodecyl alcohol, acetonitrile and cellosolve acetate was determined using the calorimeter and experimental procedure described by Betrand, Beaty and Burns (1968). A wide difference in desorption capabilities was shown among the 10 solvents. The system employed was complex, with water being present in addition to phenol on the carbon. An attempt to correlate the desorption data with the physical properties of the phenol and solvent and regular solution theory is made. A thermodynamic approach using the linear free energy-enthalpy relationship produced a reasonable correlation of the heat of formation of the phenol-solvent hydrogen bond with the desorption data. This indicated that the desorption of the phenol from carbon in this complex system is dependent upon the ability of the solvent to form hydrogen bonds with the phenol.

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INDEX TERMS: Phenols, Activated carbon, Methodology, Separation techniques, Aqueous solutions, Adsorption, Solvent extractions, Moisture content, Pollutant identification, Desorption, Organic solvents, Pollutant removal, Wet carbon, Inorganic solvents, Heat of solution.

AMIC-9438
"ORGANIC DESORPTION FROM CARBON-III. THE EFFECT OF SOLVENT IN THE DESORPTION OF PHENOL FROM DRY CARBON", Knickmeyer, W. W., Mayhan, K. G., Bertrand, G. L., Water Research, Vol. 7, No. 9, September 1973, pp 1323-1330.

The desorption of phenol from active carbon was studied using a continuous flow desorber. The system used was nearly water free to reduce water-phenol interactions. An attempt to correlate the desorption data with the physical properties of phenol and solvents, in addition to regular solution theory, proved unsuccessful. A thermodynamic approach using the linear free energy-enthalpy relationship produced a general trend by using the heat of solution for phenol in solution and a reasonable correlation using the heat of formation of the phenol-solvent hydrogen bond with the desorption data.

INDEX TERMS: Activated carbon, Adsorption, Methodology, Phenols, Separation techniques, Pollutant identification, Desorption, Pollutant removal, Continuous flow system, Dry carbon, Heat of solution, Heat of formation, Heat of wetting.

AMIC-9442
"THE DETERMINATION OF PHENOLS IN AQUEOUS EFFLUENTS", Cooper, R. L., Wheatstone, K. C., Water Research, Vol. 7, No. 9, September 1973, pp 1375-1384.

A method is described for the determination of monohydric and dihydric phenols in aqueous effluents. The phenols were extracted into methyl isobutyl ketone, the trimethylsilyl ethers prepared, separated by gas-liquid chromatography and detected by a flame ionization detector. Complete separation of phenol, cresols, xylenols, ethylphenols and dihydric phenols was achieved using dual stainless steel columns packed with Chromosorb W (AW-DCMS) coated with 5 percent tri-2,4-xylenyl phosphate and by linear temperature programming from 75 C to 125 C at 1.5 C/min; concentrations down to 0.1 mg/l of each phenol in the original sample could be determined. The results obtained by the gas chromatographic method were compared with those using standard colorimetric methods of analysis for carbonization effluents arising from different sources. The method is generally applicable to wastes containing phenols.

INDEX TERMS: Phenols, Effluents, Separation techniques, Pollutant identification, Industrial wastes, Liquid wastes, Chemical analysis, Drainage water, Flame ionization gas chromatography, Cresol, Xylenols, Dihydric phenols, Ethylphenols, Monohydric phenols, Detection limits.

AMIC-9446
"PROCEDURES FOR RADIOCHEMICAL ANALYSIS OF NUCLEAR REACTOR AQUEOUS SOLUTIONS", Krieger, H. L., Gold, S., U. S. Environmental Protection Agency, Radiochemistry and Nuclear Engineering Research Laboratory, Cincinnati, Ohio, Report No. EPA-R4-73-014, May 1973, 174 pp.

In the course of studies to evaluate potential health hazards from aqueous discharges at nuclear power stations during routine operations, the Radiochemistry and Nuclear Engineering Research Laboratory of the U. S. Environmental Protection Agency's National Environmental Research Center in Cincinnati has compiled and tested the radiochemical methods given in this manual. The composition of test solutions has ranged from mixtures of many radionuclides at microcuries per milliliter concentrations to barely detectable levels at picocuries per liter concentrations. The substrate quality has ranged from highly deionized colant water to waste solutions with high concentrations of salts and detergents. The procedures in the front section of the manual are standard methods (ASTM Standards) which are applicable for separating and measuring these radionuclides in most reactor liquid wastes. The methods in the second section have been compiled from information in analytical chemistry texts or from technical reports in the scientific literature. Method evaluation involved replicate analyses with reactor coolants, reactor wastes and specific tracer solutions as substrates. The criteria established for each method were chemical yeilds greater than 70 percent, decontamination factors at least 1000, procedure time commensurate with the half life of the nuclide being separated, and ease of analysis.

INDEX TERMS: Radiochemical analysis, Aqueous solutions, Nuclear reactors, Analytical techniques, Radioactivity techniques, Liquid wastes, Beta particle counting.

AMIC-9449
"CHLORINATION EFFECTS ON ORGANIC CONSTITUENTS IN EFFLUENTS FROM DOMESTIC SANITARY SEWAGE TREATMENT PLANTS", Jolley, R. L., Oak Ridge National Laboratory, Oak Ridge, Tennessee, Report No. ORNL-TM-4290, Contract No. W-7405-eng-26, October 1973, 342 pp.

The major objectives of this research were to develop a method for examining chlorination effects and to determine whether, as well as to what extent, chlorine-containing organic compounds are formed when effluents from domestic sanitary sewage treatment plants are chlorinated at milligram-per-liter chlorine concentrations. An additional purpose was to characterize, or identify, and quantify stable chlorine-containing and other organic compounds present in chlorinated and unchlorinated effluents. Chlorination yields were approximately the same for both primary and secondary effluents. Essentially the same effects were obtained by chlorination with either chlorine gas or hypochlorite solution. The effects of chlorination in the chlorinated effluents were determined by a method which coupled chlorination by Cl-36 radioactive tracer with separation by high-resolution anion-exchange chromatography using sensitive radioactive tracer monitoring. It was determined that chlorine-containing stable organic constituents are present after chlorination of effluents from domestic sanitary sewage treatment plants. Over 50 chlorine-containing constituents were separated from chlorinated secondary effluents. Seventeen of these chlorine-containing organic compounds were tentatively identified and quantified at the 0.5- to 4.3-microgram/liter level. In addition to the 17 chlorine-containing compounds that were identified, 32 stable organic constituents were identified and 23 of these were quantified at 2- to 190-microgram/liter levels in the effluents from domestic sanitary

AMIC-9449 (Continued) Card 2/2

primary sewage treatment plants. Nine stable organic constituents were identified, and eight of these were quantified at 5- to 90 microgram/liter levels in the effluents from domestic sanitary secondary sewage treatment plants.

INDEX TERMS: Chlorination, Organic compounds, Radioactivity techniques, Sewage treatment, Sewage effluents, Domestic wastes, Chlorine, Methodology, Environmental effects, Sampling, Chemical reactions, Anion exchange, Aqueous solutions, Separation techniques, Laboratory tests, Laboratory equipment, Cation exchange, Ion exchange chromatography, Chlorinated hydrocarbons, Synthetic sewage.

AMIC-9452
"EXPERIMENTAL STUDY OF THE PHASE-SELECTIVE ANODIC STRIPPING ANALYSIS OF MICROMOLAR CADMIUM(II) AT THE MICROMETER HANGING MERCURY DROP ELECTRODE IN 0.1 M POTASSIUM CHLORIDE", Moorhead, E. D., Davis, P. H., Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2178-2184.

Conflicting reports in the literature pertaining to the observed magnitude of the ac phase-selective current obtained in the anodic stripping of Cd from the HMDE prompted an experimental reassessment of the stripping behavior of this metal using a micrometer-type HMDE and 0.1 M KCl as base electrolyte. Reproducibility of the stripping analysis was indicated by a 1.20 percent average deviation in the measured peak height obtained for ten independent runs at the micromolar Cd(II) level. The functional dependence of peak height on signal frequency, applied ac voltage, and cadmium concentration conformed to theory developed previously for ac polarography. However, observed in-phase peak currents obtained during the stripping step were substantially smaller than those reported by previous authors for the same experiment. The influence of stripping scan rate on the Cd-Cd(Hg) system was examined, and peak heights were found to be strongly dependent on this parameter. The importance of maintaining well-controlled conditions during pre-electrolysis was indicated from brief studies of peak height dependence on solution volume and stirring rate. (Reprinted from Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2178-2184. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Cadmium, Chemical analysis, Electrochemistry, Aqueous solutions, Hanging mercury drop electrodes, Phase-selective anodic stripping, ac Phase-selective voltammetry, Chemical concentration, Trace levels, Reproducibility.

AMIC-9453
"HIGH PRECISION SAMPLING FOR CHROMATOGRAPHIC SEPARATIONS", Bowen, B. E., Cram, S. P., Leitner, J. E., Wade, R. L., Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2185-2191.

The precision of several chromatographic sampling valves of original design is shown to approach 0.05 percent for unretained solutes. Hybrid-fluidic, high pressure, and commercial valves have been characterized by measuring the precision of their column input profiles and statistical moments. A computer-based data acquisition and control system was developed for use with high precision algorithms. (Reprinted from Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2185-2191. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Separation techniques, Chromatography, Automatic control, Computers, Hydraulic valves, High pressure valves, Precision, Chromatographic sampling valves, Hybrid-fluidic valves, Data acquisition, Hamilton valves.

AMIC-9455
"ENHANCEMENT OF THE SENSITIVITY AND SELECTIVITY OF THE COULSON ELECTROLYTIC CONDUCTIVITY DETECTOR TO CHLORINATED HYDROCARBON PESTICIDES", Dolan, J. W., Hall, R. C., Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2198-2204.

Factors which influence the sensitivity and selectivity of the Coulson electrolytic conductivity detector to chlorinated hydrocarbon pesticides were determined and optimized. The most influential factors which affect sensitivity are absorptive surfaces, electrode polarization, system stability, and furnace temperature. Replacement of the standard 4-mm i.d. quartz reaction tube with one of 0.5-mm i.d., replacement of the silicone rubber septum at the furnace exit with a teflon fitting, and increasing the maximum cell voltage to 44 V dc resulted in a minimum detectability of 0.1 ng for heptachlor and a useable sensitivity of 0.4 ng as compared to 2 ng and 5 ng, respectively, for the unmodified detector. The most influential factors which affect selectivity are funace temperature, reaction gas composition, and reaction gas flow rate. Optimization of these parameters enables most chlorinated hydrocarbon pesticides to be selectively determined in the presence of other halogenated materials such as PCB with selectivities greater than 1000:1. (Reprinted from Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2198-2204. Copyright 1973 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Chlorinated hydorcarbon pesticides, Selectivity, Separation techniques, Gas chromatography, Polychlorinated biphenyls, Pollutant identification, Sensitivity, Electrolytic conductivity detector, Detection limits, Gas flow rates, Furnace temperature, Chemical composition, Reaction gas.

AMIC-9459
"ADSORPTION CHARACTERISTICS OF SILVER, LEAD, CADMIUM, ZINC, AND NICKEL ON BOROSILICATE GLASS, POLYETHYLENE, AND POLYPROPYLENE CONTAINER SURFACES", Struempler, A. W., Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2251-2254.

Container absorption of low concentrations of Ag, Pb, Cd, Zn, and Ni ions in aqueous solutions was studied using flameless atomic absorption spectrometry in order to develop a workable method for studying trace quantities of these ions in natural precipitation (rain, snow, hail). Only new containers (borosilicate glass, polyethylene, polypropylene) were used after rigorous cleaning. Fifty milliliters of test solution were stored in each container during the aging period and analyzed initially at daily intervals. After several days analyses were made at 2- to 3-day intervals, or longer. The adsorption of Ag ion on borosilicate glass and polypropylene containers was studied as related to light and temperature. No single container type proved satisfactory for all ions. Polyethylene containers did not absorb cadmium or zinc. Acidification to pH 2 with HNO_3 prevented silver, lead, cadmium, and zinc adsorption on borosilicate glass surfaces. Acidification also prevented adsorption of silver on polyethylene surfaces. Additionally, silver solutions must be maintained in the dark, even under acidified conditions, to maintain stability and minimize adsorption loss. New polypropylene containers could not be cleaned satisfactorily for cadmium and zinc studies. Extreme care was necessary to minimize contamination when working with the low ion concentrations detectable by flameless atomic absorption spectrometry.

INDEX TERMS: Adsorption, Aqueous solutions, Heavy metals, Ions, Plastics, Physical properties, Borosilicate glass, Polypropylene, Storage containers, Chemical loss.

AMIC-9470
"HANGING MERCURY DROP ELECTRODEPOSITION TECHNIQUE FOR CARBON FILAMENT FLAMELESS ATOMIC ABSORPTION ANALYSIS. APPLICATION TO THE DETERMINATION OF COPPER IN SEA WATER", Fairless, C., Bard, A. J., Analytical Chemistry, Vol. 45, No. 13, November 1973, pp 2289-2291.

Controlled potential electrolysis at a hanging mercury drop electrode (HMDE) has been coupled with carbon filament atomic absorption as an analytical technique and applied to the determination of Cu in seawater. Synthetic seawater and natural seawater samples were analyzed. Timed electrolyses at a controlled potential of -0.35 V vs. SCE were conducted with a simple three-electrode arrangement. Deaeration of analysis solutions was accomplished by bubbling N2 for 5 min prior to electrolysis and then by passing N2 over the solution during electrolysis. After electrolysis relaxation losses were examined. Five microliters of p-xylene was used to pretreat the filament cavity. The mercury was volatilized completely by heating the filament at approximately 425 C, then the Cu was atomized. Accuracy was checked by the standard additions method. The natural seawater analysis gave 0.72 microgram Cu/l which is within the range for unpolluted seawater. The practical detection limit for this technique with this electrode configuration, solution volume, and electrolysis time is 0.2 microgrum Cu/l. The absolute detection limit of the carbon filament atomizer is about 0.5 pg of Cu (essentially the same value as the sensitivity per I percent absorption. These results indicate that this is a suitable technique for the determination of Cu in unpolluted seawater with matrix interferences apparently eliminated and selective volatilization of Hg without covolatilization of Cu accomplished. In addition, in this technique, sample size is limited only by the electrolysis apparatus configuration, total amount of trace metal, and time, and is not restricted to the microliter capacity of the carbon filament.

AMIC-9470 (Continued) Card 2/2

INDEX TERMS: Copper, Sea water, Chemical analysis, Methodology, Pollutant identification, Trace elements, Electrochemistry, Hanging mercury drop electrode, Carbon filament, Flameless atomic absorption spectrophotometry, Controlled potential electrolysis, Detection limits, Accuracy.

AMIC-9472
"A MULTIPARAMETER OIL POLLUTION SOURCE IDENTIFICATION SYSTEM", Miller, J. W., U. S. Environmental Protection Agency, Edison Water Quality Research Laboratory, Edison, New Jersey, Report No. EPA-R2-73-221, Contract No. 68-01-0059, July 1973, 181 pp.

The feasibility of oil pollution source identification is demonstrated on eighty crude oils from the world's major oil fields. Measurements of fifteen diagnostic parameters were made on the 600 plus F fraction of the crude oil samples. Of the fifteen parameters studied it was demonstrated that six were sufficient to distinguish among the crude oils. These parameters are carbon and sulfur isotopic composition, sulfur, nitrogen, vanadium and nickel contents. A hydrocarbon gas chromatographic profile was also diagnostic for identification but its usefulness was reduced for aged samples by the effect of weathering. The other parameters studied were the saturate, aromatic and asphaltic contents and the carbon isotopic composition of each of these fractions, the n-paraffin distribution (odd-even predominance curves) and the sulfur gas chromatographic profile. The influence of weathering on the parameters was studied. A statistical procedure based on multivariate normal analysis was developed to compare an unknown with a data library and to give an unbiased match of the unknown with a known based on the precision of the measurement methods.

INDEX TERMS: Oil pollution, Pollutant identification, Chemical analysis, Oil spills, Water pollution sources, Statistical methods, Weathering, Oil fields, Chemical compositon, Crude oil, Oil characterization, Oil fingerprinting, Data interpretation, Saturates, Asphaltics, Aromatic hydrocarbons, Gas chromatography, Mass spectrometry, Crude oil bottoms.

AMIC-9476
"INTERMEDIA ASPECTS OF AIR AND WATER POLLUTION CONTROL", Stone, R., Smallwood, H., Ralph Stone and Company, Incorporated, Los Angeles, California, Report No. EPA-600/5-73-003, Contract No. 68-10-0729, August 1973, 365pp.

Major air and water pollutant control strategies are identified which are of current National concern. Emphasis is on artificial transfer between air or water. Natural transfers are not treated in depth and land is considered only as a means for residue disposal. Discussions include dangers of intermedia transfer from land to air or water. Control methods for each intermedia pollutant are discussed; comparative costs and expected unit process efficiencies are given. Residue disposal methods and problems are presented. Institutional factors, regulations and strategies for pollution control are summarized and discussed. These are also illustrated with a gross regional study of the Los Angeles Metropolitan Area, which is described in perspective with the National scene. Summary data are developed for major pollutants and residues discharged nationally and in the California South Coast Region, along with product/pollutant ratios for industries represented by the Standard Industrial Classification Code and other public economic sectors. The framework for a mathematical model is developed for the prediction of the effects of change in any of the elements of the production-consumption-pollution-regulation network.

INDEX TERMS: Methodology, Air pollution, Pollution abatement, Soil contamination, Legal aspects, Industrial wastes, Municipal wastes, Water pollution, Comparative costs, Model studies, Waste disposal, Efficienceis, Water quality standards, Regulation, Path of pollutants, Treatment facilities, Treatment, Pollutant removal, Pollution sources, Regulatory strategy, Air quality standards, Environmental impact.

AMIC-9477
"A TOPOLOGICALLY OPTIMUM RIVER SAMPLING PLAN FOR SOUTH CAROLINA", Sharp, W. E., Clemson University, Water Resources Research Institute, Clemson, South Carolina, Completion Report No. 36, April 1973, 31 pp. NTIS Report No. PB-222 278.

A sequential river sampling plan has been developed which is independent of the shape of a drainage basin. Mathematical analysis indicates this sampling plan will be the optimum one in the search for a pollutant coming from a single source. The procedure consists of sequential sampling at successive centroids of the river basin such that only the contaminated portion is followed after each step. The site selection for all possible source locations need only be performed once using standard river basin maps. This selection has been performed for all river basins in South Carolina and the results are summarized on a composite drainage map of the State. The map shows that under ideal circumstances no more than 11 sequential samples would be needed to locate a unique pollution source on any of the rivers of South Carolina. Many practical problems require that a simultaneous sampling plan be used and for this purpose the necessary sampling sites can be selected quickly from among the sites already marked on the map as sequential sites. These sites are uniformly distributed and a 50 percent sequential coverage of the state is possible using a simultaneous plan for only 81 sites. These have been listed in order of priority and their locations are specified in terms of road numbers where highway bridges are closest to each site.

INDEX TERMS: Water sampling, Methodology, South Carolina, River basins, Watersheds (basins), Sampling plans, *Topology, Simultaneous sampling, Sequential sampling.

AMIC-9478
"LAKE MICHIGAN DISCHARGE STUDIES", Illinois Institute for Environmental Quality, Chicago, Illinois, Final Report, June 1973, 146 pp. NTIS Report No. PB-221 869.

To investigate the feasibility of zero discharge of industrial wastes into Lake Michigan, effluents from eight of the 16 major dischargers were surveyed for the Illinois Institute for Environmental Quality. The companies surveyed were a pharmaceutical manufacturer, a coal-powered generating station, a flour mill and cereal plant, an outboard motor manufacturer, a smelter, two steel plants, and an oil piping company. The surveys included characterization of effluents, analysis of treatment facilities and procedures, feasibility of waste recycling, and some recommendations for improvement of treatment procedures. In terms of volume, the largest discharges to the lake were cooling waters.

INDEX TERMS: Industrial wastes, Electric power industry, Food processing industry, Domestic wastes, Electric powerplant, Chemical wastes, Pharmaceutical plants, Flour mills, Cereal plants, Steel mills, Piping companies, Smelters, Characterization.

AMIC-9479
"CURRENT PRACTICE IN GC-MS ANALYSIS OF ORGANICS IN WATER", Webb, R. G., Garrison, A. W., Keith, L. H., et al., U.S. Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, Georgia, Report No. EPA-R2-73-277, August 1973, 91 pp.

Experiences during five years of evaluating the application of gas chromatography-mass spectrometry (GC-MS) to wastewater analysis at the Southeast Environmental Research Laboratory have resulted in the selection of recommended practices for such applications. Liquid-liquid extraction with solvents such as methylene chloride and chloroform removed greater than 50 percent of compounds found in pulp mill and petrochemical waste at concentrations of 2 micrograms/l to 20 micrograms/l. The Kuderna-Danish evaporator was the most effective means of concentration after extraction. Diazomethane and dimethyl sulfate proved to be the most effective of five methylation reagents studied. Packed columns were effective for gas chromatography of simple mixtures and SCOT columns provided better overall performance for complex mixtures. Computerized data reduction was essential for practical use of GC-MS for samples containing many compounds. A computerized spectra matching program proved highly effective in identifying compounds contained in the computer library. The system was shown to be effective in solving problems related to fishkills caused by pesticides, confirmation of polychlorinated biphenyl residues in water and identification of compounds discharged by over a dozen industries. Over two hundred compounds were identified in industrial effluents.

INDEX TERMS: Pollutant identification, Chemical analysis, Waste water (pollution), Organic compounds, Industrial wastes, Waste identification, Solvent extractions, Organic wastes, Chemical wastes, Separation techniques, Pulp wastes, Municipal wastes, Toxicity, GC-Mass spectrometry, Sample preparation, Derivatization.

AMIC-9481
"DISTRIBUTION OF MERCURY, CADMIUM, LEAD AND THALLIUM IN A EUTROPHIC LAKE", Mathis, B. J., Kevern, N. R., Bradley University, Department of Biology, Peoria, Illinois, Project Completion Report, Contract No. DI-14-31-0001-3522, June 1973, 25 pp. NTIS Report No. PB-221 993.

Five species of fishes, two species of aquatic macrophytes, zooplankton, migratory goose feces, water and sediments from a eutrophic lake were analyzed for mercury, cadmium, lead and thallium. Hg concentrations were determined by flameless atomic absorption spectrophotometry after preparation according to the methods of D'Itri et al. (1971). Cd, Pb, and Tl concentrations in biota, sediments, and waterfowl droppings were determined using flame atomic absorption spectrophotometry after digestion with a mixture of nitric and perchloric acid. Mercury was detected in fishes and sediments only while cadmium and lead were detected in all components. Thallium was detected only in sediments. Sediments in the lake act as a 'sink' for the four metals. Mercury in axial musculature of largemouth bass was highly correlated with length and weight. A high degree of correlation between other metals and weight and length of other species was not evident. The feces of migratory waterfowl had high concentrations of both cadmium and lead. In view of the large quantity of waterfowl feces deposited within the drainage basin, it is suggested that this avenue is one of the major sources of contamination for the two metals and that fallout from airborne particulate matter is secondary. Fallout of airborne particulate matter may be the primary method by which mercury and thallium enter the lake although residual concentrations of the four metals in soil of the drainage basin were not determined.

INDEX TERMS: Mercury, Water pollution sources, Cadmium, Lead, Chemical analysis, Pollutant identification, Ecological distribution, Aquatic life, Thallium, Wintergreen Lake.

AMIC-9491
"STABILITY AND REMOVAL OF COMMERCIAL DYES FROM PROCESS WASTEWATER", Porter, J. J., Pollution Engineering, Vol. 5, No. 10, October 1973, pp 27-30.

A study has been made of the more common basic, acid, and direct dyes used by the textile industry in relation to their stability to light and water under conditions similar to those encountered when they are discharged to natural streams and reservoirs. All the basic dyes (triphenylmethane, phenazine and thiazine types) studied showed appreciable degradation during their 200-hr exposure to visible and ultraviolet light. Of the acid dyes studied, three showed drastic photoinduced degradation. The acid azo dyes were more fugitive to light than the acid anthraquinone dyes. The basic reason for degradation of acid dyes seems to be their susceptibility to electrophilic attack. The data show that the direct dyes are more resistant to photodegradation than are the acid and basic dyes and that they would be stable and resist photochemical degration in a treatment plant or receiving water. The data also show that the rate of degradation for direct dyes is at least 10 times as slow in natural daylight as in artifical light. Removal of dyes from wastewater will depend on dye class and chemical composition. Color removal can be accomplished by activated carbon, a combined treatment of a chemical oxidant and gamma radiation, and lime precipitation.

INDEX TERMS: Stability, Environmental effects, Aquatic environment, Waste water (pollution), Natural streams, Reservoirs, Industrial wastes, Physical properties, Light, Waste water treatment, Basic dyes, Acid dyes, Direct dyes, Photodecomposition, Textile industry, Pollutant removal, Decolorization, Organic dyes, Degradation rates, Fate of pollutants, Degradation products, Chemical composition.

AMIC-9492
"COMPARING THE QUALITY OF OUR WATERS", Hobbs, J. J., Medina, G., Dillon, A., Pollution Engineering, Vol. 5, No. 10, October 1973, pp 42-43.

Many extensive studies are now being conducted throughout the world on the quality of water in rivers, lakes and streams. Analyses of grab samples collected from a number of major bodies of water are presented in tabular form. It is important to note that grab sample results are of value only when related to a number of collection factors. The analysis of these samples is for the purpose of general information only.

INDEX TERMS: Water quality, Water chemistry, Water properties, Rivers, Lakes, Streams, Water analysis, Chemical analysis, Bays, Springs, Natural waters.

AMIC-9509
"DETECTION AND ESTIMATION OF ISOPROPYL METHYLPHOSPHONOFLUORIDATE AND O-ETHYL S-DIISOPROPYLAMINOETHYLMETHYLPHOSPHONOTHIOATE IN SEAWATER IN PARTS-PER-TRILLION LEVEL", Michel, H. O., Gordon, E. C., Epstein, J., Environmental Science and Technology, Vol. 7, No. 11, November 1973, pp 1045-1049.

A procedure is described for the estimation of two very potent anticholinesterase chemicals, viz., isopropyl methylphosphonofluoridate (GB) and O-ethyl S-diisopropylaminoethylmethylphosphonothioate (VX) in seawater in concentrations at the parts-per-trillion level by an enzymatic technique. Kinetic constants for the reaction of other anticholinesterases with two sources of cholinesterase and for the reaction of the cholinesterases with several substrates are given. With these data, the reader can select conditions for the development of procedures for estimating very low concentrations of these anticholinesterases in water.

INDEX TERMS: Estimating, Sea water, Pollutant identification, Water analysis, Poisons, Chemical reactions, Nerve gas, Trace levels, Anticholinesterases, Enzymatic techniques, Enzymatic inhibitors.

AMIC-9512
"OCCURRENCE OF HEXACHLOROPHENE AND PENTACHLOROPHENOL IN SEWAGE AND WATER", Buhler, D. R., Rasmusson, M. E., Nakaue, H. S., Environmental Science and Technology, Vol. 7, No. 10, October 1973, pp 929-934.

Concentrations of hexachlorophene (HCP) and pentachlorophenol (PCP) in sewage and water samples have been analyzed by gas chromatography. Sewage influent or effluent or river water samples were acidified with 4 N H_2SO_4 and extracted three times with chloroform. The chloroform extracts were dried with anhydrous Na_2SO_4 and evaporated to dryness in vacuo at 20 C to minimize any losses of volatile components. The residues were dissolved in CH_2Cl_2-methanol (5:1), ethereal diazomethane added, and the mixtures allowed to stand for 30 min at room temperature. After methylation, the samples were evaporated to dryness in a stream of N_2, redissolved in benzene, dried with Na_2SO_4, made up to 5 ml and analyzed. HCP and PCP levels in 24-hr composite samples of sewage influent collected simultaneously from three Oregon cities ranged between 20-31 ppb and 1-5 ppb, respectively. Composite effluent values from these same sewage treatment plants were 6-12 ppb HCP and 1-4 ppb PCP, reflecting a 60-70 percent removal of HCP and a 4-28 percent removal of PCP. Analyses of daily and hourly water samples from the Willamette River collected just upstream from the city of Corvallis, Oregon, showed that HCP and PCP were present in river water in concentrations varying between 0.01-0.1 ppb and 0.10-0.70 ppb, respectively. Conventional processing of raw Willamette River water at the Corvallis Taylor water treatment plant removed about 60 percent of the HCP and PCP originally present in the water leaving about 40 percent of these chlorophenols in the finished drinking water. Identifications of HCP and PCP in sewage effluent and influent, Willamette River water and treated drinking water were confirmed by mass spectrometry.

AMIC-9512 (Continued) Card 2/2

INDEX TERMS: Water analysis, Gas chromatography, Mass spectrometry, Pollutant identification, Sewage, Chemical analysis, Phenolic pesticides, Chlorinated hydrocarbon pesticides, Water sampling, Hexachlorophene, Pentachlorophenol, Sample preparation, Chemical recovery, Pollutant removal.

AMIC-9513
"TOXAPHENE ACCUMULATION IN FISH IN LAKES TREATED FOR ROUGH FISH CONTROL", Hughes, R. A., Lee, G. F., Environmental Science and Technology, Vol. 7, No. 10, October 1973, pp 934-939.

The results are presented of a study which covered the decline of toxaphene in treated lakes; the extent of toxaphene residue uptake by stocked fish; and the toxicity of 'aged' toxaphene residues compared to that of the standard mixture. Previously described methods for extracting, cleaning up and estimating toxaphene residues in aquatic samples were used. Electron capture gas chromatography was used to identify the pesticide and its presence in samples was confirmed by thin-layer chromatography. Fish, stocked in lakes retaining in the water very small amounts of toxaphene and plankton, accumulated residual toxaphene while maintaining excellent growth and reproducing successfully. Both stocked and hatched bluegills eliminated accumulated residues while maintaining excellent growth. Edible flesh of bluegills contained less than 10 percent of the whole body burden of toxaphene residues, and substantial portions of residues were removed by pan frying. Significant correlations were noted between accumulated toxaphene residue and fat content of stocked bluegills. Toxaphene and toxaphene residue accumulation were more closely related to fat content than to fish weight. Bluegills killed in lake treatment projects accumulated concentrations of toxaphene lower than concentrations of toxaphene residues found in stocked bluegills. Accumulated toxaphene in killed bluegills correlated well with fat content of the fish. Based on the changes in the toxaphene signature in gas chromatography, it is proposed that there is a partial degradation of some of the more toxic components of toxaphene.

INDEX TERMS: Pesticide residues, Pesticide toxicity, Pesticide kinetics, Pollutant identification, Water pollution effects, Bioaccumulation, Toxaphene, Fate of pollutants, Fat tissue.

AMIC-9519
"SALINITY CORRECTIONS FOR DISSOLVED OXYGEN MEASUREMENTS", Pijanowski, B. S., Environmental Science and Technology, Vol. 7, No. 10, October 1973, pp 957-958.

Presented is a convenient method of compensating for the effects of salinity on the data acquired from dissolved oxygen meters. It is pointed out that the basic design of most of these instruments does not include provision for salinity compensation or, at best, uses a fixed value. The need for a general method of compensation is emphasized, particularly when such meters are to be used in estuarine studies. The correction technique is based on earlier work by Gilbert et al. and is presented in a form suitable for development by computer for specific instruments. Illustrations demonstrating the methodology include curves for a meter intended basically for use in freshwater as well as for another which employs a fixed value of salinity compensation. The correction factors are dimensionless and can be applied to correct dissolved oxygen values in units of either ppm or ml/l.

INDEX TERMS: Salinity, Dissolved oxygen, Measurement, Water temperature, Methodology, Pollutant identification, Compensation, Correction factors.

AMIC-9528
"MERCURY IN FISH, SEDIMENTS, AND WATER IN LAKE OAHE, SOUTH DAKOTA", Walter, C. M., June, F. C., Brown, H. G., Journal Water Pollution Control Federation, Vol. 45, No. 10, October 1973, pp 2203-2210.

Analyses for total mercury content were made of fish, sediment, and water samples collected in several locations in Lake Oahe, South Dakota, and its tailwaters. Preparation of fish samples for Hg analysis consisted of thawing frozen specimens, removal of a portion of the flesh, and rigorous chemical digestion. The concentration of total Hg in the sample was determined by the Hatch and Ott flameless atomic absorption method using a Hg analyzer coupled to stripchart recorder. A total of 43 sediment samples was collected, placed in polyethylene bags and frozen. Subsamples were digested, diluted to a 500-ml volume, and analyzed for Hg content as above. Water samples were also analyzed as above. Mercury concentrations equal to or exceeding 0.5 mg/kg occurred in 30 of 225 fish samples tested (13 percent). Higher concentrations were found most frequently in predatory game fishes, primarily northern pike and walleye, from the cheyenne River arm. Sediment samples with mercury concentrations above 0.5 mg/kg were found only in the Cheyenne River arm, but water samples contained only neglibible amounts of mercury. Recommendations for further studies are presented.

INDEX TERMS: Mercury, Freshwater fish, Lake sediments, Water analysis, Pollutant identification, Chemical analysis, Flameless atomic absorption spectrophotometry, Lake Oahe, Lake Sharpe, Sample preparation, Chemical recovery, Cheyenne River, Animal tissues.

AMIC-9538
"SEASONAL VARIATIONS OF CADMIUM, COPPER, MANGANESE, LEAD, AND ZINC IN WATER AND PHYTOPLANKTON IN MONTEREY BAY, CALIFORNIA", Knauer, G. A., Martin, J. H., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 597-604.

Surface water and mixed phytoplankton samples, collected over 1 year in Monterey Bay, California, were analyzed for Cd, Cu, Mn, Pb, and Zn. Nearshore samples were collected about 16 km offshore over the Monterey Submarine Canyon. Phytoplankton samples were collected with a 0.5-m No. 20 net and concentrated on a ring of No. 20 netting with the excess water being removed by gentle vacuum. Water samples were collected with a 30-l PVC Niskin sampler; open ocean samples were processed aboard ship and stored in 4 N HNO_3 until laboratory analysis. The metals were concentrated on a chelating resin (Chelex 100), eluted with 4 N HNO_3, evaporated to dryness, combined with 1 percent concentrated HNO_3 solution, and analyzed by atomic absorption. Aliquots of dried and ground phytoplankton were digested in HNO_3 and H_2O_2. After centrifugation, the solutions were diluted and analyzed as above. The phytoplankton appeared to have little effect on the concentrations of these elements in water with the exception of Cd, which decreased during peak periods of productivity. Generally, metal levels in nearshore surface waters appeared to be more dependent on hydrographical fluctuations than on biological factors. Surface water collected on a transect between Hawaii and Monterey was analyzed for these same trace metals, for inshore-offshore comparisons. Levels of Cu, Mn, and Zn were usually higher inshore than offshore especially during periods of strong upwelling. Concentrations of Cd and Pb were almost always an order of magnitude higher inshore.

INDEX TERMS: Cadmium, Copper, Manganese, Lead, Zinc, Water analysis, Phytoplankton, Pollutant identification, Seasonal variation, Atomic absorption spectrophotometry.

AMIC-9550
"AN AUTOMATED ANALYSIS FOR UREA IN SEAWATER", DeManche, J. M., Curl, H., Jr., Coughenower, D. D., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 686-689.

An automated method adapted to a Technicon Auto Analyzer has been used to determine urea in seawater. In the flow system for automated analyses, a sample rate of 12/hr with a sampling time of 4.5 min and a 0.5 min wash gave good results. The sensitivity of the method with the 50-mm flow cell used was 0.018 absorbance units/(microgram-atoms urea-N)/liter. Ten replicate samples of 1.0 and 3.0 microgram-atoms urea-N/liter had standard deviations of 0.019 and 0.017 and a lower limit of detection less than 0.1 microgram-atom. For most precise measurements at low levels, the limit of detection is less than 0.05 microgram-atom urea-N/liter. Beer's law was found to apply over the range of 0-10 microgram-atoms urea-N/liter. The method was used to measure urea in seawater samples collected on cruise C72091 of the RV Cayuse to the Inside Passage of Southeast Alaska in October 1972. The lowest value was 0.25 microgram-atom urea-N/liter and the highest 2.20. The median value for 308 samples taken at depths from 1 to 200 m was 0.59. The automated method is rapid and sensitive enough to measure in situ urea concentrations before enrichment with N-labeled urea in nitrogen uptake experiments, eliminating the problems reported by McCarthy (1972).

INDEX TERMS: Ureas, Automatic control, Methodology, Sea water, Pollutant identification, Water analysis, Technicon AutoAnalyzer, Sensitivity, Detection limits, Precsion.

AMIC-9552
"GRADIENT ANALYSIS OF CARBON MONOXIDE AND METHANE IN POLLUTED AND OTHER NEARSHORE HABITATS", Welch, J. T., Naval Postgraduate School, Monterey, California, Master's Thesis, March 1973, 84 pp. NTIS Report No. AD-764 482.

A system for the determination of dissolved gases in seawater by gas chromatography was constructed and used to find the concentrations of methane and carbon monoxide in a variety of habitats around the Monterey Peninsula. Methane was shown to have a maximum of 0.00028 ml at 50 meters at the open ocean station, with a surface value of 0.00011 m. The surface waters at the nearshore stations were almost three times this value. Methane was also shown to be an effective tracer for sewage effluent. The carbon monoxide maximum was found at 15 meters which correlated closely with primary productivity. The surface values were lower than the nearshore values. All stations sampled were found to be highly supersaturated with both gases. This indicates that in this area, the ocean is a major source of both methane and carbon monoxide. (Abstract only)

INDEX TERMS: Water analysis, Sea water, Methane, Water pollution, Gas chromatography, Surface waters, Water pollution sources, Supersaturation, Primary productivity, Tracking techniques, Tracers, Methodology, Carbon monoxide, Gradient analysis, Dissolved gases, Monterey Bay, Chemical concentration, Nearshore habitats.

AMIC-9560
"EVALUATION OF FLAME EMISSION DETERMINATION OF PHOSPHORUS IN WATER", Seitz, W. R., U. S. Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, Georgia, Report No. EPA-660-2-73-007, August 1973, 18 pp.

NUCOR's flame spectrometer for phosphorus analysis was evaluated. Response to phosphorus in the form of H_3PO_4 was linear from 3 micrograms/liter, the detection limit, to 120 mg/liter, the highest concentration tested. Metal ions depress phosphorus emission and must be removed by cation exchange prior to analysis. High concentrations (greater than or equal to 5 mg/liter) of sulfur interfere positively. Volatile phosphorus compounds produce a larger signal for a given phosphorus concentration than nonvolatile compounds. River water samples were spiked with inorganic and organic phosphorus and analyzed. The measured phosphorus concentrations were 10-25 percent lower in river water than in deionized water.

INDEX TERMS: Water analysis, Phosphorus, Detection limits, Chemical interference, Flame emission spectroscopy, Chemical recovery.

See also: Category 2, AMIC-9167, 9323
Category 4, AMIC-9395, 9396
Category 5, AMIC-9247, 9576.

AMIC-7238
"THE TRANSPORT OF ORGANIC CARBON TO ORGANISMS LIVING IN THE DEEP OCEANS", Fournier, R. O., Proceedings of the Royal Society of Edinburgh, Section B (Biology), Vol. 73, No. 18, 1971-1972, pp 203-211.

Of the theories which have been proposed to explain the mechanism of organic carbon transport to its point of utilization in the deep ocean, none is adequately quantified to demonstrate its validity. A new mechanism is proposed based upon the occurrence of the so-called olive-green cells at various depths that suggests these cells may contribute up to 35 percent of the carbon requirements of the benthic fauna in the deep ocean. Quantitative data were obtained by collecting water with sterile or non-sterile samplers, filtering it through a membrane filter, and clearing and mounting the filter for microscopic examination. The cells are pigmented, possibly procaryotic organisms of uncertain identity. The cells were generally absent from the upper 50 m, increased in number from 50 m to a maximum at 300-500 m., and gradually decreased down to 400 m. The suggestion that these cells are the source of carbon for benthic organisms is based on three factors. First, the distribution of these cells varies directly with the level of surface productivity. Second, the negative gradient of the cell concentration below 300-500 m suggests that they are utilized throughout the water column. Third, other studies have identified similar cells in the guts of benthic and pelagic organisms.

INDEX TERMS: Benthic fauna, Distribution patterns, Cycling nutrients, Nutrient requirements, Deep water, Transport, Organic carbon, Olive-green cells, Marine environment.

AMIC-8594
"A PROCEDURE FOR SHORT-TERM BIOASSAY TESTS ON INDUSTRIAL EFFLUENTS OF LOW OXYGEN CONTENT", Ozburn, G., Kraft, J., Somppi, L., Canadian Journal of Zoology, Vol. 51, No. 7, July 1973, pp 794-795.

In a newly developed bioassay procedure concerned with the toxicity of industrial effluents with a low dissolved oxygen content, oxygenation was achieved using a pressurized oxygen supply and polyethylene bags. This method greatly reduces the possibility of stripping volatile toxins within the effluent. The decrease in toxicity that occurs if a sample is aerated with a bubbler before testing can be clearly shown with this method. The procedure has been used to determine the 96-hr LC sub 50 of a bleached kraft mill effluent for rainbow trout.

INDEX TERMS: Bioassay, Methodology, Oxygenation, Industrial wastes, Oxygen sag, Toxins, Volatility, Effluents, Toxicity.

AMIC-9010
"RESPIRATION RATES OF SOME NEW ZEALAND ECHINODERMS (NOTE)", Johnson, W. S., New Zealand Journal of Marine and Freshwater Research, Vol. 7, Nos. 1-2, June 1973, pp 165-169.

Respiratory rates were measured in four common New Zealand echinoderms, Evechinus chloroticus and Goniocidaris umbraculum (Echinoidea), and Coscinasterias calamaria and Pentagonaster pulchellus (Asteroidea). The organisms, collected from Otago Harbour and Blueskin Bay, were maintained in running sea water until their guts were cleared. Single animals were placed in airtight containers filled with air-saturated seawater, and the oxygen tension measured to the nearest 0.01 ppm at hourly intervals with a polarographic oxygen electrode. All experiments were terminated when oxygen tension reached 50 percent saturation. The respiratory rates at 12 C ranged from 3.8 to 9.8 microliters O2/h/g (live weight). The rates for Evechinus and Coscinasterias fall well within the range of metabolic rates of other echinoids and asteroids. Goniocidaris and Pentagonaster have relatively low respiratory rates.

INDEX TERMS: Respiration, Bioassay, Echinoderms, Evechinus chloroticus, Goniocidaris umbraculum, Coscinasterias calamaria, Pentagonaster pulchellus, Ion selective electrodes.

AMIC-9167
"A LIMNOLOGICAL SURVEY OF THE FRESHWATER COASTAL LAKES OF EAST GIPPSLAND, VICTORIA", Timms, B. V., Australian Journal of Marine and Freshwater Research, Vol. 24, No. 1, February 1973, pp 1-20.

The limnology of eleven lakes in East Gippsland, Victoria, Australia, was examined in varying degrees of intensity. For the largest two, Lakes Elusive and Barracoota, information is presented on physiography, major physical and chemical features, macrophytes, zooplankton, littoral invertebrates, benthos, and fish. Limited data, mainly on water chemistry and zooplankton, are given for the remaining lakes. The lakes are divisible into three groups. The four floodplain lagoons contain alkaline water dominated by sodium and bicarbonate ions. Zooplankton in each consists of Boeckella minuta, Thermocyclops hyalinus, and Daphnia lumholtzi, as well as a variety of other entomostracans. The coastal dune lakes have acid water dominated by sodium and chloride ions and a restricted zooplankton of one to three species, including Calamoecia tasmanica. Compared with coastal dune lakes of southern Queensland, these are heterogenous in mode of origin, water chemistry, and zooplankton. Despite some similarities with dune lakes, Lake Barracoota is basically different. Its physiography suggests a recent marine origin which is confirmed by the presence of two isopods and a polychaete with marine affinities.

INDEX TERMS: Water quality, Aquatic plants, Zooplankton, Benthic fauna, Freshwater fish, Physicochemical properties, Lakes, Water temperature, Dissolved oxygen, Color, Dissolved solids, Oxidation-reduction potential, Sodium, Potassium, Calcium, Magnesium, Chlorides, Bicarbonates, Sulfates, Copepods, Rotifers, Aquatic insects, Mollusks, Crustaceans, Mayflies, Diptera, Isopods, Australia, Caddisflies, Odonata, Transparency, Pelecypods.

AMIC-9175
"SOME ASPECTS OF THE BIOLOGY OF CALLIOPIUS LAEVIUSCULUS (KROYER) (CRUSTACEA, AMPHIPODA) IN THE NORTHWESTERN ATLANTIC", Steele, D. H., Steele, V. J., Canadian Journal of Zoology, Vol. 51, No. 7, July 1973, pp 723-728.

Calliopius laeviusculus, a small amphipod, was collected from several locations in the northwestern Atlantic, primarily in eastern Newfoundland, to study their biology. The organisms were most commonly found attached to algae on rocky shores with moderate wave exposure. Populations peaked in late summer when the animals swarm at the surface and may then be found in the plankton far out to sea or on protected shores. They appear to be confined to areas with positive mean monthly summer temperatures not exceeding about 22 C. Fifty percent of the females were calculated to be mature at 5.6 and 6.7 mm in the summer and winter respectively in Newfoundland waters, but, in Labrador, maturity was not achieved in females up to 10 mm in length. In Newfoundland several generations are produced per year and the females may have more than one brood. However, the females are in the resting stage between August and November-December, and young are only released from spring until late summer. In Labrador, where only one generation is produced per year, young are released in the spring but probably do not reach maturity until the autumn. In Newfoundland fecundity does not vary seasonally.

INDEX TERMS: Sexual maturity, Life cycles, Aquatic habitats, Calliopius laevicusculus.

AMIC-9271
"EFFECTS OF PESTICIDES ON EUGLENA GRACILIS. I. GROWTH STUDIES", Poorman, A. E., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 1, July 1973, pp 25-28.

Euglena gracilis was grown for one week in a 250 ml flask, the cells counted with a hemacytometer, and 9 ml aliquots distributed to culture tubes to study the effects of 2,4-D, 2,4,5-T, Aldrin Ac-10, DDT, Malathion, Parathion, and Methoxychlor on growth. Cells were also exposed to 95 percent ethanol and a 1 to 1 mixture of ethanol-acetone which were used to prepare the pesticide solutions. Tests were conducted for 24 hours with exposures of 100, 50, 10, 5, or 1 ppm pesticide and 1.0 percent solvent, and for seven days with 100, 50, and 10 ppm pesticide. Each experiment was conducted 5 or more times, and the cell numbers averaged for each series. The 24-hour tests show that the solvents had little effect on the cells, and in most cases 50 and 100 ppm of the pesticides significantly reduced growth with 2,4-D and 2,4,5-T being the most inhibitory. Concentrations of 10 ppm or less stimulated growth. The 7-day tests show that only the herbicides (2,4-D and 2,4,5-T) reduced growth and that only at the highest concentration. All other exposures stimulated growth. Further tests to study morphological alteration of cells which occurred with exposures to 50 and 100 ppm 2,4-D and 2,4,5-T showed that the effects were temporary. It is concluded that these pesticides are not a threat to Euglena since the concentrations required to inhibit growth are unlikely to occur in nature.

INDEX TERMS: Bioassay, 2 4-D, 2 4 5-T, Aldrin, DDT, Growth rates, Organic solvents, Malathion, Parathion, Methoxychlor, Euglena gracilis.

AMIC-9243
"AQUATIC SEDIMENT AS A HABITAT OF EMERICELLOPSIS, WITH A DESCRIPTION OF AN UNDESCRIBED SPECIES OF CEPHALOSPORIUM", Tubaki, K., Mycologia, Vol. 65, No. 4, July/August 1973, pp 938-941.

During a survey of the marine, brackish-, and fresh-water fungi of Japan, three species of Emericellopsis were isolated from the muds of four sites: 26 strains of E. humicola, 3 strains of E. minima, and 6 strains of E. microspora. All three species belong to the small-spored section of the genus. Cephalosporium was also found to be common in muds either as conidial states of Emericellopsis or as imperfect states only. A new species, C. polyaleurum, is described which is common in coastal muds and is characteristic both in the smaller amount of conidial production and in the formation of numerous aleuriospores. This fungus grew better on 30-100 percent seawater medium (with 1 percent glucose and 0.1 percent yeast extract) than on freshwater medium.

INDEX TERMS: Marine fungi, Muds, Sea water, Brackish water, Emericellopsis humicola, Emericellopsis minima, Emericellopsis microspora, Cephalosporium polyaleurium.

AMIC-9282
"A SENSITIVE BIO-BEHAVORIAL ASSAY FOR METHYL MERCURY", Lahue, R., Bulletin of Environmental Contamination and Toxicology, Vol. 10, No. 3, September 1973, pp 166-169.

Since slight changes in physiology or metabolism of the spider result in alteration of web structure, tests were conducted to investigate whether methylmercury could be detected in this way. Spiders (Araneus diadematus) were allowed to construct webs in specially designed cages. After photographing the webs daily for a suitable period of time, spiders were fed small amounts of methyl mercuric chloride in a drop of sugared water along with a fruit fly. Four groups of spiders were fed doses of 1, 2, 5, 50 micro micrograms/day. Two general effects of exposure were observed: web structure and frequency of web building were altered. At low doses (1 and 2 micro micrograms/day) web building was facilitated during two weeks of exposure. At these dosages, detail and size of webs also increased in more than half the webs for two weeks after which small and distorted webs predominated. At the higher doses (5 and 50 micro micrograms/day) frequency of web construction decreased to the point of complete elimination. The webs that were built were generally much smaller and less detailed than normal. This bioassay procedure is extremely sensitive and should be valuable for monitoring suspected environmental sources of contamination.

INDEX TERMS: Bioassay, Animal behavior, Methylmercury, Spiders, Webs.

AMIC-9285
"DDT INHIBITION OF ACTIVE CHLOROPHENOL RED TRANSPORT IN GOLDFISH (CARASSIUS AURATUS) RENAL TUBULES", Gruppuso, P. A., Kinter, L. B., Bulletin of Environmental Contamination and and Toxicology, Vol. 10, No. 3, September 1973, pp 181-186.

Kidneys were excised from goldfish, placed in modified Forster's saline medium, teased with tweezers into loose masses of tubules, and about 0.5 mg placed in each depression of a multiple ceramic-ring slide. After removal of adhering medium, about 0.1 ml of medium containing 0.00002 M chlorophenol red was added. DDT and its metabolites, DDD, DDE, and DDA were added to investigate their effect on epithelial cell transport of organic anions such as phenol red. Incubation was carried out for up to 3 hours in a moist chamber at 18-20 C. Every 15-30 minutes, depression slides were removed, the media drawn off and replenished, and the teased masses evaluated for dye uptake. An arbitrary visual rating on a 1 to 5 color scale was made for the functioning tubules, the ratings for comparable depressions averaged, and dye-uptake curves generated using a least squares, curve-fitting computer program. To validate the method, dose-response data were also obtained for two known competitive inhibitors, PAH (p-aminohippurate) and Diodrast (iodopyracet), and the metabolic uncoupler, DNP (2, 4-dinitrophenol). DDT and its non-polar metabolites, DDD and DDE, were clearly inhibitory at 0.0001 M. The polar metabolite, DDA, appeared to be a more effective inhibitor than DDT. The rapidity of the inhibition indicates that metabolic conversion of DDT is not required for the inhibition. Three mechanisms are proposed which may underly the toxicity of DDT and like compounds.

INDEX TERMS: Animal metabolism, Inhibition, DDT, Absorption, Bioassay, Goldfish, DDE, DDD, Transport, Chlorophenol red, DDA.

AMIC-9307
"UPTAKE OF FLUORIDE BY WATER HYACINTH, EICHHORNIA CRASSIPES", Rao, K. V., Khandekar, A. K., Vaidyanadham, D., Indian Journal of Experimental Biology, Vol. 11, No. 1, January 1973, pp 68-69.

Water hyacinths (Eichhornia crassipes) which are known to act as scavengers, were collected from the Hussain Sagar tank in Hyderabad, India, and analyzed for fluoride and other trace elements (Ca, Mg, Na, K, Mn, Fe, Co, Ni, Ti, Cu, Pb, Zn, P) TO EVALUATE THE POTENTIAL USEFULNESS OF THIS PLANT FOR REMOVING FLUORIDES FROM WATER. The fluoride concentration was 25 ppm in leaves and 60 ppm in petioles for a background concentration of 1 ppm in the tank. To further investigate water hyacinth as a fluoride scavenger, plants were exposed up to 26 days to concentrations of 0, 5, 10, 15, 20, and 25 ppm fluoride and analyzed for fluoride content. Uptake ranged from 11 to 75 mg in the course of 4 weeks. Since uptake was appreciable only at higher concentrations (greater than 10 ppm), water hyacinth is unsuitable for defluoridation since levels in natural waters are generally below this level.

INDEX TERMS: Fluorides, Water hyacinth, Bioassay, Bioaccumulation, Biological magnification.

AMIC-9309
"FISHES AS INDICATORS OF WATER QUALITY AND THEIR SIGNIFICANCE FOR ECONOMIC USE", Jankovic, D., Archiv fur Hydrobiologie, Vol. 44, No. 2, March 1973, pp 222-228.

Fishes react differently to the intensity and nature of pollution, which makes them useful as indicators of water quality. Alburnus alburnus L., Chondrostoma nasus L., Scardinius erythrophthalmus L., Blica bjoerkna L., and others are rather tolerant of wastewaters of industry, mining and sewage from villages and agriculture. The decrease of economically valuable fish species, Cyprinus carpio carpio L., Acipenser ruthenus L., Stizostedion lucioperca L., and others, in the Danube and its tributaries depends on various factors, one of them being the pollution caused by untreated effluents. The knowledge of these adverse effects on the fauna of the Danube system makes possible an actual project for the development of fisheries. (In German)

INDEX TERMS: Bioindicators, Water quality, Industrial wastes, Sewage effluents, Mine wastes, Farm wastes, Freshwater fish.

AMIC-9311
"THE CHIRONOMIDS OF THE PERIPHYTON IN THE YUGOSLAV PART OF THE RIVER DANUBE", Jankovic, M., Archiv fur Hydrobiologie, Vol. 44, No. 2, March 1973, pp 249-257.

The report gives a preliminary account of the fauna of a stretch of the Yugoslav part of the Danube, 50 km long. The results were obtained at the beginning of April 1971. Twenty-one species of chironomid lavae were recorded in the Danube between Belgrade and Smederevo, 70 percent of them for the first time. Eighty-one percent of the species were of the subfamily Orthocladiinae. Cricotopus algarum, the commonest and most abundant species was the only one which occurred in all the localities. Less frequent but almost as abundant was Rheorthocladium rubicundus. Rh. rhyacobius was also important despite its relatively low abundance. The subfamily Chironominae was represented only by 3 species, two of them playing periodically a more or less important role in the periphyton fauna. More frequent was Polypedilum gr. convictum, which exhibited considerable production in the polluted part of the Danube where another species of the genus, P. gr. laetum, was the predominant species. The municipal and industrial wastewaters reduce the number of chironomid species and cause changes of their composition. Thus species of Chironominae were predominant in places affected by the iron smelter, whereas Orthocladiinae predominated in the part polluted by municipal wastewaters as well as in the clean sector of the Danube. (In German)

INDEX TERMS: Aquatic insects, Water pollution effects, Periphyton, Midges, Dominant organisms, Speciation, Systematics, Biological communities, Secondary productivity, Ecological distribution, Danube River, Chironomids, Species abundance, Yugoslavia.

AMIC-9314
"OBSERVATIONS ON THE ECOLOGY AND DISTRIBUTION OF THE TURBELLARIAN FAUNA OF THE DANUBE DELTA", Mack-Fira, V., Cirstea-Nastasescu, M., Archiv fur Hydrobiologie, Vol. 44, No. 2, March 1973, pp 266-268.

An account is given of the turbellarian fauna of the three main regions of the Danube Delta: river, river-marine and predeltaic. Eurytopic, euryhaline and eurythermal species could be distinguished. The Turbellaria of the Danube Delta are, with few exceptions, wide-spread in other Rumanian inland waters. (In German)

INDEX TERMS: Ecology, Ecological distribution, Aquatic habitats, Aquatic animals, Speciation, Systematics, Turbellaria, Flatworms.

AMIC-9316
"ON THE SYSTEMATICS AND ECOLOGY OF THE GENUS CHAMAESIPHON (CYANOPHYCEAE). 2. ECOLOGY", Kann, E., Archiv fur Hydrobiologie, Suppl. 41 (Algological Studies 8), June 1973, pp 243-282.

A compilation of the ecological factors governing the occurrence of the Chamaesiphon species investigated clearly reveals the environmental requirements of the abundant species, those of less frequently occurring species are accordingly more obscure. Chamaesiphon is a predominantly running water form, although some species grow exclusively on inanimate surfaces (stones, glass, plastics), while others grow only on living substrates (algae, aquatic plants). Few occur on both types. In general, the species have a wide temperature tolerance; only a few (Ch. geitleri, Ch. fuscus, Ch. rostafinskii) appear to prefer running water of constantly low temperatures (i.e., also in summer). A similarly wide tolerance is displayed for the chemical quality of the water. With two exceptions, the Chamaesiphon species thrive equally well in calcium-rich water as in calcium-poor water, although some species are significantly more abundant in the former. It appears from previous investigations that Ch. fuscus is a Ca-poor water form and that Ch. geitleri prefers Ca-rich water. Only a small amount of data exists on the role played by the trophic level of the water body. The available data indicate that Chamaesiphon species grow best in unpolluted water, although some can tolerate polluted conditions. Ch. polymorphus is the only species which has been found growing in polysaprobic water. (In German)

INDEX TERMS: Cyanophyta, Aquatic algae, Ecology, Systematics, Environmental effects, Speciation, Dominant organisms, Water quality, Aquatic habitats, Resistance, Ecological distribution, Chamaesiphon, Species abundance.

AMIC-9317
"RED LIGHT AND NITROGEN STARVATION INDUCED CHANGES IN PIGMENT COMPOSITION (PHYCOERYTHRIN, CHLOROPHYLL FORMS) AND PHOTOSYNTHETIC O2 EVOLUTION OF PORPHYRIDIUM SP.", Hoarau, J., Guerin-Dumartrait, P. E., Leclerc, J.-C., Archiv fur Hydrobiologie, Vol. 39, No. 8, June 1973, pp 317-332.

Porphyridium sp. Lewin/Bloom. 637, was grown at 8500 ergs/sq cm/s intensity in red light (654 nm) or in white light. It has been verified that algae cultivated in this white light, giving a large proportion of green and yellow radiations, show the same pigment composition and photosynthetic O2 evolution as algae cultivated in green light. Inoculum was either synchronized cells or cells previously deprived in nitrogen (effects of light being studied during the starvation removal). Nitrogen starvation includes a rapid dropping of the phycoerythrin/chlorophyll (Per/Chl) quantitative ratio caused by the fall of the Per content. Photosynthetic activities are reduced but remaining Per forms are still active for the energy transfer to Chl a. Refeeding gives a rapid increase of pigment contents, specially for the Per. When grown in red light, after previous starvation or not, Porphyridium cells show comparatively with white light cells a net lowering of the Chl content without important changes in Per content (counter complementary chromatic adaptation). Absorption spectra of algae measured at -196 C reveal three main forms of Chl a: Ca670, Ca677 and Ca683. In red light, the Ca683/Ca677 ratio is decreased while the Ca670/Ca677 is slightly increased. Measurements of photosynthetic O2 evolution indicate that in red light cells of low Chl content, efficiency of Chl for 664 nm radiations is increased. Efficiencies of Per and Chl for green (547 nm) radiations are little affected. (In French)

INDEX TERMS: Plant pigments, Deficient elements, Light quality, Photosynthetic oxygen, Nitrogen, Rhodophyta, Porphyridium.

AMIC-9318
"THE INFLUENCE OF EUTROPHIC LAKE SEDIMENTS ON THE GROWTH OF DIFFERENT PLANKTONIC ALGAE", Javornicky, P., Fujita, D. K., Goldman, C. R., Archiv fur Hydrobiologie, Suppl. 41 (Algological Studies 8), June 1973, pp 341-362.

In order to assess the effect of substances leached from sediments on the production of phytoplankton in a large, shallow, eutrophic lake (Clear Lake, California), one in situ experiment and four laboratory bioassays were conducted. The field experiment showed the effects of sediments on various species or groups of algae to differ: the presence of sediment inhibited the growth of Anabaena flos-aquae and A. circinalis while it simulated the growth of Chlorococcales. In vitro bioassays were conducted with seven algal strains, Aphanizomenon flos-aquae, Microcystis aeruginosa, Oscillatoria limnetica, Nitzschia kuetzingiana, Navicula pelliculosa, Chlorella minutissima, and Scenedesmus intermedius, in 50-ml flasks containing sediment extract, a synthetic imitation of sediment extract, enriched (Ca, Mg, CO3, SiO3) extract, or enriched imitation. Aphanizomenon and Chlorella grew well in the sediment and synthetic extracts for 200 hours which demonstrated that the cells were able to store required nutrients that were missing from the synthetic extract. This test also showed that the chelating effect of EDTA and citric acid used in the synthetic extract was similar to that of the humic substances in the sediment extract. The results with the enriched extracts led to the following conclusions: (1) Growth of Aphanizomenon is definitely limited by Fe and probably by P. (2) Growth of Microcystis and Oscillatoria is definitely limited by N and possibly by P. (3) Growth of Nitzschia is definitely limited by N and probably by P, Fe and Si. (4) Growth of Navicula is definitely limited by N and possibly by P. (5) Growth of Chlorella is definitely limited by N and Fe. (6) Growth of Scenedesmus is definitely limited by Fe, probably by N and possibly by P.

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INDEX TERMS: Nutrient requirements, Growth rates, Diatoms, Lyanophyta, Chlorophyta, Bioassay, Sediments, On-site tests, Phosphates, Iron, Nitrates.

AMIC-9321 (Continued) Card 2/2

about intermediate in mean dry weight (1.8 gm/ sq m) as compared to other oligotrophic lakes and was dominated by Chironomidae.

INDEX TERMS: Photoplankton, Primary productivity, Benthic fauna, Seasonal, Zooplankton, Water quality, Rotifers, Dinoflagellates, Pigments, Crustaceans, Diatoms, Cyanophyta, Chlorophyta, Protozoa, Mowich Lake.

AMIC-9321
"A LIMNOLOGY STUDY OF A HIGH MOUNTAIN LAKE IN MOUNT RAINIER NATIONAL PARK, WASHINGTON STATE; USA", Larson, G. L., Archiv fur Hydrobiologie, Vol. 72, No. 1, June 1973, pp 10-48.

Mowich Lake, a high mountain lake in the Western Washington State Cascade Mountains, was studied from March to November 1967 to determine biotic relationships. Alkalinity, pH, oxygen, N, P, color, dissolved solids, temperature, transparency, conductance and primary production were determined. Phytoplankton samples were collected, enumerated, and extractable pigments determined. Zooplankton were collected from 7 depths, counted, and reproductive rates calculated. Macrobenthos was sampled at 5 depths. In general, the lake was low in mineral content and unproductive. The winter lake cover appeared to play an important role in primary production by way of nutrient additions. Primary production, extractable phytoplankton pigments and total phytoplankton biomass were strongly correlated in both time and space, and were maximal in July. The maximum primary production was 152/sq m and 21/cu m mg C assimilated per day. Maximum phytoplankton biomass was 32/sq m and 1.7/ cu m gm fresh weight. The activity quotient ((mg C assimilated/sq m/day)/(mg phytoplankton biomass/ sq m)) indicated the primary production of Mowich Lake to be in the oligotrophic range. The zooplankton community consisted of eight species of Rotifera. The only crustacean, Eucyclops agilis, was occasionally taken pelagically, but was usually confined to littoral and benthic regions. Zooplankton populations were maximal between early October and mid-November. The egg ratio reproductive rate, B (eggs/female/day), was maximal from September to early October. Other population coefficients were also calculated for Kellicottia longispina and Keratella hiemalis. The macro-benthos was

AMIC-9322
"SOME ARCTIC LIMNOLOGY AND THE HIBERNATION OF INVERTEBRATES AND SOME FISHES IN SUB-ZERO TEMPERATURES", Holmquist, C., Archiv fur Hydrobiologie, Vol. 72, No. 1, June 1973, pp 49-70.

Five shallow (less than 2 m depth) lakes in permafrost areas of northern Alaska were investigated to determine whether bottom-living animals occur and survive in frozen environments. Samples were collected in the summer of 1970. A number of macroscopic plants, algae, and animals were identified. The animals included hydrozoa, Turbellaria, Tardigarda, Gastrotricha, Polychaeta, Oligochaeta, Hirudinea, Crustacea, Insecta, Hydrachnida, Mollusca, Bryozoa, Porifera, Nematoda, and fish. The results of the survey are discussed with respect to the possible winter temperatures of the bottom habitats for invertebrates of such areas, the frost resistance of invertebrates, the oxygen supply, the mode of hibernating in invertebrates, and the actual lakes with their animals. The available literature on low temperature survival of invertebrates is also reviewed. Since the area concerned is compound and varied topographically, geologically and climatically, and the invertebrates live in microclimatic and microecological conditions as compared with the larger, more mobile vertebrates, it is impossible to deduce anything as regarding the winter conditions of the actual lakes or the frost-resistance of animals existing there from what is known from the better-investigated temperate areas or from laboratory conditions.

INDEX TERMS: Overwintering sites, Cold resistance, Aquatic plants, Oligochaetes, Mollusks, Diatoms, Chlorophyta, Cyanophyta, Survival, Hydrozoans, Turbellaria, Tardigrades, Gastrotricha, Polychaetes, Leeches, Hydrachnids, Bryozoa, Porifera.

AMIC-9323
"STUDIES ON PHYTOPLANKTON IN RELATION TO ITS PRODUCTION AND SOME PHYSICAL-CHEMICAL FACTORS IN LAKE SVINSJOEN", Lande, A., Archiv fur Hydrobiologie, Vol. 72, No. 1, June 1973, pp 71-86.

Limnological investigations were carried out during 1968 and 1971 on Lake Svinsjoen, a moderately eutrophic lake about 30 km southwest of Oslo. Investigations included measurements of primary production, quantitative phytoplankton, pH, specific conductivity, Fe, Mn, orthophosphate, Ca, Mg, oxygen, alkalinity, Na, K, sulfate, chloride, and bicarbonates. Primary production was determined by the dark bottle method and by C-14 uptake. Samples were collected from various depths with a transparent Ruttner water sampler and transferred to glass and polyethylene bottles for analysis. The results show that pH values lie between 7.0 and 9.0 in mixolimnion during the summer season, and the calcium content is about 30 mg/l. The orthophosphate content is about 10-15 micrograms/l in mixolimnion during the winter, but the summer measurements show values below 3 micrograms/l. The dominating phytoplankton species in 1971 were the diatoms Cyclotella comta and Synedra acus during May and June, and the Chlorophyta species Tetraedron punctulatum during July and August. The highest number of Tetraedron cells was 9,200,000 cells/l, found in August 1971. The two methods of determining primary productivity on some occasions gave different results which were difficult to justify. A study of the relation between the primary production and the standing crop of phytoplankton, shows that the daily renewal cofficient lies between 1.0 and 0.3 in Svinsjoen.

INDEX TERMS: Primary productivity, Dominant organisms, Physicochemical properties, Radioactivity techniques, Cyanophyta, Diatoms, Dinoflagellates, Chlorophyta, Lake Svinsjoen, Dark bottle method.

AMIC-9324
"AN IN SITU EXAMINATION OF THE GRAZING ACTIVITIES OF NATURAL ZOOPLANKTON COMMUNITIES", Haney, J. F., Archiv fur Hydrobiologie, Vol. 72, No. 1, June 1973, pp 87-132.

In Heart Lake, grazing rates for the water column exceed 100 percent/day in the summer, but become less than 10 percent/day during the winter. The lower vertical boundary of zooplankton filter-feeding is closely defined by a 1 ppm dissolved oxygen isopleth during summer stratification. Grazing rates measured with different food items showed some seasonal differences. The populations of dominant filter-feeding zooplankton species in Heart Lake corresponded with grazing rate maxima and minima recorded during the same period. Daphnia rosea and D. galeata were the most important grazers in Heart Lake, 1969, together accounting for approximately 80 percent of the total annual grazing activity. Several species of zooplankton migrate vertically in Heart Lake, resulting in shifts of grazing to the upper stratum at night. At least some species filter more rapidly at night. Eutrophic Heart Lake and the acid bog lake were very similar, with intense grazing by Cladocera limited vertically to the upper 3 meters. In contrast, copepod domination of the zooplankton and extremely low grazing rates uniformly distributed throughout the water column characterized the oligotrophic lake. A comparison of grazing rates and primary productivity in these three lakes showed (1) high grazing and high primary productivity in Heart Lake (2) high grazing and low primary productivity in the bog lake and (3) low grazing and moderate primary productivity in the oligotrophic lake. Phytoplankton renewal rates in oligotrophic lakes are generally far in excess of zooplankton grazing rates, whereas in eutrophic lakes the two rates are comparable. Grazing rates of zooplankton communities were measured in situ by automatically releasing a small quantity of P-32-labeled cells (yeast, algae, and bacteria) inside a plexiglass grazing chamber in the lake and

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assaying the zooplankton for radioactivity after 5 min feeding. Studies were conducted in the eutrophic Heart Lake and on two occasions in a deep oligotrophic lake and a shallow acid bog.

INDEX TERMS: Grazing, Eutrophication, Zooplankton, Primary productivity, Feeding rates, Trophic level, Oligotrophy, Bogs, Dominant organisms, Diurnal distribution, Heart Lake.

AMIC-9325
"A CULTURE SYSTEM FOR ARTEMIA, DAPHNIA, AND OTHER INVERTEBRATES WITH CONTINUOUS SEPARATION OF THE LARVAE", Sorgeloos, P., Persoone, G., Archiv fur Hydrobiologie, Vol. 72, No. 1, June 1973, pp 133-138.

An apparatus developed for continuous culturing of Artemia, Daphnia, and other invertebrates consists of five chambers, four of which have funnel-shaped bottoms, which are connected by tubes and siphons. Chamber A contains the food supply which can be an algal culture and is connected by siphons to chamber E, the water collector, and chamber B, the adult culturing chamber. Chamber B is connected by a tube from the bottom to chamber C, the larvae collecting chamber, which in turn is connected from the side to chamber D, the water supply. To operate the system, an aquarium pump is switched on by a timer for 5 minutes every half hour to pump water from the water supply (D) to the water collector (E). This activates the siphons connecting the food supply (A) and the culture chamber (B) to bring food and aerated water into chamber B. At the same time the inflow of water carries the larvae from B into the larvae collecting chamber C and the overflow in C goes to the water supply (D). A filter in the culture chamber prevents the transit of adults into the larval chamber. Larvae can be collected by means of a value in the bottom of the collecting chamber. The equipment has been used for 6 months with no special problems.

INDEX TERMS: Cultures, Laboratory equipment, Waterfleas, Automatic control, Brine shrimp, Continuous cultures, Artemia salina, Daphnia magna.

AMIC-9327
"THE EFFECT OF pH, CO2, CONCENTRATION AND BACTERIA ON THE GROWTH OF THE BLUE-GREEN ALGA OSCILLATORIA REDEKEI VAN GOOR", Meffert, M.-E., Archiv fur Hydrobiologie, Vol. 72, No. 2, July 1973.

Axenic and non-axenic suspensions of Oscillatoria redekei van Goor were cultivated to observe the effects of (1) deficiency of CO2, (2) CO2 at different pH values, and (3) bacteria. In axenic suspensions, decreases of CO2 and pH values above 10 caused extensive fragmentation and autolysis, most of the trichomes being destroyed. In non-axenic suspensions, fragmentation and autolysis were not so serious, so that the trichomes growth continued. At pH values between 7-10, growth of axenic cultures without fragmentation and autolysis was only possible in the range of pH 9. Trichomes of non-axenic suspensions showed a larger range of growth. Measurements from Lake Edeberg show that growth rate and trichome length (cells/trichome) correlate better with the free CO2-concentration than with other parameters. The results suggest that O. redekei fixes CO2 and not bicarbonate ion even though it can tolerate only low concentrations of free CO2. Lakes rich in bicarbonate and carbonate are typical biotopes of blue-green algae since pH values are high and CO2 levels are low. The disappearance of these algae may result from extensive turbulence which lowers pH and increases CO2 in the epilimnion. Aeration of lakes to remove phosphorus therefore may have the secondary effect of eliminating blue-green algae. Since algae growth increased and autolysis was limited in the presence of bacteria under optimal conditions and at high CO2 levels, the "CO2-effect" of bacteria presented by Lange is not valid for O. redeki.

INDEX TERMS: Hydrogen ion concentration, Carbon dioxide, Photosynthesis, Nutrient requirements, Bioassay, Cultures, Growth rates, Oscillatoria redeki.

AMIC-9328
"THE OCCURRENCE OF MICROTURBELLARIA IN SOME BRITISH LAKES OF DIVERSE CHEMICAL CONTENT", Young, J. O., Archiv fur Hydrobiologie, Vol. 72, No. 2, July 1973, pp 202-224.

The distribution and seasonal occurrence of Microturbellaria in three different habitats in the littoral zone of calcium-rich, lowland, 'productive' lakes and calcium-poor, upland, 'unproductive' lakes were investigated over the course of a year using three different sampling methods. Sampling methods, and methods used in the extraction from samples and identification of Microturbellaria are described. Eleven species occurred in both lake types, eight species occurred in Ca-rich lakes, and eleven species occurred in Ca-poor lakes. The total number of species collected from 6 calcium-rich and 6 calcium-poor lakes visited at monthly intervals over a year ranged from 9 to 12 species and 3 to 18 species, respectively. Species recorded frequently seemed to have a wide distribution within the range of habitats considered in each lake. Species with a more restricted habitat distribution were these recorded only infrequently. A study of the vertical distribution of Microturbellaria on the floor of a calcium-rich lake suggested that some species were confined to the littoral and other species occurred also in the deeper water. The peak number of specimens recorded in calcium-poor and calcium-rich lakes occurred in July and May to July, respectively. Ecological notes are presented on some of the common species found.

INDEX TERMS: Calcium, Lakes, Population, Distribution patterns, Water quality, Turbellaria.

AMIC-9329
"EXPERIMENTAL ECOLOGICAL INVESTIGATIONS OF CHRIONOMUS THUMMI AND CHIRONOMUS PIGER (DIPTERA, CHIRONOMIDAE)", Scharf, B. W., Archiv fur Hydrobiologie, Vol. 72, No. 2, July 1973, pp 225-244.

In the year 1956 the species Chironomus thummi was divided into two subspecies, which in 1972 were elevated to species: C. thummi and C. piger. In this work the ecological differences between the species in relation to temperature and oxygen pressures were investigated. Differences were found in the resistance to cold, and the duration of development at different temperatures and at various oxygen pressures. The larvae of C. piger are more resistant to cold than those of C. thummi which is in accord with what is known from natural conditions. The African C. pulcher is less resistant than C. thummi. No significant differences in the heat resistance and the preferred temperature of the two species could be found. At 0 and 15 C the embryos of C. thummi develop more slowly than those of C. piger, but the development from egg to imago occurs quicker in C. thummi. The observation that the larvae of C. thummi are more resistant to anaerobic conditions than those of C. piger can be confirmed by means of the rearing under diminished oxygen pressures.

INDEX TERMS: Diptera, Cold resistance, Dissolved oxygen, Heat resistance, Chironomus piger, Chironomus thummi, Chironomus pulcher.

AMIC-9330
ROTENONE METHODS IN A LARGE RIVERSYSTEM", Hocutt, C. H., Hambrick, P. S., Masnik, M. T., Archiv fur Hydrobiologie, Vol. 72, No. 2, June 1973, pp 245-252.

The use of rotenone, block net, and potassium permanganate was tested as a method for sampling fish in the New River, Virginia and West Virginia. Six sites were sampled by stretching the net across the river and applying about 3.8 liters of 2.5 percent emulsified rotenone at a location 68-91 meters above the net. The water was detoxified by distributing approximately two pounds of potassium permanganate below the block net. Fish were collected from the net, preserved, and identified. Data on numbers and kinds of fish were analyzed by a computer program which calculated diversity and redundancy for rotenone and seine data. The species and number collected by rotenoning at each station is listed. Rotenone collections yielded 40 species compared to 36 by seine. Thirty-one species were common to both methods. Species collected by the rotenone method but not by seine were: Nocomis leptocephalus, Noturus insignis, Cottus b. bairdi, Lepomis cyanellus, Etheostoma caeruleum, E. osburni, Percina maculata, Ictalurus punctatus, and Pylodictus olivaris. All except the latter two species are uncommon in the main-channel New River. Species collected only by seine have scattered distributions and may not have been collected by rotenoning because of seasonal variations. Mean values of diversity and redundancy for rotenone were 3.11 and 0.34, respectively, compared with 2.73 and 0.31 for seining. Rotenone techniques yielded an average of 26 species per collection compared to 14 by seine over the same area. The rotenone method is concluded to be a valuable sampling procedure.

INDEX TERMS: Rotenone, Sampling, Nets, Freshwater fish, Species diversity, Redundancy, New River.

AMIC-9341
"GERMANIUM INCORPORATION INTO THE SILICA OF DIATOM CELL WALLS", Azam, F., Hemmingsen, B.E., Archiv fur Mikrobiologie, Vol. 92, No. 1, July 10, 1973, pp 11-20.

A non-photosynthic diatom, Nitzschia alba; two marine photosynthetic diatoms, Cylindrotheca fusiformis and Cyclotella nana; and a freshwater photosynthetic diatom, Navicula pelliculosa, were exposed to various ratios of Ge-68-labeled $Ge(OH)_4/Si(OH)_4$ (0.01, 0.1, or 1.0) in an attempt to trace the metabolic fate of Ge and to examine the possibility that Ge might follow the same metobolic pathway as Si. Cell counts, viability, Ge uptake and incorporation, isotope discrimination, silicic acid uptake, and effects of Ge on metabolism were determined. The diatoms took up labelled germanic acid from their growth media and incorporated up to 80 percent of it into the silica of their cell walls. Silicification appeared to be required for germanium incorporation. The uptake and incorporation of germanic acid was dependent upon the relative concentrations of Ge and Si. At Ge/Si of 0.01, no inhibition of growth or of silicic acid uptake by N. alba was observed. The cell morphology was also normal and 60 to 80 percent of the Ge-68 taken up was incorporated. At Ge/Si of 0.1, silicic acid uptake and growth of N. alba were inhibited by about 95 percent. Concomitantly, striking morphological aberrations occurred. 10 to 20 percent of the $Ge-68(OH)_4$ taken up was incorporated. The possible use of labeled $Ge(OH)_4$ for the study of silicon metabolism is discussed.

INDEX TERMS: Diatoms, Growth rates, Absorption, Bioassay, Radioactivity techniques, Germanium, Silicon, Metabolic pathways, Transport, Viability.

AMIC-9343
"NITROGEN FIXATION BY THE UNICELLULAR BLUE-GREEN ALGA APHANOTHECE", Singh, P. K., Archiv fur Mikrobiologie, Vol. 92, No. 1, July 10, 1973, pp 59-62.

The alga Aphanothece sp., which grows vigorously in rice fields of the Central Rice Research Institute, India, was isolated for use in determining rates of nitrogen fixation in media free of combined nitrogen. Nitrogen fixation was estimated by the micro-Kjeldahl technique. Cells were counted using a haemocytometer. The alga grew well both in media containing nitrate and in media lacking nitrate. Little lag occurred when cells grown in media containing nitrate were transferred to a nitrate-lacking medium, and growth continued for 18-25 days. The generation time for this alga was 12 hr, and more than 2 mg of N were fixed in 25 days. Other algae (Plectonema and Anacystis) from a similar habitat failed to grow in medium lacking nitrate.

INDEX TERMS: Nitrates, Bioassay, Nutrient requirements, Nitrogen fixation, Aphanothece, Culture media.

AMIC-9345
"TOXICITY OF THE HERBICIDE KURON (SILVEX) TO BLUEGILL EGGS AND FRY", Wilbur, R. L., Whitney, E. W., Transactions of the American Fisheries Society, Vol. 102, No. 3, July 1973, pp 630-633.

Experimental treatment with herbicide Kuron of two alligatorweed-infested North Carolina streams was initiated by the U. S. Army Corps of Engineers in summer, 1965. Surveillance of fish and invertebrate populations was provided by the U. S. Bureau of Sport Fisheries and Wildlife. The effects of Kuron on bluegill eggs and fry were examined under laboratory conditions to provide insight on how reproduction of the sunfish family may have been affected by Kuron treatments applied to the streams. Eggs from each of nine bluegills were treated with Kuron concentrations of 0.0 ppm (control), 1.0 ppm, 1.0 ppm, 5.0 ppm, and 10.0 ppm acid equivalents. Analysis of variance indicated that hatching was not significantly affected by treatments but that survival of fry to an age of 6 days was affected by the treatments. No fry survived at 10.0 ppm and only a token few survived the 5.0 ppm treatment.

INDEX TERMS: Pesticide toxicity, Herbicides, Fish eggs, Fry, Water pollution effects, Bioassay, Fish reproduction, Sunfishes, Freshwater fish, Chlorinated hydrocarbon pesticides, Lethal limit, Kuron, Lepomis macrochirus, Survival, Median tolerance limit.

AMIC-9348
"BOTTOM MACROFAUNA IN THE GOCZALKOWICE DAM RESERVOIR IN THE YEARS 1965-1969", Krzyzanek, E., Acta Hydrobiologica. Cracow, Vol. 15, No. 2, 1973, pp 189-196.

Investigations of the bottom macrofauna of the dam reservoir at Goczalkowice were carried out from 1965-1969 as a continuation of those carried out from the beginning of its existence. Samples were taken at permanent points situated in 4 zones of the reservoir for analysis. The temperature of the water was 10 and 25 C, the pH value being 7.5-8.0. In the years 1965-1967 a further decrease in the amount of bottom macrofauna was observed, but from 1968 there was a gradual increase. Oligochaeta and the larvae of Chironomidae (mainly Procladius and Chironomus plumosus) dominated quantitatively. The number of large Mollusca, mainly Unio pictorum, also increased. The upper and central zones were most numerously populated by the bottom macrofauna. Usually the encountered forms had already been noted in previous years.

INDEX TERMS: Benthic fauna, Reservoirs, Systematics, Speciation, Aquatic animals, Aquatic insects, Mollusks, Annelids, Dominant organisms, Nematodes, Crustaceans, Bottom sampling, Macroinvertebrates.

AMIC-9349
"CUMULATION OF RADIOACTIVE SUBSTANCE IN DAM RESERVOIRS", Kwapulinski, J., Acta Hydrobiologica. Cracow, Vol. 15, No. 2, 1973, pp 215-225.

Benthos, periphyton, phytoplankton, zooplankton, bottom sediment, and higher plant samples were obtained from one rheolimnic and two limnic reservoirs to investigate the accumulation of radioisotopes in the various components. Three accumulation values were calculated for sediments and periphyton by dividing sample concentration by (1) specific water concentration or (2) by the mean concentration for water, and (3) by dividing mean sample concentration by mean water concentration. Values for other organisms were obtained using specific sample values and mean water values. The sediments accumulated radioisotopes 1,600 to 9,500 times depending on the type of sediment and hydrologic conditions. Periphyton accumulations ranged from 100 to 98,000 times. Other accumulations were: benthos, 5,900-12,000 times; zooplankton, 4,300-7,400 times; phytoplankton, 7,200-13,000 times; and aquatic plants, 8,700-40,000 times. It is concluded that because of the large uptake abilities of the sediments and organisms, self-purification processes are active in the reservoirs except in the event of turbulence when recontamination occurs. Periphyton should be useful as bioindicators of beta radioactivity contamination and also provide useful information on previous contamination levels.

INDEX TERMS: Radioisotopes, Benthos, Periphyton, Phytoplankton, Zooplankton, Sediments, Aquatic plants, Bioindicators, Biological magnification, Bioaccumulation.

AMIC-9356
"FIELD STUDIES ON PHOTOSYNTHESIS OF CLADOPHORA GLOMERATA (CHLOROPHYTA) IN GREEN BAY, LAKE MICHIGAN", Adams, M. S., Stone, W., Ecology, Vol. 54, No. 4, Summer 1973, pp 853-862.

Net photosynthesis of Cladophora glomerata was measured at three sites in lower Green Bay, Lake Michigan, from late spring through summer, 1971. Lower levels of productivity occurred early in the season at two of the sites, when water temperatures were lowest. At the third site water temperature and productivity varied the least. Contrary to other reports, it was found that Cladophora made relatively efficient use of low illumination. Under statistically similar temperature and irradiance levels, productivity was higher with increasing proximity to the mouth of the Fox River. Nitrogen, calcium, strontium, sodium, and zinc also were highest in concentration in plants receiving the greatest amount of effluents from the Fox River in comparison with the site receiving the least. Site differences in productivity appear to be related to nutrient levels, whereas seasonal differences in productivity are probably most closely related to seasonal temperature differences.

INDEX TERMS: Photosynthesis, Chlorophyta, On-site data collections, Environmental effects, Water pollution effects, Aquatic algae, Chemical analysis, Plant tissues, Cladophora glomerata, Green Bay, Chemical composition, Fox River, Seasonal variation, Photosynthetic rates, Data interpretation.

AMIC-9357
"HALF-SATURATION CONSTANTS FOR UPTAKE OF NITRATE AND AMMONIA BY RESERVOIR PLANKTON", Toetz, D. W., Varga, L. P., Loughran, E. D., Ecology, Vol. 54, No. 4, Summer 1973, pp 903-908.

Observations were made in order to learn if the uptake of NH4 and NO3 by freshwater plankton can be described by the Michaelis-Menten expression. Uptake of NO3 and NH4 by reservoir plankton was estimated at 5 concentrations using N-15 tracer techniques. A hyperbola results when the uptake velocity (v) of NO3 and NH4 is plotted against concentration (S). The S/v vs S transformation of the Michaelis-Menten expression was used to estimate K sub s. For a mixed population of blue-green algae in Lake Carl Blackwell, Oklahoma, K sub s was about 43 mg NO3-N/(cu m), when the initial concentration was 7.53 mg NO3-N/(cu m). In Lake Keystone, where the initial concentration of NO3-N was 419.17 mg/(cu m), enrichment with NO3 increased v in a similar way, suggesting use of the Michaelis-Menten model may not be realistic.

INDEX TERMS: Absorption, Ammonia, Nitrates, Plankton, Reservoirs, Water temperature, Lake Carl Blackwell, Half saturation constants, Sample preparation, Michaelis-Menten equation, Transparency.

AMIC-9367
"SEASONAL CHANGES IN POPULATION DENSITY AND VERTICAL DISTRIBUTION OF PROSOBRANCH VELIGERS IN OFFSHORE PLANKTON AT PLYMOUTH", Fretter, V., Shale, D., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 3, August 1973, pp 471-492.

Vertical and horizontal hauls were taken at approximately fortnightly intervals from April 1969 to April 1970 at L 3 (lat. 40 degrees 17.7 minutes N, long. 4 degrees 11.2 minutes W) and L 4 (lat. 50 degrees 15 minutes N, long. 4 degrees 12.5 minutes W). Thirty-two species of prosobranch veliger were present at L 3; these larvae were not as numerous at L 4 and only 26 species were recorded. The number of species was highest in the summer: the number of veligers was highest in February. After mid October both the number of species and the abundance of veligers decreased rapidly and remained low until early February. Veligers of some species occurred later at L 3 and L 4 than in more inshore waters and these were probably individuals carried beyond tidal influences which would normally lead to settlement on the shore. They included Lacuna vincta, Littorina littorea and L. neritoides. Veligers of all ages were found at all depths. At their time of greatest abundance veligers of many species occurred maximally at 5 or 10 m, with a variable decrease towards greater depths and a sudden one towards the surface. This distribution later changed giving a proportionally greater number at greater depth. When numbers were low the larvae scattered through the water column with little or no indication of a preferred depth. An examination of the age composition of veligers of rissoids, Natica alderi, Nassarius reticulatus and Philbertia linearis from certain catches showed that the surface accumulation at the time of abundance was composed of a high percentage of young veligers: in an ageing population there was a higher percentage of larvae, especially the older ones, at greater depths, except for Nassarius reticulatus

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which consistently showed maximal numbers above 10 m until the larvae became scarce. When blooms of Phaeocystis occurred they affected the distribution, driving the larvae away from the surface.

INDEX TERMS: Larval growth stage, Ecological distribution, Gastropods, Mollusks, Invertebrates, Salinity, Water temperature, Veligers, Population density, Seasonal variation, Vertical distribution, Sample preservation, Marine environment.

AMIC-9370
"BROWN SEAWEED AS AN INDICATOR OF HEAVY METALS IN ESTUARIES IN SOUTH-WEST ENGLAND", Bryan, G. W., Hummerstone, L. G., Journal of the Marine Biological Association of the United Kingdom, Vol. 53, No. 3, August 1973, pp 705-720.

Concentrations of copper, zinc, lead, aluminum, manganese and iron in the brown seaweed Fucus vesiculosus have been measured in samples collected over its range of distribution in four estuaries having different degrees of metal contamination. Factors controlling the concentrations in the weed have been studied and include the concentrations of metals in the water, seasonal changes, the position of the weed in the intertidal zone and the particular portion of the plant which is analyzed. It is concluded that analysis of the weed gives a reasonable indication of average conditions in the water at points along an estuary and provides a method of making comparisons with the same estuary in subsequent years or with other estuaries.

INDEX TERMS: Phaeophyta, Kelps, Estuarine environment, Heavy metals, Bioindicators, Water pollution, Pollutant identification, Plant tissues, Chemical analysis, Water analysis, Seasonal variation, England, Biological magnification.

AMIC-9373
"THE ZOSTERA EPIFAUNAL COMMUNITY IN THE YORK RIVER, VIRGINIA", Marsh, G. A., Chesapeake Science, Vol. 14, No. 2, June 1973, pp 87-97.

The invertebrate epifauna occurring on Zostera marina L. in the lower York River, Virginia, was sampled with the aid of SCUBA for 14 consecutive months from a collecting station located at each of three different water depths within a single eelgrass bed. The plants were clipped at their bases and the organisms were washed from the plants into a 0.5-mm sieve, then preserved in 8-10 percent seawater-formalin solution. Each blade was stripped of sediment, epiphytes and sessile fauna. Cleansed plants were oven-dried at 80 C for 48 hr, then weighed to the nearest 0.1 g. A total of 112 invertebrate species were collected. The five most abundant non-colonial species (Bittium varium, Paracerceis caudata, Crepidula convexa, Ampithoe longimana and Erichsonella attenuata) accounted for approximately 59 percent of the total fauna. These species dominated the epifauna throughout most of the year. Several other species, including Balanus improvisus, Molgula manhattensis, Polydora ligni and Ercolania fuscata, were abundant for only brief periods. A relatively high average index of affinity (58 percent) between all synchronous sample pairs indicated a generally homogeneous fauna, although several species were differentially distributed with depth. Exfoliation of Zostera after June caused a steady decline in plant biomass, but the abundance of epifauna continued to increase into the summer and fall. Lowest total numbers and species counts occurred in February and early March. Diversity values (H') ranged from 1.92 to 3.90 bits/individual and averaged 3.04 bits/individual for all stations. High species numbers in summer were generally counteracted by relatively low equitabilities (epsilon), with H' showing little seasonal change. The primary sources of nutrition for the epifauna appeared to be (1) plankton and suspended

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particulate matter, (2) detritus and microorganisms on the plant blades, and (3) epiphytic algae.

INDEX TERMS: Biological communities, Food webs, Fish food organisms, Marine plants, Marine animals, Biomass, Dominant organisms, Estuarine environment, Marine microorganisms, Crustaceans, Annelids, Mollusks, Nematodes, Rotifers, Diatoms, Marine fish, Diptera, Epiphytes, Epifauna, Eelgrass, York River, Seasonal variation, Species abundance, Species diversity, Zostera marina, Macroinvertebrates, Flatworms, Acorn worms, Tunicates, Sponges, Bryozoa, Coelenterates, Nemerteans.

AMIC-9374
"LARVAE OF THE BURROWING SHRIMP, UPOGEBIA AFFINIS, (CRUSTACEA, DECAPODA, UPOGEBIIDAE), FROM VIRGINIA PLANKTON", Sandifer, P. A., Chesapeake Science, Vol. 14, No. 2, June 1973, pp 98-104.

Four zoeal stages of Upogebia affinis taken in plankton samples from the York River estuary and adjacent lower Chesapeake Bay, Virginia, are described and figured. Upogebia affinis zoeae may be identified readily in plankton samples. Distinguishing characteristics include an unarmed carapace and rostrum in all stages, the shape and spination of the telson, and the flattened appearance of the endopodites of the pereiopods in late stages.

INDEX TERMS: Larval growth stage, Zooplankton, Chesapeake Bay, Crustaceans, Invertebrates, Estuarine environment, Marine animals, Upogebia affinis, York River, Zoeae, Animal morphology, Burrowing shrimp.

AMIC-9376
"STANDING CROP OF SALT MARSHES SURROUNDING CHINCOTEAGUE BAY, MARYLAND-VIRGINIA", Keefe, C. W., Boynton, W. R., Chesapeake Science, Vol. 14, No. 2, June 1973, pp 117-123.

Chincoteague Bay is surrounded by approximately 95 sq km (23,000 acres) of irregularly flooded salt marsh dominated by short Spartina alterniflora. The maximum standing crop, chemical composition, and live:dead ratio of the marsh grasses were estimated from samples taken at 20 marsh stations in August, 1970. Samples consisting of all the aerial plant parts were taken from a total of 20 sites. Plant parts lying on the ground and no longer attached to the plant were also included in the sample. The samples were oven-dried to constant weight at 100 C, and the estimated weight of plant material per sq m at each station was determined. To obtain weights of organic material, the samples were ground, charred, and burned at 550 C until the ash weight remained constant. Ash-free dry weight was then determined as the difference between the weight of the ash and the weight of the subsample. The pulverized samples were analyzed for C, N, P, K, Ca, and Mg. Live standing crop ranged from 427 to 558 g dry matter/sq m and 335 to 470 g organic matter/sq m. The total standing crop of live plants consisted of 48 million kg of dry material of which 39 million kg was organic material. Chemical analysis indicated that phosphorus and potassium were rapidly leached from the dead plants while magnesium tended to be retained. Live:dead ratios ranged from 0.9 to 2.3 and were lower than those found in regularly flooded marshes.

INDEX TERMS: Standing crops, Salt marshes, Tidal marshes, Organic matter, Chemical analysis, Chemical composition, Marsh grasses, Chincoteague Bay, Sample preparation, Species abundance, Spartina alterniflora.

AMIC-9377
"MORTALITY OF MARKET-SIZED OYSTERS (CRASSOSTREA VIRGINICA) IN THE VICINITY OF A DREDGING OPERATION", Rose, C. D., Chesapeake Science, Vol. 14, No. 2, June 1973, pp 135-138.

The oyster lease in Palmetto Bayou, southern Louisiana, was inspected 4-5 months after dredging occurred to determine sediment-induced damage to market-sized oysters. It was assumed that mortality near the spoil bank would exceed that at site further from the bank. The average mortality of market-sized oysters collected at seven sampling stations within 595 m of a spoil bank crossing the oyster lease was 57 percent, as compared to an average mortality of 17 percent of the remainder of the lease. Sediment (2-15 cm thick) commonly covered oysters taken from the affected area. Theoretical mortality was estimated to be 48 percent.

INDEX TERMS: Mortality, Dredging, Sedimentation, Environmental effects, Oysters, Mollusks, Marine animals, Spoil banks, Bottom sampling, Shellfish farming, Shellfish, Estuarine environment, Invertebrates, Eastern oyster, Crassostrea virginica, Palmetto Bayou, Macroinvertebrates, Data interpretation.

AMIC-9378
"CHANGE IN FEEDING AND BODY CONDITION OF BROWN BULLHEADS OVERWINTERING IN THE HEATED EFFLUENT OF A POWER PLANT", Massengill, R. R., Chesapeake Science, Vol. 14, No. 2, June 1973, pp 138-141.

Winter food habits and condition factors of the brown bullhead, Ictalurus nebulosus, were determined from specimens collected in the discharge canal of the Connecticut Yankee Atomic Power Company plant and Chapman Pond, a cove of the Connecticut River unaffected by artificial heating. Stomach content analysis indicated that fish overwintering in the heated discharge fed while those in water at 2 C from Chapman Pond did not. Fish, annelids, insects, molluscs and zooplankton were consumed, with fish the most abundant food. Bullheads began feeding before the temperature reached 4 C in Chapman Pond. The normal bullhead diet of invertebrates shifted to smaller fish in the densely populated canal. Although the bullheads in the canal fed throughout the winter, their body condition was poorer than that of fish overwintering in Chapman Pond.

INDEX TERMS: Thermal stress, Heated water, Water pollution effects, Food habits, Fish physiology, Powerplants, Fish food organisms, Life cycles, Annelids, Aquatic insects, Overwintering sites, Mollusks, Zooplankton, Crustaceans, Freshwater fish, Brown bullhead, Ictalurus nebulosus, Chapman Pond, Elvers, Stomach analysis.

AMIC-9380
"MUD SHRIMP (CALLIANASSA) LARVAE (CRUSTACEA, DECAPODA, CALLIANASSIDAE) FROM VIRGINIA PLANKTON", Sandifer, P. A., Chesapeake Science, Vol. 14, No. 3, September 1973, pp 149-159.

Larval stages attributed to three species of Callianassa (designated as spp. A, B and C) taken in plankton samples from the lower Chesapeake Bay are described and figured. Evidence concerning tentative identification of spp. A and B is discussed, and it is suggested that these larvae may be ascribed to Callianassa biformis and Callianassa atlantica, respectively.

INDEX TERMS: Zooplankton, Chesapeake Bay, Larval growth stage, Crustaceans, Invertebrates, Ecological distribution, Estuarine environment, Mud shrimp, Zoeae, Animal morphology, Sample preservation.

AMIC-9383
"COMPARATIVE ECOLOGY AND ZOOPLANKTON OF TWO MARYLAND PONDS INCLUDING A CONGENERIC OCCURRENCE OF DIAPTOMUS (CALANOIDA: COPEPODA)", Smrchek, J. C., Chesapeake Science, Vol. 14, No. 3, September 1973, pp 188-196.

Two freshwater ponds, one permanent (Pond 1) and the other temporary (Pond 2), located on the western Maryland shore of the upper Chesapeake Bay were studied periodically from April 1970 to January 1971. Periodic physiochemical data, plant and zooplankton samples, and general seasonal observations were obtained. The temporary pond became dry in mid-September and remained so until late November. Free carbon dioxide, dissolved oxygen, and hardness fluctuated irregularly throughout the study. In August the pH in the permanent pond decreased greatly with little subsequent recovery. After Pond 2 again contained water, hardness increased to over 400 percent of values before drying. Lists of aquatic flowering plants were prepared for both ponds. Each pond contained a distinct assemblage of zooplankters probably influenced by the amount of aquatic vegetation present. Total zooplankton species numbers in each pond were almost equal, but the temporary pond contained greater quantities of zooplankton. Two generations per year of D. sanguineus were found in Pond 2. Eubranchipus vernalis (Verrill) and E. holmani (Ryder) were found in December in Pond 2; the general life cycle of these anostracans is briefly outlined. A congeneric occurrence of two calanoid copepods Diaptomus birgei Marsh and D. sanguineus Forbes was found in May in temporary Pond 2. Both are of the same subgenus (Onychodiaptomus Light). Various causes and mechanisms explaining congeneric occurrences are briefly reviewed. Slight size differences, insufficient time due to several factors discussed, for competitive exclusion to operate to completion, and partial seasonal separation appear to best explain the present co-occurrence.

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INDEX TERMS: Zooplankton, Ecology, Ponds, Freshwater, Crustaceans, Copepods, Invertebrates, Physicochemical properties, Aquatic plants, Speciation, Water chemistry, Waterfleas, Growth stages, Rotifers, Species abundance, Macrophytes.

AMIC-9384
"THE BIOLOGY OF BROWN ALGAE ON THE ATLANTIC COAST OF VIRGINIA. II. PETALONIA FASCIA AND SCYTOSIPHON LOMENTARIA", Rhodes, R. G., Connell, M. U., Chesapeake Science, Vol. 14, No. 3, September 1973, pp 211-215.

Microscopic, brown algal crusts and filaments were collected in the summer from an oyster reef on the Atlantic coast of Virginia and isolated into culture. Developmental studies showed that the isolates were microscopic stages of Petalonia and Scytosiphon. These two brown algae exist the year around in the form of either microscopic or macroscopic plants. In culture no sexual reprduction was found linking the two stages of either Petalonia or Scytosiphon. The zoospores from the macroscopic plants of Petalonia and Scytosiphon developed directly into crusts and initials on the crusts developed directly into macroscopic plants. Culture conditions of 10 C and a 9-15 hour photoperiod stimulated the development of macrothalli in both taxa.

INDEX TERMS: Plant growth, Phaeophyta, Plant morphology, Marine algae, Marine plants, Cultures, Germination, Water temperature, Salinity, Benthic flora, Sessile algae, Speciation, Biology, Petalonia fascia, Scytosiphon lomentaria, Plant development, Culturing techniques.

AMIC-9402
"A NEW MULTIPARAMETER SEPARATOR FOR MICROSCOPIC PARTICLES AND BIOLOGICAL CELLS", Steinkamp, J. A., Fulwyler, M. J., Coulter, J. R., et al., Review of Scientific Instruments, Vol. 44, No. 9, September 1973, pp 1301-1310.

A new flow-system instrument for quantitative analysis and sorting of microscopic particles, particularly biological cells, based on multiple measurements of physical and biochemical properties has been developed. Cells stained with fluorescent dyes in liquid suspension enter a unique flow chamber where electrical and optical sensors measure cell volume, single- or two-color fluorescence, and light scatter, and emerge in a liquid jet that is broken into uniform droplets. Sensor signals are electronically processed several ways for optimum cell discrimination and are displayed as pulse-amplitude distributions using a pulse-height analyzer. Processed signals trigger cell sorting according to preselected parametric criteria. Sorting is accomplished by electrically charging droplets containing the cells and electrostatically deflecting them into collection vessels. This instrument is described in detail with illustrative examples of experiments using polystyrene fluorescent microspheres, cultured human cells, and human leukocytes.

INDEX TERMS: Instrumentation, Separation techniques, Cytological studies, Sorting, Staining, Counting, Counting chambers.

AMIC-9417
"A CONTRIBUTION TO THE ECOLOGY AND DISTRIBUTION OF AQUATIC ACARI IN THE ST. LAWRENCE GREAT LAKES", Modlin, R. F., Gannon, J. E., Transactions of the American Microscopical Society, Vol. 92, No. 2, April 1973, pp 217-224.

Aquatic Acari were investigated in benthic, planktonic, and neustonic habitats in Lakes Michigan, Huron, Superior, and St. Clair. Sampling was carried out using bottom grab samplers, plankton nets and specially designed floating nets modified from Zaitsev (1963). The mites were preserved in 10 percent formalin in the field and transferred to Koenike's solution in the laboratory. Temporary mounts were made in 50 percent lactic acid solution. Of the 382 Great Lakes specimens examined, 15 genera and 21 species were found. These collections increased the number of known Great Lakes water mites to 21 genera and 32 species. The water mites were not abundant in terms of biomass nor species composition. The scarcity of aquatic vegetation is an important limiting factor. Benthic littoral and sublittoral habitats had the greatest numbers of individuals and species. Species composition and biomass diminished rapidly with depth. Hygrobates longipalpis and Lebertia porosa were most abundant and widely distributed in benthic habitats. Piona rotunda and Unionicola crassipes were most common in the plankton and Hydrozetes, Limnohalacarus, and Soldanellonyx were unique to the neuston.

INDEX TERMS: Ecological distribution, Great Lakes, Aquatic habitats, Ecology, Limiting factors, Speciation, Animal groupings, Water mites, Hydracarina, Neuston, Species abundance, Sample preservation.

AMIC-9418
"PREPARATION OF SLIDE PERIPHYTON FOR VARIOUS PRODUCTIVITY ANALYSES", Czarnecki, D. B., Williams, H. D., Nordheim, E. I., Transactions of the American Microscopical Society, Vol. 92, No. 3, July 1973, pp 364-371.

An analytical procedure which employs ultrasonic vibration for the removal of diatoms from microscope slides has been used to obtain data on community chlorophyll content and diatom composition from the same sample. In this procedure the periphyton slide is placed in a polyethylene bag filled with $MgCO_3$ saturated 90 percent acetone and the bag suspended in a vibrator filled with tap water and a small amount of wetting agent. The instrument is set at maximum cavitation for 30 min after which the bag is removed, its content poured into centrifuge tubes and centrifuged at top speed for 10 min. Acetone solutions of the contents were analyzed for chlorophyll content. Dilutions and centrifugations of the remaining tubes yield a suspension from which the diatom frustules may be cleaned and mounted. In applying the above technique, a recovery rate of over 99 percent was maintained using slide substrates incubated over a period of 8 weeks.

INDEX TERMS: Periphyton, Primary productivity, Diatoms, Systematics, Methodology, Measurement, Chrysophyta, Biological communities, Chlorophyll, Algae, Slide preparation, Sample preparation, Frustules, Recovery.

AMIC-9419
"STERILE CULTURE TECHNIQUES FOR SPECIES OF THE ROTIFER ASPLANCHNA", Aloia, R. C., Moretti, R. L., Transactions of the American Microscopical Society, Vol. 92, No. 3, July 1973, pp 364-371.

Several new techniques are subscribed for culturing the rotifer Asplanchna brightwelli, the protozoan, Paramecium aurelia, and the bacterium Aerobacter aerogenes. The bacterium is grown at 37 C, harvested by centrifugation, and stored in a separatory funnel in a concentrated suspension at 4 C. Aliquots of the bacterial medium are fed to cultures of paramecia which are maintained at 31 C. Portions of the paramecia solutions, in turn, are fed to rotifer populations at room temperature. The entire culture scheme is sustained by employing aseptic procedures. Sterile culture conditions were maintained by working under aseptic hoods containing UV germicidal lamps turned on at all times. The glassware was vigorously washed in Tide, thoroughly rinsed in tap and distilled water, drained dry, wrapped in tin foil, and autoclaved at 15 psi for 20 min. Glassware used for chemicals was washed separately from that used for bacteria, paramecia, and rotifers.

INDEX TERMS: Protozoa, Bacteria, Rotifers, Methodology, Life cycles, Growth rates, Harvesting, Microorganisms, Culturing techniques, Sterile cultures, Culture media, Growth media, Sample preparation.

AMIC-9420
"BIOTIC CHARACTER AS RELATED TO STREAM MINERAL CONTENT", Neel, J. K., Sr., Transactions of the American Microscopical Society, Vol. 92, No. 3, July 1973, pp 404-415.

Nine montane streams in or near deciduous forests in eastern Kentucky and western Virginia were studied in relation to those factors involved in the level of autotrophism and benthos composition present. Samples of vegetation and macrobenthos were collected during each of several collecting trips and the water was analyzed for O2 (one time), alkalinity, hardness, Ca, Mg, inorganic P, ammonia, and nitrite nitrogen. Algae and other plants were scraped or pulled from the bottom, macrobenthos was taken with a Surber net from movable materials, submerged vegetation, and along bank overhangs, and naiad clams and crayfish were often picked up or caught by hand. Vegetation was preserved and stored in 2-4 percent formaldehyde solutions. Diatoms were later cleaned in acid and mounted in Hyrax. Macrobenthos was fixed in formalin, washed with water, sorted, and stored in alcohol. Parts for microslides were cleared in Euparol essence and mounted in diaphane. The streams fell into two distinct classes with respect to hardness and alkalinity - five with these values below 30 mgl (Type B streams) and four with them exceeding 50 mgl (Type A streams). B streams contained as much or more phosphorus and nitrogen as the A's, but had no vegetation other than very sparse algal growth, and, with one exception, lacked molluscs. Type A streams had abundant flowering plants and/or algae at all seasons and well-developed mollusc populations. Benthic insects also showed definite A and B characteristics, although the two stream types had a number of forms in common. Neither degree of shading nor stream size seemed primarily involved in scarcity of plants in B streams. Allochthonous debris was more concentrated in B streams. In one stream system the biota changed from B to A in character with downstream mineral increase.

AMIC-9420 (Continued) Card 2/2

INDEX TERMS: Biological properties, Natural streams, Benthos, Aquatic animals, Aquatic plants, Ecological distribution, Water quality, Water chemistry, Bottom sampling, Water sampling, Aquatic algae, Invertebrates, Systematics, Organic matter, Mollusks, Aquatic insects, Annelids, Crustaceans, Water analysis, Montane streams, Mineral content, Sample preservation, Macroinvertebrates, Flatworms.

AMIC-9422
"AN AEROPHILOUS DIATOM COMMUNITY FROM HOCKING COUNTY, OHIO", Lowe, R. L., Colling, G. B., Transactions of the American Microscopical Society, Vol. 92, No. 3, July 1973, pp 492-496.

An aerophilous winter diatom community consisting of 41 taxa was dominated by Melosira roseana Rabh., both in terms of number of cells and bio-mass. Scanning electron microscopy revealed details of M. roseana auxospore and vegetative cells not previously reported.

INDEX TERMS: Diatoms, Biological communities, Cytological studies, Aquatic habitats, Ecological distribution, Aerobic conditions, Dominant organisms, Winter, Scanning electron microscopy, Sample preparation, Species abundance.

AMIC-9423
"STREPTOCEPHALUS MOOREI N. SP., A NEW FAIRY SHRIMP (ANOSTRACA) FROM MEXICO", Belk, D., Transactions of the American Microscopical Society, Vol. 92, No. 3, July 1973, pp 507-512.

More than 200 specimens of the genus Streptocephalus were collected in Chihuahua, Mexico, and fixed in 70 percent ethanol. A few specimens were washed in several changes of distilled water for 24 hr before placing them in 10 percent formalin for 24 hr. The fairy shrimp were then prepared for study by scanning electron microscopy. The Anostraca collected were a new species, S. moorei; the species is fully described and compared with other species already known for the genus.

INDEX TERMS: Crustaceans, Aquatic animals, Systematics, Speciation, Invertebrates, Mexico, Fairy shrimp, Streptocephalus moorie, Animal morphology, Anostraca, Macroinvertebrates, Scanning electron microscopy, Sample preparation, Sample preservation.

AMIC-9424
"OBSERVATIONS ON RED COLORED CELLS OF PERIDINIUM WISCONSINENSE EDDY FROM BUCKHORN LAKE, ONTARIO", Nicholls, K. H., Transactions of the American Microscopical Society, Vol. 92, No. 3, July 1973, pp 526-528.

Plankton samples taken from Buckhorn Lake, a eutrophic lake, revealed that Peridinium wisconsinense, widely distributed in the lake, exhibited a red coloration which masked the normal yellowish-brown pigment. The dimensions of 25 cells were recorded to determine a relationship, if any, between cell size and the red color. The red color of active cells in the plankton was not related to abnormally large cell size as has been believed for other species of Peridinium. Because the red color in active cells appears to be the result of preparation for encystment, it is suggested that P. wisconsinense has a cycle of encystment and excystment similar to that of P. cinctum f. westii.

INDEX TERMS: Dinoflagellates, Color, Life cycles, Phytoplankton, Aquatic algae, Pyrrophyta, Canada, Eutrophication, Microscopy, Pollutant identification, Seston, Peridinium wisconsinense, Buckhorn Lake, Cell size, Flagellates.

AMIC-9426
"TOXICITY BIOASSAY OF HEAVY METALS IN WATER USING TETRAHYMENA PYRIFORMIS", Carter, J. W., Cameron, I. L., Water Research, Vol. 7, No. 7, July 1973, pp 951-961.

The toxicities of five heavy metal compounds on the survival of the ciliated protozoan Tetrahymena pyriformis were determined. Three-day old cultured cells were exposed to five concentrations of each test compound in one or more of three water series; distilled, soft, and hard water. A culture of each sample was placed in a plastic petri dish and covered with mineral oil to prevent evaporation. The cells were counted initially, then again at 0.5 h, 1 h, 2 h, 1 day, 2 days, 3 days, and on the fourth day. Lethal threshold concentrations and tolerance limit medians were determined by graphic methods. On weight bases cadmium was most toxic, followed in decreasing toxicity by mercury, cobalt, zinc, and lead. Compared to similar fish data, all heavy metals were more toxic to T. pyriformis except lead. The toxicity of lead in soft versus hard water exemplified an antagonistic effect with greater than seven times the amount of lead necessary in hard water to produce comparable mortality as lead in soft water. On the other hand, the toxicity of mercury is about twice as great in hard water as in soft water (a synergistic effect). T. pyriformis appears to be a more sensitive indicator than fish of heavy metal contamination of water. T. pyriformis bioassay should prove a good means of determining the existence of many water pollutants.

INDEX TERMS: Bioindicators, Heavy metals, Bioassay, Toxicity, Water pollution effects, Protozoa, Cultures, Mercury, Cobalt, Zinc, Lead, Cadmium, Water (hardness), Water pollution, Lethal limit, Invertebrates, Tetrahymena pyriformis, Synergistic effects, Median tolerance limit, Culture media.

AMIC-9427
"THE CONSTRUCTION OF A SAND PROFILE SAMPLER: ITS USE IN THE STUDY OF THE VORTICELLA POPULATIONS AND THE GENERAL INTERSTITIAL MICROFAUNA OF SLOW SAND FILTERS", Lloyd, B., Water Research, Vol. 7, No. 7, July 1973, pp 963-973.

A simple and inexpensive method is described by which the component groups of the interstitial fauna can be examined undisturbed by direct microscopy. The method has been developed specifically to locate and enumerate the functional interstitial microfauna of slow sand filters used in water purification and it is designed to demonstrate the spatial relations of the constituent populations as they develop in time in a flowing system. Details of construction and methods of operating the sampler developed in this study are given. It has the features of (1) simple construction and time composed of cheap materials; (2) no mechanical closure device, thus no jamming; and (3) the depth distribution of living organisms being examined directly and immediately without disturbing the column or subsampling. The sampler has been successfully applied to monitoring the development of Protozoa and Rotifera in pilot scale and full scale slow sand filters at the London Metropolitan Water Board's Walton and Ashford Common Treatment Works. Results are presented for the incidence of the general microfauna and for the development, vertical distribution and effect of flow rate on the Vorticella populations.

INDEX TERMS: Connate water, Aquatic microorganisms, Fabrication, Protozoa, Rotifers, Annelids, Nematodes, Copepods, Aquatic populations, Sand profile sampler, Sampling equipment, Direct sampling, Sand filters, Flatworms, Species abundance, Vorticella spp.

AMIC-9428
"BIODEGRADATION OF UREA IN RIVER WATERS UNDER CONTROLLED LABORATORY CONDITIONS", Evans, W. H., David, E. J., Patterson, S. J., Water Research, Vol. 7, No. 7, July 1973, pp 975-985.

The biodegradation of urea in river waters has been evaluated under laboratory conditions. Urea will degrade to ammonia at a rate depending on the bacterial state of the river water and on the water temperature. Under normal conditions no breakdown may be expected to occur at temperatures below 8 C for 14 days contact. In river waters with a high suspended solids content, simulating extreme winter river conditions, a maximum breakdown of 3-6 percent daily of the original urea levels was found for temperatures not exceeding 8 C during the first 7 days contact.

INDEX TERMS: Ureas, Biodegradation, Laboratory tests, Natural waters, Degradation rates, Degradation products.

AMIC-9429
"CHRONIC EFFECT OF LOW pH ON FATHEAD MINNOW SURVIVAL, GROWTH AND REPRODUCTION", Mount, D. I., Water Research, Vol. 7, No. 7, July 1973, pp 987-993.

Fathead minnows (Pimephales promelas) were continuously exposed to reduced pH levels of 4.5, 5.2, 5.9, 6.6 and 7.5 (control) during a 13-month, one-generation test in order to measure the effect of such exposure on reproduction and growth of these fish. Since the TL sub 50 to the minnows was close to 4.0, two acute tests were performed in the same system after the chronic test to determine the lethal pH. Survival was not affected, even at the lowest pH tested. Fish behavior was abnormal, and fish were deformed at pH 4.5 and 5.2. Egg production and egg hatchability were reduced at pH 5.9 and lower, and all eggs were abnormal. A pH of 6.6 was marginal for vital life functions, but safe for continuous exposure. Free carbon dioxide, liberated by the addition of sulfuric acid to reduce the pH, may have had an unknown effect. The fish did not become acclimated to low pH levels. The TL sub 50 values in the acute tests were 4.05 and 4.2. In one test all fish died in the chamber maintained between pH 3.6 and 3.8, while all survived in pH 4.5-4.6. In the other test 20 percent survived pH 4.1-4.3 and none died at 4.5. Since exact lethal levels were not essential and pH control was very difficult, no further refined testing was done.

INDEX TERMS: Hydrogen ion concentration, Fish physiology, Toxicity, Water pollution effects, Bioassay, Growth stages, Animal growth, Fish behavior, Fish reproduction, Fathead minnow, Pimephales promelas, Survival, Median tolerance limit, Teratogenicity.

AMIC-9430
"THE REALITY OF THREE BRITISH BIOTIC INDICES", Sladecek, V., Water Research, Vol. 7, No. 7, July 1973, pp 995-1002.

In Great Britain three indices are used for classification of streams according to benthic invertebrates: the Trent River Board Biotic Index (Woodiwiss, 1964), the Lothians River Purification Board Index (Graham, 1965) and the Score-System (Chandler, 1970). All these indices are based in reality on the saprobic system of Kolkwitz and Marsson (1902, 1908, 1909) and its modern developments, mainly the saprobic index by Pantle and Buck (1955) and the saprobic valency by Zelinka, Marvan and Kubicek (1959). There is no substantial difference among the procedures named and the results are comparable among themselves as pointed out in this paper. The British indices deal only with a part of the whole extent of water quality and are restricted to running waters.

INDEX TERMS: Natural streams, Benthic fauna, Invertebrates, Bioindicators, Aquatic insects, Water quality, Annelids, Crustaceans, Mollusks, Growth stages, Nematodes, Biotic index, Saprobic index, Water mites, Species abundance, Macroinvertebrates, Flatworms.

AMIC-9431
"WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH. REPORT ON AMMONIA AND INLAND FISHERIES", Water Research, Vol. 7, No. 7, July 1973, pp 1011-1022.

The purpose of this review is to summarize the state of knowledge on the effect of ammonia on fish, to determine whether firm criteria can be established, and to indicate areas where further research is required. Data were primarily from European sources. The survey shows that sewage effluent and effluents from certain industries and from agriculture are common sources of ammonia in water. Of the parameters investigated (pH, CO2, DO, hardness, alkalinity, temperature, and salinity), it is found that the harmful effects of ammonia on fish were related to the pH value and the temperature of the water due to the fact that only the un-ionized fraction of ammonia is poisonous. The un-ionized fraction increases with rising pH value, and with rising temperature. Fish differ slightly in their tolerance to ammonia depending on species. The difference in tolerance being more significant for short periods of exposure. The difference in tolerance is, however, not great enough to justify different criteria for different species. The lowest toxic concentration found for salmonids is 0.2 mg NH3/l (un-ionized), but other adverse effects caused by prolonged exposure are only absent at concentrations lower than 0.025 mg NH3/l (un-ionized). Concentrations of total ammonia which contain this amount of un-ionized ammonia vary from 19.6 mg/l (pH 7.0, 5 C) to 0.12 mg/l (pH 8.5, 30 C). The criterion should not be applied to temperatures below 5 C or to pH values above 8.5 when other factors have to be taken into consideration.

INDEX TERMS: Water quality standards, Ammonia, Freshwater fish, Toxicity, Water temperature, Hydrogen ion concentration, Water pollution sources.

AMIC-9436
"EFFECT OF COPPER AND HEXAVALENT CHROMIUM ON THE SPECIFIC GROWTH RATE OF CILIATA ISOLATED FROM ACTIVATED-SLUDGE", Sudo, R., Aiba, S., Water Research, Vol. 7, No. 9, September 1973, pp 1301-1307.

Three species of protozoa, Vorticella microstoma, Colpidium campylum, and Opercularia sp., which commonly occur in activated sludge, were cultured in the presence of copper and hexavalent chromium to determine the effect of these metals on growth rates. Alcaligenes faecalis, which was found to be essentially unaffected by Cu and Cr, was added to mass and monoxenic cultures of protozoa as the sole food source. Metallic concentrations ranged from 0.05 to 1.6 mg Cu/l and 0.10 to 51.2 mg Cr/l which were added as copper sulfate and potassium dichromate. The term IL sub m (median inhibitory limit) was used to define the metal concentration required to reduce the specific growth rate of protozoa to one-half of that of a control. The IL sub m for copper was: 0.25 mg/l (V. microstoma), 0.32 mg/l (C. campylum), and 0.27 mg/l (Opercularia sp.). Regarding hexavalent chromium, IL sub m for V. microstoma, C. campylum, and Opercularia sp. were 0.53, 12.9 and 20.2 mg/l, respectively. Acclimation of each protozoa to these metals for 96 hr resulted in IL sub m enhanced values of 1.2-2.2 times as large as that for the control.

INDEX TERMS: Protozoa, Bioassay, Toxicity, Copper, Chromium, Growth rates, Vorticella microstoma, Colpidium campylum, Opercularia.

AMIC-9439
"STATISTICAL ANALYSIS OF BIOLOGICAL DATA FROM PREOPERATIONAL-POSTOPERATIONAL INDUSTRIAL WATER QUALITY MONITORING", Jensen, A. L., Water Research, Vol. 7, No. 9, September 1973, pp 1331-1347.

Trends in data on aquatic populations can be assessed using simple statistical methods and plotting results on control charts. The procedure was developed specifically to monitor the effects of industrial water, e.g. from power plants, on water quality based upon preoperational and postoperational data. Since many conditions cause changes in populations, the control charts are constructed with action limits which specify normal deviations of data. A statistical method is given to eliminate seasonal fluctuations in data. When data fall outside the action limits, a disturbance in the system is suspected. Since sampling of bottom fauna on the basis of transects in statistically unsound, a procedure of stratified sampling was developed for calculating statistical values on the basis of subpopulations. Use of the procedure is demonstrated with data from Browns Ferry Nuclear Power Plant which is being constructed by TVA on Wheeler Reservoir in northern Alabama. It is shown that stream monitoring can detect only relatively large changes that occur in aquatic populations.

INDEX TERMS: Monitoring, Water pollution effects, Aquatic populations, Statistical methods, Control charts, Data interpretation.

AMIC-9440
"BOTTOM FAUNA CHANGES DURING ARTIFICIAL RESERVOIR DESTRATIFICATION", Lackey, R. T., Water Research, Vol. 7, No. 9, September 1973, pp 1349-1356.

Parvin Lake, Colorado, a 19 ha mesotrophic reservoir with maximum depth of 10 m and mean depth of 4.4 m, was studied to evaluate the effects of thermal destratification (aeration) on bottom fauna. Identical sampling programs were carried out during a control year (Nov 1968-Oct 1969) and a treatment year (Nov 1969-Oct 1970). Samples were collected with an Ekman dredge, sieved through a wash bucket and the organisms separated by sugar flotation and rose bengal dyeing. Sampling sites (4) were selected on the basis of previous studies, preliminary sampling, and depth. Four macrobenthic species were abundant during the study: Asellus intermedius (isopod), Chaoborus sp. (phantom midge), Hyalella azteca (amphipod), and Lumbriculus inconstans (annelid). Several species of Chironomidae were present and treated collectively. Hyalella significantly increased in abundance in shallow water during destratification. Chironomid larvae declined in abundance in the profundal zone during destratification in Winter and Summer. Asellus, Chaoborus, and Lumbriculus were not significantly altered in abundance during destratification.

INDEX TERMS: Benthic fauna, Aquatic populations, Aeration, Destratification, Midges, Isopods, Amphipods, Annelids, Diptera.

AMIC-9445
"AN INTRODUCTION TO THE PHYTOPLANKTON, PRIMARY PRODUCTION AND RELEVANT HYDROGRAPHY OF LOCH ETIVE", Wood, B. J. B., Tett, P. B., Edwards, A., Journal of Ecology, Vol. 61, No. 2, July 1973, pp 569-585.

Primary productivity was measured in Loch Etive for the purpose of estimating the contribution of phytoplankton to the carbon cycle. The meteorology and hydrography were also assessed. Phytoplankton was collected at various depths in plastic water bottles, filtered, pigment extracted, and chlorophyll and ptin measured by fluorescence. Phytoplankton was identified and counted under the microscope. Primary production was measured by the C-14 method. The loch has a large catchment area, and inflowing freshwater reduces average salinity. Analysis of currents in terms of a two-layer system shows that separation of the deep (salty landwards flowing) and surface (brackish, seawards flowing) layers proceeds at 6-8 km/day. The upper 10 m of the water column corresponds approximately to the brackish and the euphotic zone. Standing crop in this zone of the lower loch ranged from about 7 to about 250 mg C/cu m based on pigment measurements. Skeletonema costatum was the dominant phytoplankter but small flagellates were also important. About 70 g C/sq m/yr is a rough estimate of gross annual primary production in the euphotic zone of the lower basin. A number of factors qualify this value, most important being difficulties in measuring CO2 concentrations, and day-to-day fluctuations in light intensity. Light is considered to be the most important limiting factor in the loch, and the effects of the wet west highland climate dominate the ecology of the phytoplankton.

INDEX TERMS: Biomass, Phytoplankton, Primary productivity, Carbon cycle, Diatoms, Dominant organisms, Light intensity.

AMIC-9475
"THE RELATIONSHIP OF ENZYME KINETIC HETEROTROPHY ANALYSIS TO OTHER EUTROPHICATION INDICES", Koob, D. D., Utah State University, Utah Agricultural Experiment Station, Logan, Utah, Research Report No. 11, June 1973, 14 pp. NTIS Report No. PB-221 540.

Three locations in Bear Lake, an ultraoligotrophic lake on the Utah-Idaho border, were sampled for five eutrophication indicators - primary productivity, total bacterial concentrations, coliform concentrations, V sub t values, and dark uptake rates for inorganic carbon. In general, samples from the northern and central water gyres of the lake were similar, but different from samples from the southern gyre. No numerically significant correlations were found between any two of the parameters tested, although similar weekly patterns of change were noted for dark uptake of inorganic carbon and V sub t values at two of the locations. Highest rates of carbon fixation (both photosynthetic and non-photosynthetic) and of organic carbon uptake occurred at the location nearest concentrated human occupation. High values for coliform counts, V sub t values, and primary productivity occurred during periods of high tourist activity. A stimulatory influence of Swan Cree inflow on primary productivity was indicated.

INDEX TERMS: Water analysis, Oligotrophy, Trophic level, Bear Lake, Enzyme kinetic heterotrophy, Eutrophication index.

AMIC-9480
"BIOLOGICAL INVESTIGATIONS OF LAKE WINGRA", Koonce, J. F., Teraguchi, M., Baumann, P. C., et al., University of Wisconsin, Laboratory of Limnology, Madison, Wisconsin, Report No. EPA-R3-73-044, August 1973, 118 pp.

An investigation of seasonal changes in species diversity and biomass of phytoplankton, zooplankton, benthos, and fish in Lake Wingra, Madison, Wisconsin, was conducted during 1970 and 1971. The objective of this study was to obtain ecological data on the biological components of an aquatic ecosystem and to utilize these data along with concurrent chemical data to aid the development of systems models of nutrient and energy fluxes in lake drainage basins. Interpretations of data gathered during this study reveal several important considerations for models of lake systems and future studies of Lake Wingra. Phytoplankton associations, for example, appear to be adaptive, self-organizing systems. Such behavior suggests the possibility to apply optimization principles to phytoplankton models. The data suggest, furthermore, that optimization analysis can be based on size particle distributions of the phytoplankton, which, rather than species, appears to be the basis of phytoplankton categories. Zooplankton and benthos analyses, on the other hand, indicate that energy and nutrient fluxes may be adequately approximated by simulating only a few species. Finally, results of fish studies imply that models of whole lake ecosystems must account for the mobility of predators in estimating their impact on prey populations, which should be characterized by differing spatial and temporal susceptibility to predation.

INDEX TERMS: Phytoplankton, Zooplankton, Benthos, Freshwater fish, Biology, Biomass, Cycling nutrients, Energy budget, Model studies, Ecological distribution, Primary productivity, Biorhythms, Standing crops, Fish food organisms, Water chemistry, Dominant organisms, Energy conversion, Lake Wingra, Seasonal variation, Species diversity, Species abundance, Seasonal succession, Nutrient sources.

AMIC-9483
"BIOLOGICAL FIELD AND LABORATORY METHODS FOR MEASURING THE QUALITY OF SURFACE WATERS AND EFFLUENTS", Weber, C. I. (Ed.), U. S. Environmental Protection Agency, Analytical Quality Control Laboratory, Cincinnati, Ohio, Report No. EPA-670/4-73-001, July 1973, 187 pp.

This manual contains biological methods selected by a committee of biologists for use in routine field and laboratory works in fresh and marine waters during short-term enforcement studies, water quality trend monitoring, effluent testing and research projects. These methods are considered to be the best that are presently available.

INDEX TERMS: Analytical techniques, Water quality, Monitoring, Methodology, Plankton, On-site tests, Laboratory tests, Pollutant identification, Periphyton, Aquatic life, Fish, Toxicity, Aquatic plants, Phytoplankton, Zooplankton, Biomass, Chemical analysis, Aquatic algae, Aquatic bacteria, Rotifers, Protozoa, Crustaceans, Standing crops, Bioassay, Bibliographies, Bioindicators, Model studies, Resistance, Aquatic insects, Invertebrates, Annelids, Mollusks, Water pollution effects, Fishing, Animal physiology, Plant physiology, Data interpretation, Macroinvertebrates, Biometrics, Sampling techniques, Sample preparation, Quantitative analysis, Sample preservation.

AMIC-9484
THE BIOLOGY OF BLUE-GREEN ALGAE, Carr, N. G., Whitton, B. A. (Editors), Botanical Monographs, Vol. 9, Blackwell Scientific Publications, London, England, 1972, 676 pp.

This volume gives an account of most aspects of blue-green algal biology that are of general interest, or are currently the subject of particularly marked activity. Some of the topics are: 'Synthesis of Metabolic Intermediates' - A.J. Smith; 'Metabolic Control and Autotrophic Physiology' - N.G. Carr; 'Photosynthetic Reactions and Components of Thylakoids' - D.W. Krogmann; 'Fine Structure and Chemical Composition of the Cell Envelopes' - G. Drews; 'Cytochemical Examination' - G.W. Fuhs; 'Lipid Composition and Metabolism' - B.W. Nichols; 'Biliproteins and Bile Pigments' - D.J. Chapman; 'Mutagenesis and Genetic Recombination' - C. Van Baalen; 'Phycoviruses' - R.S. Safferman; 'The Heterocyst' - P. Fay; 'Nitrogen Fixation' - W.D.P. Stewart; 'Gas Vacuoles' - A.E. Walsby; 'Freshwater Plankton' - B.A. Whitton; 'Physiology and Ecology of Marine Blue-Green Algae' - G. E. Fogg; 'Ecology of Blue-Green Algae in Hot Springs' - R.W. Castenholz; 'Interactions with Other Organisms' - B.A. Whitton; 'The Relationship between Blue-Green Algae and Carbonate Deposits' - S. Golubic; 'Status of Classical Taxonomy' - T.V. Desikachary; 'Evolutionary and Ecological Aspects of the Cyanophytes' - T.D. Brock; 'Autotrophy and Heterotrophy in Unicellular Blue-Green Algae' - R.Y. Stanier; 'Culture Collections' - J. Komarek; 'Notes of Isolation and Laboratory Culture' - N.G. Carr, J. Komarek, B.A. Whitton; 'Continuous Culture of Filamentous Blue-Green Algae' - J. Thomas; 'Mass Cultivation of Anacystis nidulans' - F. Juttner.

INDEX TERMS: Cytological studies, Phytoplankton, Aquatic algae, Cyanophyta, Marine algae, Ecology, Soil algae, Nuisance algae, Biology, Chemical composition.

AMIC-9514
"THEORETICAL EFFECTS OF ARTIFICIAL DESTRATIFICATION ON ALGAL PRODUCTION IN IMPOUNDMENTS", Lorenzen, M., Mitchell, R., Environmental Science and Technology, Vol. 7, No. 10, October 1973, pp 939-944.

Artificial mixing is an important tool in the management of eutrophic lakes and reservoirs. Theoretical models of phytoplankton production are briefly reviewed and a model for application to mixed impoundments is derived. The model considers both nutrient depletion and the balance between photosynthesis and respiration as potential biomass limiting factors. The results of model calculations show that nutrient limited biomass is directly proportional to the depth of mixing, whereas light-limited peak biomass decreases linearly with increased depth of mixing. It is believed that in impoundments where artificial destratification is a successful control technique, nutrient limited algal blooms are replaced by light-limited blooms of smaller magnitude. The most important variables are the depth available for mixing and the attenuation of light in the water column.

INDEX TERMS: Destratification, Impoundments, Primary productivity, Effects, Limiting factors, Eutrophication, Depth, Model studies, Nutrient depletion, Artificial mixing.

AMIC-9520
"CARBON DIOXIDE AND PH: EFFECT ON SPECIES SUCCESSION OF ALGAE", Goldman, J. C., Shapiro, J., Science, Vol. 182, No. 4109, October 19, 1973, pp 306-307.

Arguments are presented to refute Shapiro's hypothesis (see AMIC-6551) that predominance of blue-green algae results from a lowering of aqueous CO2 concentration as the pH rises in natural waters. Three objections are presented: (1) that algal growth is not controlled by free CO2 concentrations, (2) that the pH can affect the availability of nutrients other than CO2, and (3) that the result of changing the pH may be through its effects on algal enzymes that may be involved in nutrients transport. Shapiro's responses to these objections are also presented.

INDEX TERMS: Limiting factors, Dominant organisms, Carbon dioxide, Hydrogen ion concentration, Succession.

AMIC-9525
"ACUTE TOXICITY OF BERYLLIUM SULFATE TO THE COMMON GUPPY", Slonim, A. R., Journal Water Pollution Control Federation, Vol. 45, No. 10, October 1973, pp 2110-2122.

The acute toxicity of beryllium sulfate solutions to guppies was determined in five static bioassays. Other bioassays evaluated those factors that may affect the median tolerance limits such as the fish age, increase of pH, and previous exposure to beryllium. Some preliminary radioberyllium studies on Be uptake in guppies are presented to gain some insight into the mechanism of Be toxicity. The 96-hour median tolerance limit was 20.3 mg/l in hard water and 0.19 mg/l in soft water. Acute toxicity was independent of fish age but reduced to some extent by buffering the solutions. Proper preexposure conditioning significantly increased the tolerance of guppies to very toxic concentrations. Radio-beryllium data on exposed fish and some individual organs, as well as on the effects of various factors on beryllium uptake, were reviewed in conjunction with the toxicity data. These results indicate that the toxicity and lethality may not depend on the amount of beryllium concentrated within the fish, but more likely on the effect on a particular target organ or cellular or subcellular component.

INDEX TERMS: Toxicity, Beryllium, Bioassay, Water pollution effects, Age, Absorption, Environmental effects, Water chemistry, Guppy, Median tolerance limit, Bioaccumulation, Lebistes reticulatus, Beryllium sulfate, Beryllium radioisotopes, Data interpretation.

AMIC-9527
"EFFECTS OF RESIDUAL CHLORINE ON AQUATIC LIFE", Brungs, W. A., Journal Water Pollution Control Federation, Vol. 45, No. 10, October 1973, pp 2180-2193.

Increased use of chlorine and recent studies of residual chlorine toxicity in aquatic systems have emphasized the need for close scrutiny of present disinfection procedures. This review discusses chlorine uses and chlorine chemistry and emphasizes toxicity studies in the field and in the laboratory. Interim criteria, based on knowledge to date, for permissible concentrations of total residual chlorine are: (1) in areas receiving wastes treated continuously with chlorine, not to exceed 0.01 mg/l for the protection of more resistant organisms only, or not to exceed 0.002 mg/l for the protection of most aquatic organisms; and (2) in areas receiving intermittently chlorinated wastes, not to exceed 0.2 mg/l for a period of 2 hr/day for more resistant species of fish, or not exceed 0.04 mg/l for a period of 2 hr/day for trout and salmon. If free chlorine persists, more restrictive criteria are warranted. Alternate procedures or substitutes for chlorination should be investigated.

INDEX TERMS: Aquatic life, Water pollution effects, Industrial wastes, Pollutant identification, Waste water (pollution), Municipal wastes, Toxicity, Aquatic animals, On-site tests, Laboratory tests, Chlorination, Methodology, Lethal limit, Mortality, Waste water treatment, Effluents, Marine animals, Marine plants, Persistence, Aquatic plants, Chlorine residual, Species diversity, Dechlorination.

AMIC-9529
"TOTAL DISSOLVED ELECTROLYTE EFFECTS ON PERIPHYTON", Dickman, M., Journal Water Pollution Control Federation, Vol. 45, No. 10, October 1973, pp 2211-2215.

Periphyton are good pollution indicators because they, unlike many fish and bottom fauna, cannot leave an area during severe pollution and return after conditions have improved. A study was made of the periphyton above and below a sulfite pulp and paper mill, and continuous conductivity monitoring supplemented the data collected on pH, temperature, alkalinity, oxygen, and turbidity. Results showed no significant differences in any of the water chemistry parameters above or below the pulp mill. The continuous monitoring, however, revealed peak values for conductivity below the mill that were not duplicated above the mill. The peaks indicated a change in one or more of the parameters that could not be found using random sampling techniques.

INDEX TERMS: Periphyton, Electrolytes, Dissolved solids, Water pollution effects, Liquid wastes, Pulp wastes, Sessile algae, Water chemistry, Bioindicators, Monitoring, Protozoa, Salts, Data interpretation.

AMIC-9530
"ENVIRONMENTAL CONTROL OF PHYTOPLANKTON CELL SIZE", Parsons, T. R., Takahashi, M., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 511-515.

On the basis of ecological and physiological data, those determinate factors contributing to phytoplankton cell size are the: (1) rate of nitrate or ammonia input to the cell, (2) extinction coefficient of the water, (3) mixed layer depth, (4) light intensity, (5) sinking rate of phytoplankton, and (6) upwelling velocity of the water. Two different sized species of phytoplankton, the large Ditylum brightwellii and the small Coccolithus huxleyi, were used to demonstrate this phenomenon mathematically. From the results obtained it was apparent that the growth rates for C. huxleyi are higher than those for D. brightwellii in areas which are known to be predominated by small-celled phytoplankton (e.g. stable subtropical seas such as the Sargasso Sea and temperate waters such as the subarctic Pacific). On the other hand the larger phytoplankton species shows a higher growth rate in areas of tropical and antarctic upwelling as well as in coastal environments; this also is in general agreement with current observations.

INDEX TERMS: Phytoplankton, Environmental effects, Physiological ecology, Plant growth, Growth rates, Limiting factors, Marine algae, Cell size.

AMIC-9531
"INFLUENCE OF HUMIC SUBSTANCES ON THE GROWTH OF MARINE PHYTOPLANKTON: DIATOMS", Prakash, A., Rashid, M. A., Jensen, A., et al., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 516-524.

Humic compounds isolated from brownish water of a mangrove swamp and from Fucus vesiculosus and Laminaria digitata were studied in relation to their influence on the growth of axenic and nonaxenic marine diatom cultures. Growth was measured by estimation of cell numbers and volumes at frequent intervals in a Coulter counter equipped with a volume converter. Responses to humic additives were determined by exposing the cultures to 1 or 5 microCi of activity of C-14 added as C-14-$NaHCO_3$ and incubating them at 10 C and 4 klux light intensity for 2-4 hr. The activity was measured with a thin-window gas-flow counter. Chlorophyll a content was also measured. The humic and fulvic acids extracted from decomposed residues of the two littoral marine algae and from mangrove leachates, stimulated the growth of a number of marine diatoms. This stimulatory effect was dependent on the concentration as well as the molecular size of the humic additive. Low molecular size fractions at low concentrations generated the maximum growth responses, as evidenced by increased cell yield, growth rate, chlorophyll concentration, and radiocarbon assimilation.

INDEX TERMS: Humic acids, Fulvic acids, Diatoms, Growth rates, Water pollution, Laboratory tests, Phaeophyta, Plant growth, Mangrove swamps, Cell volume, Chlorophyll a, Culture media, Sample preparation.

AMIC-9532
"PHYTONEUSTON ECOLOGY OF A TEMPERATE MARINE LAGOON", Hardy, J. T., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 525-533.

Comparison of neuston (upper 0.4 cm) and plankton (10 cm deep) water samples from a temperate marine lagoon and an adjacent, less sheltered bay indicates that: (1) the surface microlayer exhibits greater and more rapid environmental fluctuations than the subsurface water; (2) no abundant phytoneuston populations develop outside the lagoon; (3) in the main lagoon fairly abundant phytoneuston populations develop; (4) phytoneuston populations are most developed in the shallow sheltered pond area of the lagoon, particularly in summer; (5) taxonomic diversity is generally lower and dominance greater in well-developed phytoneuston populations than in underlying phytoplankton populations; (6) photosynthetic assimilation ratios are greater in phytoneuston than in phytoplankton populations.

INDEX TERMS: Lagoons, Temperate, Ecology, Phytoplankton, Bays, Dominant organisms, Primary productivity, Standing crops, Biological communities, Protozoa, Marine algae, Marine environment, Phytoneuston, Sample preservation, Sample preparation, Species diversity, Species abundance, Silicoflagellates.

AMIC-9533
"A STUDY OF PLANKTON DYNAMICS AND NUTRIENT CYCLING IN THE CENTRAL GYRE OF THE NORTH PACIFIC OCEAN", Eppley, R. W., Renger, E. H., Venrick, E. L., et al., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 534-551.

The dynamics of phytoplankton growth in relation to nutrient concentrations were studied in the subtropical central gyre of the North Pacific in November 1971. Rates of excretion of phosphate, ammonium, and urea-N by zooplankton and rates of assimilation of carbon, nitrate, ammonium, and urea-N by phytoplankton were measured. The growth rate of phytoplankton was estimated to be about 0.2-0.3 doublings/day in the 70-80-m mixed layer, apparently limited by concentrations of both nitrogen and phosphate. Only nitrogen concentration was so limiting at a station near the western edge of the California Current. No diel changes in concentrations of ambient nutrients were observed. Urea-nitrogen appears to be an important source of nitrogen for phytoplankton growth in these waters and to be an important excretory product of zooplankton. Concentrations of phosphate and ammonium were extremely low, but turnover times were estimated to be of the order 3-5 days for ammonium and greater than 10 days for urea and phosphate. Biomass of phytoplankton in the mixed layer was also very low, and corresponded approximately to that expected if a laboratory culture were operated as a nitrogen-limited chemostat with a concentration of about 0.48 microgram-atom N/liter in the incoming culture medium and a dilution rate of about 0.13 per day. Physiological differences were noted between the phytoplankton in the mixed layer and that living below the thermocline, as were differences in chemical composition (ratio of C:Chl a and C:N).

AMIC-9533 (Continued) Card 2/2

INDEX TERMS: Cycling nutrients, Zooplankton, Phytoplankton, Growth rates, Limiting factors, Pacific Ocean, Photosynthesis, Mixolimnion, Phosphates, Nitrogen, Biomass, Water pollution, Water analysis, Vitamins, Trace elements, Carbon, Excretion rates, Assimilation rates, Data interpretation, Chemical composition.

AMIC-9534
"REGRESSIONS BETWEEN BIOLOGICAL OCEANOGRAPHIC MEASUREMENTS IN THE EASTERN TROPICAL PACIFIC AND THEIR SIGNIFICANCE TO ECOLOGICAL EFFICIENCY", Blackburn, M., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 552-563.

Simple regressions of various standing stocks on each other and on primary productivity were compared by covariance analysis for different seasons, latitudes, and longitudes in the eastern tropical Pacific. The stock of zooplankton varies significantly with that of chlorophyll a to a power less than 1.0 in all seasons and areas, and it is shown that a similar relation probably exists between the corresponding rates of daily production. A similar relation holds in the regression of standing stock of fish-cephalopod micronekton, suitably lagged, on stock of zooplankton. Thus the relative amount of organic matter transferred from one trophic level to another probably decreases with an increase of stock and production at the lower level, so that ecological efficiency is higher in oligotrophic than in eutrophic situations, in tropical oceans. Standing stock of chlorophyll a varies significantly with primary productivity to a power less than 1.0. The stock of crustacean micronekton sometimes varies with the stock of chlorophyll a to a power greater than 1.0, which is interpreted as a feeding aggregation. (Reprinted from Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 552-563. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Pacific Ocean, Standing crops, Primary productivity, Regression analysis, Biological properties, Tropical regions, Zooplankton, Temporal distribution, Spatial distribution, Chlorophyll a, Ecological distribution, Latitudinal studies.

AMIC-9535
"GRAZING OF PSEUDOCALANUS MINUTUS ON NATURALLY OCCURRING PARTICULATE MATTER", Poulet, S. A., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 564-573.

The quantity and size of particulate matter consumed by Pseudocalanus minutus were studied in seawater samples collected from different depths and from closely spaced stations. The heterogeneity in particle distribution resulted from quantitative and qualitative fluctuations in the particle spectrum, although at times the total concentration was about the same. Pseudocalanus minutus consumed particles between 4 and 100 microns. An electivity index value was more often positive for 25.4-57.0-micron particles. On the average, particles less than 39 microns were more readily eaten than larger particles. The consumption by copepods at different locations was related not only to particle concentration but also to the pattern of the particle size spectrum. Pseudocalanus was able to shift its grazing pressure from small to large particles to compensate for a reduction in density of small particles. (Reprinted from Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 564-573. Copyright 1973 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Grazing, Food habits, Laboratory tests, Particle size, Selectivity, Browse utilization, Particulate matter, Pseudocalanus minutus, Bedford Basin, Vertical distribution, Particle concentration.

AMIC-9542
"A NEW METHOD FOR THE ESTIMATION OF ABSOLUTE MICROFOSSIL NUMBERS, WITH REFERENCE ESPECIALLY TO DIATOMS", Battarbee, R. W., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 647-653.

Random distribution of diatoms for estimation of absolute microfossil numbers can be obtained using an evaporation tray with depressions to hold four cover slips. A measured quantity of well mixed suspension is added to the tray and allowed to evaporate without disturbance. The cover slips can then be removed or the samples mounted directly by inverting a slide with mountant on the cover slips. Statistical analyses of randomness and variance showed that the technique is statistically reliable. Procedures are given for utilizing these data in conbination with data on water content, sediment density, and deposition rate to produce meaningful results. Data obtained for Lough Neagh, Northern Ireland suggest a relationship between increasing total diatom deposition, increasing importance of alkalibiontic species in fossil diatom communities, and the possible progress of eutrophication.

INDEX TERMS: Diatoms, Cytological studies, Sample preparation, Counting.

AMIC-9543
"A PORTABLE APPARATUS FOR MEASURING RELATIVE GAS VACUOLATION, THE STRENGTH OF GAS VACUOLES, AND TURGOR PRESSURE IN PLANKTONIC BLUE-GREEN ALGAE AND BACTERIA", Walsby, A. E., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 653-658.

An apparatus developed to measure gas vacuolation, strength of gas vacuoles, and cell turgor pressure in blue-green algae and bacteria is based on the finding that a quasi-quantitative estimate of gas vacuoles can be obtained from the decrease in turbidity when gas vacuoles are collapsed by application of pressure. The apparatus comprises three main parts: a cylinder of compressed gas connected to a gas inlet system with a gauge to monitor the pressure, which is connected to a pressure-resistant glass nephelometer tube housed in a nephelometer; and a battery-powered millivolt meter with amplifier, monitoring the output of the nephelometer photocell. Readings are made by admitting gas in steps of 50 kN/sq m to a final pressure of 1.4 MN/sq m and recording turbidity at each step. Cell turgor pressure is determined with a second sample containing sucrose solution at a concentration of 0.5 M. The pressure required to collapse the vacuoles is equal to the cell turgor pressure. The relative degree of gas vacuolation can be estimated from the ratio delta T sub a to T sub c, where delta T sub a is the change in turbidity when all vacuoles are collapsed and T sub c is the turbidity due to the cells remaining after collapsing all gas vacuoles. The equipment is portable and costs about 560 dollars for parts.

INDEX TERMS: Cyanophyta, Mechanical equipment, Bacteria, Gas vacuolation, Turgor pressure.

AMIC-9544
"PATTERNS OF RADIOCARBON UPTAKE BY A THERMOPHILIC BLUE-GREEN ALGA UNDER VARYING CONDITIONS OF INCUBATION", Sperling, J. A., Hale, G. M., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 658-662.

In vitro and fast (40 cm/sec), and slow (1-3 cm/sec) flow in situ methods of sampling were compared by measuring the primary productivity of Mastigocladus laminosus Cohn using each procedure. Current effect and the mechanics of in vitro incubation were distinguished by comparing the distributions of radioactivity within the cores. Thick (4.5-4.6 mm) and thin (10-1.5 mm) mats were grown on styrofoam in aquaria and transferred to a laboratory stream model for in situ tests. For in vitro tests, samples were taken with a steel cork borer, placed in 20-ml screwcap vials, and the vials placed in the stream model. C-14-labeled NaHCO3 was introduced into the stream and samples taken for radioactivity counts after 3 and 9 hours. The data suggest that the in vitro technique for determining radiocarbon primary productivity of thermophilic algae that form gelatinous mats in justified, whether the cores be thick or thin, when the core is composed entirely of algae free from bacteria or substratum. Under these conditions the total uptake of in vitro incubations approaches that of in situ incubations. Where cores are bounded by bacteria or substratum, estimates of primary productivity may by underrated by the in vitro technique.

INDEX TERMS: Bioassay, Primary productivity, On-site tests, Cyanophyta, In vitro tests, Mastigocladus laminosus.

AMIC-9547
"DECOMPOSITION OF MARINE COPEPODS", Harding, G. C. H., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 670-673.

As the first step in establishing the proportion of net damaged to dead copepods in plankton tows, experiments were conducted to investigate the rate of decomposition of dead animals. Samples of Calanus finmarchicus, which had been killed by suffocation, were sealed in 30-ml vials containing Halifax water at 4 C or Sargasso Sea surface water at 22 C. Additional tests were conducted in which Calanus were sterilized by gamma radiation or autoclaving. The irradiated Calanus were also incubated at 20-22 C in seawater filtered through a 0.22-micron filter. One vial of each series was opened at 24 hour intervals, until decomposition and the carcasses stained for bacteria with carbol thionin. The material was stained on a 0.45-micron filter which was later mounted in Permount on a glass slide. Rod-shaped bacteria decomposed dead Calanus within 11 days in 4 C Halifax water and within 3 days in 22 C Sargasso Sea water. In both cases initial infection occurred on the exoskeleton and apparently progressed into the organisms through the mouth. The urosome and internal extremities were the last to be attacked. Samples in filtered seawater were covered with small coccoid bacteria after 49 days, but copepod tissues were all distinguishable. Collection of surface corpses by net is thought to be impossible after the first day of death in subtropical waters and beyond the sixth day in temperate coastal waters.

INDEX TERMS: Biodegradation, Sampling, Copepods, Sea water, Bacteria.

AMIC-9549
"OBSERVATIONS ON UPSTREAM MIGRATION BY IMAGINES OF SOME PLECOPTERA AND EPHEMEROPTERA", Madsen, B. L., Bengtson, J., Butz, I., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 678-681.

The migration of the imagines of some stream insects was investigated using sticky traps prepared with transparent polyethylene sheets to which had been applied a layer of sticky adhesive (Tanglefoot). The sheets were set up transversely over the stream, using a wooden frame or wires with one sticky side facing upstream and the other downstream. The plecopteran Brachyptera risi showed upstream migration; Nemoura sp. did not. The ephemeropterans Caenis rivulorum, Baetis (rhodani and vernus), and Ephemerella ignita all showed upstream migration.

INDEX TERMS: Aquatic insects, Mature growth stage, Migration patterns, Mayflies, Stoneflies, Upstream, Downstream, Imagines.

AMIC-9554
"BIOLOGICAL MODELS OF FRESHWATER COMMUNITIES", Taub, F. B., University of Washington, College of Fisheries, Seattle, Washington, Report No. EPA-660/3-73-008, August 1973, 81 pp.

Data from continuous cultures of an alga (Chlamydomonas reinhardtii) and protozoan (Tetrahymena vorax) have been used to construct a model of algal standing crop over ranges of light intensity, dilution rate, and nutrient concentration both in the absence and presence of predation by the protozoa. The model has been used to demonstrate response surfaces for the steady-state standing crop values for the algae and protozoa over the ranges used in the laboratory experiments (shown as isopleths). The physical variables had a marked effect on the algal standing crop which influenced the growth rate of the protozoan. The standing crop of the protozoan was determined by growth and dilution rates. The effect of the predation was dependent on the protozoan standing crop. The response surfaces indicate that predation can reduce algal standing crop only within certain ranges of the variables considered. The experimental density results and the model projections, adjusted for the daily varying flow rates, are shown. The chemical analyses for steady-state cultures are reported but not entirely integrated into the model. The comparative toxicities of Aroclor 1242, a polychlorinated biphenyl and DDT, were tested on the alga and protozoan, and also on daphnids, ostracods, and guppies.

INDEX TERMS: Standing crops, Model studies, Ecosystems, Biological communities, Food chains, Environment effects, Protozoa, Growth rates, Laboratory tests, Pesticide toxicity, Freshwater fish, Crustaceans, Predation, Computer models, Aquatic algae, Primary productivity, Secondary productivity, Continuous cultures, Population density.

AMIC-9555
"EFFECTS OF PROTOZOA ON THE FATE OF PARTICULATE CARBON", Holm, H. W., Smith, F. A., U. S. Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, Georgia, Report No. EPA-660/3-73-007, August 1973, 42 pp.

Laboratory studies were designed to define the role of protozoa in the fate of particulate (bacterial) organic carbon. Specific objectives were (1) to measure the effects of selected environmental parameters on protozoan growth ates, (2) to measure organic carbon in bacteria and protozoa, and (3) to quantitate carbon transformations in predator-prey experimental systems. A growth system containing 200 million Citrobacter/ml in 0.001 M phosphate of pH 7.5, incubated at 25 C at a shaking rate of 100 rpm, was found to be an optimal environment for protozoan growth. The nutrient bacterium, Citrobacter, contained 8.6 times 10 to the minus 11 power mg C/cell, and Tetrahymena pyriformis contained 1.1 ng C/cell. T. pyriformis altered the amount and form of carbon in the system while growing on bacteria. Of the total organic carbon present at the initiation of the predator-prey experiment (93 mg), 93 percent was in the bacterial fraction. Within 96 hours, 38 percent of the carbon was released as CO2; 5 percent was present as inorganic carbon in the water and the remainder (57 percent) was decreased from 86 to 2 mg within 96 hours, while the carbon in the protozoan biomass increased from 1 to 40 mg. In the bacterial control, 11 percent of the organic carbon was released as CO2 within 96 hours while negligible amounts of inorganic carbon remained in the water.

INDEX TERMS: Protozoa, Growth rates, Environmental effects, Aquatic bacteria, Cycling nutrients, Food chains, Carbon cycle, Limiting factors, Ecosystems, Particulate carbon, Biotransformation, Substrate utilization, Fate of pollutants, Tetrahymena pyriformis, Citrobacter.

AMIC-9556
"AN INTRODUCTION TO THE IDENTIFICATION OF CHIRONOMID LARVAE", Mason, W. T., Jr., U. S. Environmental Protection Agency, Analytical Quality Control Laboratory, Cincinnati, Ohio, EPA Report, January 1973, 90 pp.

This identification guide was prepared to serve as a supplement to those more definitive descriptions of chironomid larvae by Johannsen (1934-37), Roback (1957), Curry (1961), Darby (1962), and Beck and Beck (1966), which take into account a variety of head and body characteristics for classification. Head capsules of various species are pictured to complement the keys to subfamily and genus, and to familiarize the beginner with structures that are used for identification.

INDEX TERMS: Aquatic insects, Diptera, Larvae, Systematics, Speciation, Midges, Chironomids, Insect morphology, Sample preservation.

AMIC-9557
"BIOLOGICAL MONITORING OF THE AQUATIC ENVIRONMENT BY THE ENVIRONMENTAL PROTECTION AGENCY", Weber, C. I., Reprint from: Biological Methods for the Assessment of Water Quality, Special Technical Publication 528, American Society for Testing Materials, Philadelphia, Pennsylvania, 1973, pp 46-60.

The responsibility for water quality monitoring in the EPA is shared by the Office of Monitoring, Office of Air and Water Programs, Office of Enforcement and General Counsel, and Office of Research. Four types of monitoring have been identified - ambient trend monitoring, source monitoring, case preparation monitoring, and research monitoring. The water quality monitoring network of the EPA will consist of 5000 to 10,000 EPA-funded stations and 40,000 to 50,000 stations operated by state and local agencies. The data will be stored in a central EPA computerized system called STORET. The responsibility for quality control and the development, validation and standardization of chemical, microbiological, and biological methodology for water and wastewater has been assigned to the Analytical Quality Control Laboratory (AQCL) (now the Methods Development and Quality Assurance Research Laboratory-MDQARL) in Cincinnati. Water quality is reflected in the species composition and diversity, population density and physiological condition of indigenous communities of aquatic organisms. Biological methodology employed in water quality monitoring in the EPA deals primarily with sample collection, sample processing, counting and identification of aquatic organisms, biomass measurements, measurement of bioaccumulation and biomagnification of pollutants, and biological data processing and interpretation.

INDEX TERMS: Monitoring, Water quality, Methodology, Bioindicators, Species diversity, Bioaccumulation, Biological magnification, Data interpretation.

AMIC-9558
"DESCRIPTION AND ECOLOGY OF THREE STENONEMA MAYFLY NYMPHS", Lewis, P. A., Offprint from: Proceedings of the First International Conference on Ephemeroptera, Florida A and M University, Tallahassee, Florida, August 12-20, 1970, pp 57-72.

Three previously undescribed mayfly nymphs (Stenonema scitulum, S. terminatum and S. integrum) were collected from the Ohio and Scioto Rivers and from natural substrates in small streams in the Ohio Basin. The nymphs were reared in tanks to the adult stage and the subimaginal skins, nymphal exuviae and nymphs were preserved in 70 percent ethanol. Complete descriptions are given for the three species of nymphs.

INDEX TERMS: Mayflies, Immature growth stage, Ecological distribution, Aquatic insects, Systematics, Speciation, Water quality, Nymphs, Insect morphology.

AMIC-9559 (Continued) Card 2/2

INDEX TERMS: Thermal powerplants, Phytoplankton, Thermal stress, Growth rates, Condensers, On-site investigations, Aquatic algae, Cooling water, Primary productivity, Heated water, Water pollution effects, Laboratory tests, Methodology, Measurement, Plant growth, Environmental effects, Photosynthesis, On-site tests, Lake Wylie, Seasonal variation, Pumping rates, Data interpretation.

AMIC-9559
"FIELD INVESTIGATIONS OF THE RESPONSE OF PHYTOPLANKTON TO THERMAL STRESS", Gurtz, M. E., Weiss, C. M., University of North Carolina, Department of Environmental Sciences and Engineering, Chapel Hill, North Carolina, ESE Publication No. 321, December 1972, 152 pp.

Investigations are reported of the effects of condenser passage on phytoplankton productivity and subsequent growth. Samples before and after condenser passage were collected simultaneously for three different levels of temperature rise (10, 20, and 30 F delta T) on six dates at the Allen steam-electric generating plant on Lake Wylie, North Carolina. Controlled cooling rates appropriate to the average seasonal meteorological conditions and temperatures involved were applied to the samples. Productivity measurements using the carbon-14 method were made at several times during the cooling period, including a final determination after 26 hours. A relationship between the intake temperature, delta T, and primary productivity was found. Relatively constant inhibitions occurred for a 10 or 20 F rise in temperature, regardless of the initial temperature, although a trend toward greater inhibitions at initial temperatures greater than 83 F was suggested. A 30 deg F delta T produced successively greater inhibitions in productivity with increasing intake temperature. Maximum inhibition occurred during the first 1-2 hours of cooling, and neither further inhibition nor recovery was observed during the remainder of the 26-hour cooling period. Results suggest that some stimulation of photosynthesis may have occurred from mechanical effects of condenser passage. Growth of thermally stressed samples in nutrient-enhanced laboratory cultures was correlated with the magnitude of thermal exposure; the highest final yields during a 2-week period were found for the samples with the greatest thermal stress. Diversity changes in phytoplankton populations following thermal exposure were suggested as a reason for these results. Implications of findings for power plant design were also discussed.

AMIC-9585
"EFFECTS OF DIELDRIN ON BROWN TROUT IN FIELD AND LABORATORY STUDIES", Dacre, J. C., Scott, D., New Zealand Journal of Marine and Freshwater Research, Vol. 7, No. 3, September 1973, pp 235-246.

Fifty-five liters of dieldrin spray were accidentally discharged into the Silver Stream, a tributary of the Taieri River, Otago, New Zealand, in September 1963. All the brown trout (Salmo trutta) in the lower portion of the stream were killed. A quantitative survey was not carried out until January 1964, and some repopulation was noted. The bottom fauna was sampled 7 days after the release of dieldrin. Statistical analyses of the data showed no significant effect of dieldrin on the benthic fauna. Bioassays were conducted to determine the LC sub 50 for comparison with other species. Tissue analyses for dieldrin residues were also carried out by gas-liquid chromatography. The 24-hr LC sub 50 for dieldrin was found to be 0.016 ppm. Minimum residue levels of dieldrin in skeletal muscles, liver, and brain were 1-2 ppm.

INDEX TERMS: Brown trout, Water pollution effects, Dieldrin, Pesticide toxicity, Benthic fauna, Pesticide residues, On-site investigations, Laboratory tests, Bioassay, Lethal limit, Median tolerance limit, Animal tissues, Bioaccumulation.

See also: Category 1, AMIC-8561, 9268, 9350, 9366, 9371, 9379, 9481, 9513, 9538
Category 3, AMIC-9126, 9561.

AMIC-6941
"SURVIVAL OF BACTERIA IN EXTREME ENVIRONMENTS", Weiss, R. L., Indiana University, Bloomington, Indiana, Dissertation Abstracts No. 73-2765, 1972, 235 pp. (Complete report not available from AMIC.)

Sulfolobus acidocaldarius is a newly described species of sulfur oxidizing bacteria able to live at low pH and high temperature. The organism is also characterized by facultative autotrophic growth on sulfur or simple organic compounds and a subunit cell wall lacking peptidoglycan. In nature Sulfolobus was found to exist at temperatures from 60-94 C and at pH values from 1.6-3. The temperature optimum for growth was 70-75 C; whereas the pH optimum for C-14-glutamate uptake was from 2-4. Survival and growth of Sulfolobus in extreme conditions were demonstrated by slide immersion studies and electron microscopy of natural samples taken at pH 2-3 and 75 C. These studies showed that in addition to Sulfolobus, two groups of rod shaped bacteria exist at 75 C. These are distinguished from Sulfolobus by their morphology and cell wall structure. Electron microscopic studies showed that in flowing habitats with deposits of elemental S cells were enriched with thin filamentous appendages known as pili. These were not found on cells from bubbling pools containing S crystals, suggesting that the possession of filaments is a response to the physical flow of the habitat rather than the presence of S. The results of laboratory experiments suggest a role of filament in the attachment of cells to S. This attachment was observed directly by fluorescent and scanning electron microscopy. Additional studies were carried out on the cell envelope to determine the biochemical nature of the unusual cell wall structure. These studies demonstrated a lipoprotein and a highly charged cell wall with a high proportion of hydrophobic amino acids. Conceivably such a structure could contribute to the survival of Sulfolobus in extremes of temperature and pH.

AMIC-6941 (Continued) Card 2/2

INDEX TERMS: Sulfur bacteria, Thermophilic bacteria, Cytological studies, Hot springs, Acidic soils, Acidic water, Survival, Sulfolobus acidocaldarius, Characterization, Cell wall, Chemical composition.

AMIC-8641
"ATP POOLS IN ACTIVATED SLUDGE", Chiu, S. Y., Kao, I. C., Erickson, L. E., et al., Journal Water Pollution Control Federation, Vol. 45, No. 8, August 1973, pp 1746-1758.

The possibility was investigated of using adenosine triphosphate (ATP) in process identification and control. The behavior of ATP concentration was studied along with measurements for heterogeneous microbial populations, such as chemical oxygen demand (COD) and MLSS, in a continuous stirred tank reactor at various dilution rates. At each dilution rate, the physiological behavior of cells harvested from the continuous-flow reactor was studied using batch experiments. Efforts were made to investigate the relation among APT, biomass, and substrate concentration in all experiments, and the relation between the ATP content in the cells and the substrate removal rate. Results of the experiments indicate that dilution rate can affect sludge activity and cellular ATP content significantly and that ATP concentrations in experiments with both continuous and batch cultures were generally proportional to the biomass and the amount of substrate removed. Because ATP concentration responds rapidly to cell viability and changes with population shifts and the phase of growth, it is concluded that ATP may be a useful variable in process identification, operation, and control, although further understanding of the relationship between ATP concentration and activated sludge behavior is necessary if its full potential as a measurable variable is to be realized.

INDEX TERMS: Activated sludge, Biological treatment, Methodology, Nutrient removal, Efficiencies, Waste dilution, Laboratory tests, Chemical concentration, ATP pools, Batch cultures, Substrate utilization, Sewage microorganisms, Process control, Process identification, Continuous cultures.

AMIC-9034
"CELL YIELD AND GROWTH RATE IN ACTIVATED SLUDGE", Sherrard, J. H., Schroeder, E. D., Journal Water Pollution Control Federation, Vol. 45, No. 9, September 1973, pp 1889-1897.

A laboratory study of the completely mixed activated sludge process showed that the observed cell yield coefficient corresponding to each value of sludge age or mean cell residence time is a conceptually and practically significant parameter. At low cell residence times, low mixed liquor suspended solids, high sludge production, and high removal of inorganic nutrients may be expected, while long residence times lead to removal. Removal of biochemical oxygen demand is nearly constant under both conditions.

INDEX TERMS: Activated sludge, Growth rates, Laboratory tests, Biological treatment, Nutrient removal, Cell yield, Sewage microorganisms, Residence time, Substrate utilization.

AMIC-9126
"SULFUR AND THE TOXICITY OF THE RED ALGA CERAMIUM RUBRUM TO BACILLUS SUBTILIS", Ikawa, M., Thomas, V. M., Jr., Buckley, L. J., Uebel, J. J., Journal of Phycology, Vol. 9, No. 3, September 1973, pp 302-304.

In an investigation the antibiotic activity of algae, the red alga Ceramium rubrum showed the greatest growth inhibitory activity against B. subtilis. Quantities of C. rubrum were collected and assayed to determine the nature of the inhibitory substance. The algae were washed, blotted, and allowed to air dry at room temperature. The dried algae were ground, extracted with benzene for 4-5 days in a Soxhlet extractor, and dried in vacuo to yield the crude active extract. The crude extract was dissolved in chloroform and chromatographed to yield an active fraction which was prepared for further identification by thin-layer chromatography. Crystalline sulfur was the inhibitory substance isolated from the red seaweed. This alga was unusual in that it contained a much higher free sulfur content than other red and brown algae tested.

INDEX TERMS: Rhodophyta, Algal toxins, Sulfur, Inhibition, Growth rates, Marine algae, Bacteria, Toxicity, Isolation, Sulfur compounds, Bacillus subtilis, Ceramium rubrum, Sample preparation, Thin layer chromatography.

AMIC-9142
"MICROBIAL DEGRADATION OF PETROLEUM AT LOW TEMPERATURE", Cundell, A. M., Traxler, R. W., Marine Pollution Bulletin, Vol. 4, No. 8, August 1973, pp 125-127.

Hydrocarbon-degrading bacteria were isolated from littoral sediments collected in Chesapeake Bay, Nova Scotia, and from oil-contaminated soil adjacent to a natural oil seep at Cape Simpson, Alaska by an enrichment culture technique using Nos. 1 and 6 fuel oils and naphthalene as enrichment substrates. The enrichment flasks were incubated at 0, 8, 16 and 24 C. The majority of bacteria were isolated from the 16 and 24 C enrichment flasks and were members of the genera Pseudomonas, Arthrobacter, Corynebacterium, Vibrio, Achromobacter, and Brevibacterium. The range of hydrocarbon utilization was studied using a Pseudomonas and an Arthrobacter isolate. Growth on solid media containing the hydrocarbons at 16 C was used as criteria and it was shown that the isolates grew at the expense of dodecane, hexylbenzene, naphthalene, phenanthracene, decalin, tetralin and methylcyclohexane but not xylene. Growth occurred between 8 C and 24 C within 14 days of incubation suggesting the bacteria are tolerant of a range of temperatures. The data suggest that bacteria existing in low temperature marine and coastal environments play a significant role in the biodegradation of pollutant hydrocarbons.

INDEX TERMS: Isolation, Bottom sediments, Marine bacteria, Microbial degradation, Littoral, Growth rates, Petroleum hydrocarbons, Substrate utilization, Fate of pollutants, Hydrocarbon-oxidizing bacteria, Aromatic hydrocarbons, Aliphatic hydrocarbons.

AMIC-9176
"NATURAL HABITAT OF CARYOPHANON LATUM", Trentini, W. C., Hachen, C., Canadian Journal of Microbiology, Vol. 19, No. 6, June 1973, pp 689-694.

When samples of fresh dung from pigs, horses, sheep, or cattle were enriched to encourage the growth of Caryophanon latum, the organism was found to be specifically associated with cattle dung. Several sheep dung samples were found to be positive for C. latum, but all were taken from a pasture where sheep and cattle were grazed together. All samples taken from sheep not pastured with cattle were negative. Autoclaved samples of cattle, horse, and sheep dung all supported growth and natural morphology of C. latum after 1-4 days exposure. Control samples exposed to air in areas far removed from cattle were uniformly negative. Aseptically collected 'free catch' samples from cattle were mainly negative, as were samples collected from the fistulated rumen. Enrichment of various other sources was undertaken. Our total findings support the hypothesis that C. latum is a natural, specific, and temporary resident of cattle dung and is dispersed to new droppings by contaminated air and also probably by flying insects or cattle movement.

INDEX TERMS: Farm wastes, Water pollution sources, Pollutant identification, Isolation, Habitats, Domestic animals, Bacteria, Caryophanon latum, Schizomycetes, Environmental samples.

AMIC-9177
"DISSOCIATION IN A MARINE PSEUDOMONAD", Gow, J. A., DeVoe, I. W., MacLeod, R. A., Canadian Journal of Microbiology, Vol. 19, No. 6, June 1973, pp 695-701.

Eight morphological variants, the product of colonial dissociation, were isolated from cultures of the marine pseudomonad B-16. Features which distinguished the variants were smooth versus rough colony type, the presence or absence of color, and differences in colony diameter. The variants differed in their capacity to form stable protoplasts and to grow at suboptimal Na(plus) concentrations in defined medium. All, however, required Na(plus) for growth. The ability of the organism to accumulate alpha-aminoisobutyric acid (AIB) and the requirement for Na(plus) for this process was not affected by dissociation.

INDEX TERMS: Marine bacteria, Isolation, Radioactivity techniques, Growth rates, Sodium, Salt tolerance, Assay, Methodology, Essential nutrients, Deficient elements, Absorption, Pseudomonads, Bacterial physiology, Characterization, Dissociation, Bioaccumulation, alpha-Aminoisobutyric acid, Culture media, Protoplasts, Cell morphology, Nutrient media.

AMIC-9183
"COMPETITIVE GROWTH OF SEWAGE ORGANISMS", Poon, C. P. C., Wang, K. K., Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 99, No. EE4, August 1973, pp 489-498.

Because of the occasional overgrowth of Geotrichum candidum in the Field Point Sewage Treatment Plant (Providence, R.I.), especially during winter, studies were undertaken to determine whether certain environmental factors, particularly street runoff, might give this fungus a competitive advantage over sewage bacteria. Growth characteristics of sewage bacteria and Geotrichum were compared by the Warburg respirometric technique under identical conditions when exposed to simulated salted snow melt at 10 and 20 C. The snow melt contained chloride ion concentrations of 5,000 and 10,000 mg/l and asphalt (with and without ultraviolet irradiation) 5-500mg/l. As expected, all activities under control conditions at 20 C, including oxygen uptake rate, specific growth rate, and rate of COD removal, indicated that the sewage fungus was less competitive. However, low temperature, slug doses of chloride ion at 5,000 mg/l and 10,000 mg/l concentrations, and the presence of ultraviolet irradiated asphalt were found to affect differently the growth of activated sludge and Geotrichum. Individually or in combination, these factors significantly reduced the growth activities of activated sludge while Geotrichum was much less affected under the same environment. It is concluded that such factors in combination with low pH and high carbohydrate content in sewage could cause a predominance of sewage fungus in treatment plants.

INDEX TERMS: Sewage bacteria, Fungi, Water temperature, Cold resistance, Urban runoff, Asphalt, Growth rates, Competition, Sodium chloride, Geotrichum candidum.

AMIC-9248
"DIRECT FLUORESCENT-ANTIBODY TECHNIQUE FOR THE MICROBIOLOGICAL EXAMINATION OF FOOD AND ENVIRONMENTAL SWAB SAMPLES FOR SALMONELLAE", Insalata, N. F., Mahnke, C. W., Dunlap, W. G., Applied Microbiology Vol. 26, No. 3, September 1973, pp 268-270.

Comparative studies of a modified fluorescent-antibody procedure and the 5 7 day method used by the Association of Official Analytical Chemists for the detection of Salmonella were made on 151 samples of wheat products and 183 swab samples from in-process equipment. The agreement between the two methods for the 334 samples tested was 92.5 percent. Fod samples yielded 94.7 percent agreement, whereas the swab samples yielded 90.7 percent agreement. There were 7.5 false positives for the total number of samples tested. No false negatives were obtained by using the fluorescent-antibody method. The study also demonstrated that pooling suspect samples is possible to permit larger numbers to be tested simultaneously by FA.

INDEX TERMS: Salmonella, AOAC Methods, Fluorescent antibody techniques, Method evaluation.

AMIC-9258
"QUANTITATIVE EXTRACTION OF ADENOSINE TRIPHOSPHATE FROM CULTIVABLE AND HOST-GROWN MICROBES: CALCULATION OF ADENOSINE TRIPHOSPHATE POOLS", Dhople, A. M., Hanks, J. H., Applied Microbiology, Vol. 26, No. 3, September 1973, pp 399-403.

Existing data on adenosine triphosphate (ATP) pools in microbes are deficient for two reasons: (1) incomplete extractions of ATP, and (2) the failure to take into account that the adverse effects of extracting procedures on standard ATP exert analogous effects on the ATP released from bacterial cells. Methods for correcting observed yields and calculating ATP pools have been demonstrated. Three bacterial species were used in the studies on extraction of ATP: Escherichia coli, Mycobacterium phlei, and Mycobacterium lepraemurium. Perchloric acid and n-butanol were disqualified because of inconvenient procedures. The new extraction procedure had minimal effects on standard ATP, liberated 100 percent of the ATP pools from the three representative species of microbes, and caused no ionic imbalance or quenching of bioluminescence. This method involves vortexing of cell suspensions for 10 s with 23 percent chloroform (vol/vol), heating at 98 C for the required time (E. coli, 3 min; M. phlei, 5 min; M. lepraemurium, 10 min) and then 1 min at 98 C with vacuum to dry the samples. Heat or chloroform alone may suffice for some microbes and release total ATP from plant and animal cells.

INDEX TERMS: Separation techniques, E. coli, Adenosine triphosphate, Mycobacterium phlei, Mycobacterium lepraemurium, Sample preparation.

AMIC-9303
"CHEMICAL CHARACTERISTICS, BACTERIAL COUNTS, AND POTENTIAL SHELF-LIFE OF SHRIMP FROM VARIOUS LOCATIONS ON THE NORTHWESTERN GULF OF MEXICO", Cobb, B. F., III, Vanderzant, C., Thompson, C. A., Jr., Custer, C. S., Journal of Milk and Food Technology, Vol. 36, No. 9, September 1973, pp 463-468.

Because of the variation in microbiological characteristics of different waters and consequent spoilage patterns in shrimp, amino nitrogen (AA-N), ammonia, total volatile nitrogen (TVN), trimethylamine nitrogen (TMN), bacterial content, and pH were evaluated as means of measuring spoilage and shelf-life of shrimp. Freshly harvested white shrimp (Penaeus setiferus) from 13 locations on the northwestern coastline of the Gulf of Mexico and brown shrimp (P. aztecus) from 3 water depths near Port Aransas, Texas, and from a commercial fishing boat were placed on sterile ice, allowed to spoil, and examined. Samples for chemical analysis were homogenized with trichloroacetic acid and centrifuged. Both TVN and AA-N varied considerably from sample to sample and did not show a consistent pattern of change during iced storage. TMN production was evident in boat-shrimp samples with high TVN levels. Bacterial counts of fresh shrimp did not exceed 10,000/g. Nine of the 10 boat-shrimp samples had counts in excess of 1 million/g. Counts of samples spoiled on sterile ice ranges from 2 million-10 billion/g. The ratio TVN/AA-N may be useful in conjunction with apperance and odor as a measure of spoilage. Samples with TVN/AA-N greater than 1.3 mg N/millimole were evaluated as poor. Maximum potential shelf-life of boat-shrimp was reduced 0-15 days by handling and storage.

INDEX TERMS: Shrimp, Chemical analysis, Odor, Microbial degradation, Biological samples, Spoilage, Sample preparation.

AMIC-9353
"THE MICROCALORIMETRY OF MICROBIAL GROWTH", Jones, J. M., Process Biochemistry, Vol. 8, No. 9, September 1973, pp 19-20.

A flow microcalorimeter has been used to monitor the heat production of bacterial cultures. In the calorimeter, solutions are pumped through cells which are situated in a sandwich of semiconductor thermopiles and a heat sink. Heat transferred across the thermopiles produces a small voltage directly proportional to the heat. Plots of actual and integrated heat output, glucose concentration, acetate concentration, and cell concentration versus time show that thermograms reveal two distinct phases in growth patterns: (1) the exponential growth phase and (2) the phase in which acetate produced in phase 1 is consumed. Therefore, heat output can be used to describe the separate phases of growth processes. Several applications of the technique are suggested such as monitoring of fermentation processes, production of antibiotics, and reactions to antibiotics.

INDEX TERMS: Bacteria, Monitoring, Growth rates, Heat, Cultures, Microcalorimetry.

AMIC-9435
"SOIL BACTERIA IN LAND-DRAINAGE WATER", Evans, M. R., Owens, J. D., Water Research, Vol. 7, No. 9, September 1973, pp 1295-1300.

A general viable count was made of bacteria in the discharge of a subsurface pasture drain during the winter of 1971/72 to determine whether significant loss of natural soil bacteria occurred and whether concentrations fluctuated with flow rate. Viable counts were made on 134 samples by membrane filtration. Soil samples from various depths in the drainage plot were used to estimate the number of bacteria occurring in the soil. The concentration of bacteria in the drainage water was related to flow rate, and an equation was developed to describe this relationship. The total number of viable bacteria in the drainage water discharged during the 4 months represented approximately 0.1 percent of an estimate of the total number of viable bacteria present in the soil of the experimental plot. It was concluded that the numbers of bacteria lost from soil by wash-out in drainage water were an insignificant fraction of the probable annual production of bacteria in the soil.

INDEX TERMS: Flow rates, Soil bacteria, Drainage water.

AMIC-9433
"A THEORETICAL STUDY OF FACTORS INFLUENCING THE MICROBIAL POPULATION DYNAMICS OF THE ACTIVATED-SLUDGE PROCESS - I. THE EFFECTS OF DIURNAL VARIATIONS OF SEWAGE AND CARNIVOROUS CILIATED PROTOZOA", Curds, C. R., Water Research, Vol. 7, No. 9, September 1973, pp 1269-1284.

Mathematical models and computer simulations have been used in examining the theoretical implications of diurnal variations in sewage flow, bacterial content of the sewage, and sewage substrate concentration on the microbial population dynamics and effluent quality of a completely-mixed activated-sludge plant. Variations in sewage substrate resulted in variations in the concentrations of substrate in the effluent and bacteria in the sludge. Variations in the bacterial content of sewage affected only the bacteria-consuming ciliate populations whereas variations in the flow of sewage affected all populations. When all three sewage parameters were varied simultaneously the effect was cumulative. The effects of carnivorous ciliates preying on bacteria-consuming ciliates have been considered for the first time. At least four types of ciliate predator/prey situations could arise since both carnivore and prey can be either free-swimming or attached forms. In general, when the carnivore was a free-swimming form, oscillations, which may or may not dampen, were obtained; when the carnivore was an attached form, the ciliate prey was washed out of the reactor. However, the predictions of the population dynamics of the organisms also depend to a large extent on the values of the various growth constants used.

INDEX TERMS: Sewage bacteria, Activated sludge, Flow rates, Population, Mathematical models, Protozoa, Growth rates, Flagellates, Substrates.

AMIC-9497
"VIRUS REMOVAL IN HAWAIIAN SOILS", Young, R. H. F., Burbank, N. C., Jr., Journal American Water Works Association, Vol. 65, No. 9, Part 1, September 1973, pp 598-604.

Three types of Hawaiian soils (Wahiawa, Lahaina and Tantalus) were used in laboratory studies in percolation columns to determine the extent of travel or possible breakthrough of viruses into the underlying source of water supply. The viruses used were a coliphage T4 BII mutant, and poliovirus Type II (Lansing) H8. The columns containing the selected soils were subjected to intermittent percolating water with a known concentration of virus, simulating the action of a cesspool leaching into the ground. The effluent from the soil column was collected and analyzed for viral content by plaque-forming techniques. The Wahiawa and Lahaina soils were 100 percent effective in the retention or adsorption of bacteriophage T4 from percolating water at the applied concentration of 2.5 million/ml of feed solution at depths of 6 and 2.5 in. Breakthrough of the bacteriophage occurred immediately in both soils for the 1.5-in.-deep soil columns at an applied concentration of 1.5 million/ml of feed solution. The Tantalus cinder subsoil proved ineffective in holding the bacteriophage at the recorded thicknesses of 15, 12, and 6 in. at the applied concentration 1.5 million/ml of feed solution. The breakthrough concentration was 500,000/ml. Percolation tests with Wahiawa and Lahaina soils and Tantalus cinder demonstrated that short soil columns did not completely remove poliovirus Type II from percolating water when the virus was applied at a dosage of 150,000 pfu/ml. Breakthrough occurred immediately for the 1 1/2- and 2 1/2-in. soil columns. Results with Tantalus cinder dosed at 150,000 pfu/ml of poliovirus Type II demonstrated very low virus retention.

AMIC-9497 (Continued) Card 2/2

INDEX TERMS: Viruses, Soils, Efficiencies, Percolating water, Leaching, Retention, Hawaii, Lactosols, Volcanic cinder, Pollutant removal.

AMIC-9498
"IDENTIFICATION AND INCIDENCE OF KLEBSIELLA IN CHLORINATED WATER SUPPLIES", Ptak, D. J., Ginsburg, W., Willey, B. F., Journal American Water Works Association, Vol. 65, No. 9, Part 1, September 1973, pp 604-607.

Concern over the standard method of classifying coliforms, caused the Microbiology Unit, Water Purification Lab., City of Chicago, to institute a study to determine whether a more accurate and rapid classification could be obtained. The "Modified R/B Enteric Differential System" was selected and used to identify the cause of the occasional positive reactions which occurred during water analysis. The bacterium identified was Klebsiella pneumoniae which is known to be of fecal origin. Since the standard IMViC test would have identified Aerobacter aerogenes, generally considered to be of non-fecal origin, an improved laboratory procedure appears to be needed. The modified R/B procedure used by the Water Purification Laboratory and the resulting reactions are described. Klebsiella has also been found to occur more frequently in treated water supplies than other organisms possibly because it is encapsulated in the mucoid phase. Therefore, procedures should be employed to avoid incorrect identification of the organisms.

INDEX TERMS: Pathogenic bacteria, Pollutant identification, IMViC test, Standard methods, R/B procedure, Klebsiella.

AMIC-9505
"SEDIMENT COLIFORM POPULATIONS AND POST CHLORINATION BEHAVIOR OF WASTEWATER BACTERIA", Hulka, S. C., Keen, S. R., Davis, E. M., Water and Sewage Works, Vol. 120, No. 10, October 1973, pp 79-81.

Enumeration and identification of bacteria in wastewater collected from the overflow weirs of two secondary clarifiers, showed that significant aftergrowth of bacteria occurred when samples were chlorinated at a level of 1.0 mg/l. Total coliform bacterial counts, fecal coliform bacteria and the types considered "non-coliform" all demonstrated remarkable regrowth. Fecal streptococci on the other hand, exhibited an appreciably slower die-off rate than in the non-chlorinated sample. The data suggest that chlorination effectively decreased the competitive bacterial populations. Surviving bacteria are listed. Survival of enteric bacteria in effluent from waste stabilization ponds was found to be distinctly related to phytoplankton concentrations. The results of survival tests after chlorination at levels up to 5.0 mg/l with samples containing more than 20,000 areal standard units of phytoplankton suggest that if disinfection is incomplete, nutrients are present, and bacterial competition is reduced, indicator and pathogenic bacteria may reestablish. Indicator bacteria have also been found in sediments of u npolluted waters, and high levels were found in some cases where sediments were disturbed. It is recommended that rapid and more precise methods of generic identification be developed to eliminate erroneous conclusions which may occur from elevated counts of bacteria resulting from bacterial aftergrowth or natural populations.

INDEX TERMS: Chlorination, Sediments, Waste water (pollution), Enteric bacteria, Pathogenic bacteria, Aftergrowth, Survival.

AMIC-9541
"BACTERIAL DECOMPOSITION PROCESSES IN LAKE WINGRA SEDIMENTS DURING WINTER", Boylen, C.W., Brock, T. D., Limnology and Oceanography, Vol. 18, No. 4, July 1973, pp 628-634.

Samples of sediment were collected from Lake Wingra, Wisconsin, from January 19 - July 21, 1972, for use in tests to determine whether bacteria in sediments adapted to low temperatures. Samples were collected with a type R sampler, transferred to collection bottles, and kept at 4 C until use. DO and air, water, and sediment temperatures were recorded at the time of sampling. Glucose incorporation was measured by adding C-14-labeled material to sediment suspensions and incubating in the dark at temperatures of 0 to 50 C. Release of C-14-labeled CO2 was measured by trapping it in scintillation fluid. Growth rates were studied by preparing cultures of the sediment bacteria for incubation at 4, 15, and 25 C. The results show that viable counts of bacteria were always higher at 25 C than 4 C, although the temperature of the sediments remained below 4 C for over 3 months. All of the organisms isolated and initially cultivated at 4 C grew better at 25 C; no obligately psychrophilic bacteria were found. Isotope studies to measure the temperature optima of the resident bacterial flora showed that the optimum temperature for incorporation of C-14-glucose into cell material and conversion of C-14-glucose into C-14-CO2 remained at 25 C or greater all winter. A true psychrophilic flora does not develop in these sediments in winter, and bacterial decomposition processes occur at a much slower rate in winter than in summer.

INDEX TERMS: Cultures, Bacteria, Growth rates, Water temperature, Degradation (decomposition), Adaptation, Metabolism.

AMIC-9561
"METHOD FOR THE SELECTIVE ENUMERATION OF BLUE-GREEN BACTERIA IN WATER", McCurdy, H. D., Jr., Hodgson, W. F., Applied Microbiology, Vol. 26, No. 5, November 1973, pp 682-686.

A membrane filter method for the selective enumeration of blue-green bacteria has been developed which, on the basis of studies with laboratory cultures and field tests, has proved to be both practical and reproducible. The filters are incubated under specified conditions of temperature and illumination on a mineral salts agar medium supplemented with yeast extract and containing cycloheximide to eliminate eukaryotic contaminants. (Reprinted from Applied Microbiology, Vol. 26, No. 5, November 1973, pp 682-686. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Pollutant identification, Aquatic bacteria, Cyanophyta, Aquatic algae, Selectivity, Methodology, Separation techniques, Isolation, Membrane filters, Enumeration, Prokaryotes, Culturing techniques, Eukaryotes, Reproducibility.

AMIC-9562
"MICRODILUTION ANTIBIOTIC SUSCEPTIBILITY TEST: EXAMINATION OF CERTAIN VARIABLES", Tilton, R. C., Lieberman, L., Gerlach, E. H., Applied Microbiology, Vol. 26, No. 5, November 1973, pp 658-665.

A semiautomated microdilution susceptibility test is described. The effect of certain parameters such as inoculum size, growth media, incubation conditions, and inoculum despensing systems was studied with E. coli, Staphylococcus aureus, and Pseudomonas aeruginosa. Both medium type and inoculum size caused significant variations in the minimum inhibitory concentrations (MIC) of certain antibiotic-organism combinations. No effect on MIC was observed as a function of incubator type. Efforts to read a reproducible MIC value in less than 12 h failed. A commercially available wire pronged inoculator was determined to be inaccurate and unsafe. Disposable dropper pipettes proved to be economical, accurate, and precise. Although a standard method for microdilution antibiotic susceptibility testing is not proposed, data are presented which show that future attempts at standardized procedures are mandatory if inter- and intralaboratory reliability is desired.

INDEX TERMS: Resistance, Antibiotics (pesticides), E. coli, Methodology, Cultures, Inhibition, Toxicity, Pesticide toxicity, Antibiotic dilution tests, Staphylococcus aureus, Pseudomonas aeruginosa, Minimum inhibitory concentrations.

AMIC-9564
"APPLICABILITY OF THE REVERSE-FLOW FILTER TECHNIQUE TO MARINE MICROBIAL STUDIES", Griffiths, R. P., Hanus, F. J., Morita, R. Y., Applied Microbiology, Vol. 26, No. 5, November 1973, pp 687-691.

The validity of using the reverse-flow filtration technique to quantitatively concentrate marine bacteria was evaluated with both a pure culture of Vibrio marinus and seawater samples. After filtration, the volume of the filtrate and the combined concentrates were measured to determine the concentration factor. Analyses were made on all fractions. Colony forming units (CFU) in the various fractions and in unfiltered samples were determined by the spread-plate technique using Lib-X medium. Total substrate uptake was determined by assaying for C-14 with labeled glutamate, and biomass was determined with C-14-labeled proline. Assay of biomass in the concentrate, filtrate, membrane filter, and filter washings showed that essentially no concentration occurred, and most of the bacteria remained on the filter. Furthermore data indicate that cells were altered during the filtration procedure. Since the number of cells lost on the filter is significant and inconsistent they cannot be represented by a constant. Consequently, results obtained by this procedure should be interpreted with caution.

INDEX TERMS: Marine bacteria, Separation techniques, Reverse-flow filtration, Preconcentration, Method validation.

AMIC-9566
"LIPOLYTIC BACTERIA IN THE OTTAWA RIVER", Blaise, C. R., Armstrong, J. B., Applied Microbiology, Vol. 26, No. 5, November 1973, pp 733-740.

Lipolytic bacteria were isolated from two stations on Brewery Creek, an arm of the Ottawa River, during the winter of 1971-72. Total counts were approximately sevenfold higher at the more polluted downstream station, whereas lipolytic counts were about 100-fold higher. At this station, significantly more lipolytic bacteria grew on plates incubated at 20 C than at 4 C, suggesting that the population was comprised of both mesophiles and psychrophiles. However, at the upstream station, approximately the same number were obtained at both temperatures. A total of 434 isolates, mainly from the downstream station, were tentatively classified. The major groups were Pseudomonas, Acinetobacter-Moraxella, and Aeromonas. Though the total number of lipolytic bacteria was fairly constant throughout the winter, the relative abundance of the acinetobacters dropped from approximately 90 percent in November to less than 10 percent in March, and then increased. The aeromonads and pseudomonads showed the opposite trend. Most of the bacteria, though isolated at 4 C, also grew at 30 C. Lipolysis, however, was generally strongest at 20 C or below. (Reprinted from Applied Microbiology, Vol. 26, No. 5, November 1973, pp 733-740. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Aquatic bacteria, Isolation, Water temperature, Water pollution, Biological properties, Lipids, Bioindicators, Lipolytic bacteria, Biochemical characteristics, Substrate utilization, Ottawa River, Psychrophilic bacteria, Mesophilic bacteria, Biochemical tests.

AMIC-9567
"ESCHERICHIA COLI SEROGROUPS ISOLATED FROM STREAMS IN PENNSYLVANIA, 1965 TO 1972", Glantz, P. J., Applied Microbiology, Vol. 26, No. 5, November 1973, pp 741-743.

Of 3,200 cultures of Escherichia coli isolated from streams in Pennsylvania over a 7-year period, 82.46 percent or 2,639 were O serogrouped. The largest number of cultures (33.4 percent) belonged to O groups 1 to 26, and the second highest number (16.8 percent) belonges to O groups 60 to 88. The individual E. coli O groups most frequently isolated were ADO3, 18ac, 2a, 3, 7, 73, 139, and OX13. Practically every known standard E. coli O group was found in the streams. It was not possible to identify the K and H antigen of every E. coli isolate. Serotypes of E. coli O2a:K1:H6, O26:K60:H11, O55:K59:H27, O86:K62:H2, 112ab:K68:H2, 125ab:K70:H21, 128ab:K67:H2, and O138:K81:H14 known to be pathogenic for humans and animals were identified. Cultures having the same K antigen but a different H antigen for enteropathogenic E. coli O groups 6, 18ab, 18ac, 11ab, 126, 127a, 139, 141, and 147 were also isolated. (Reprinted from Applied Microbiology, Vol. 26, No. 5, November 1973, pp 741-743. Copyright 1973 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: E. coli, Natural streams, Pollutant identification, Isolation, Water pollution sources, Pathogenic bacteria, Enteric bacteria, Pennsylvania, Serotypes, Biochemical tests, Fecal coliforms, Culturing techniques.

AMIC-9571
"THE MICROBIAL ASSOCIATIONS DEVELOPING ON EXPERIMENTAL TRICKLING FILTERS IRRIGATED WITH DOMESTIC SEWAGE", Halls, N. A., Board, R. G., Journal of Applied Bacteriology, Vol. 36, No. 3, September 1973, pp 465-474.

Organisms in trickling filters were sampled by pumping waste from a sewage treatment plant through rotating Perspex tubes with roughened inside surfaces. The biological films were collected by plugging one end of the tubes, adding Ringer's solution and glass beads, plugging the open end of the tube, and shaking to dislodge the film. Disrupted films were cultured for 5 days and tested by Gram staining, by the oxidase test, and for motility, carbohydrate breakdown, and gelatin hydrolysis. The bacterial flora of the film which developed on experimental trickling filters irrigated with domestic sewage was dominated by Acinetobacter and yellow-pigmented Gram negative rod-shaped organisms and it was deduced that purification in certain aerobic waste treatment processes may depend upon an association of these 2 organisms. Further evaluation of the operational procedures likely to have a selective influence on the microbial association which becomes dominant was made in studies using synthetic sewage.

INDEX TERMS: Sampling, Sewage bacteria, Dominant organisms, Separation techniques, Trickling filters, Acinetobacter.

AMIC-9572
"THE OBSERVATION OF MICRO-ORGANISMS ON SURFACES BY INCIDENT FLUORESCENCE MICROSCOPY", Paton, A. M., Jones, S. M., Journal of Applied Bacteriology, Vol. 36, No. 3, September 1973, pp 441-443.

Two methods were developed for viewing surfaces for microorganisms by incident fluorescence microscopy. The direct method involves applying optical brighteners and counterstains directly to samples such as meat, fish, skin, plants and minerals and mounting them on glass slides for microscopic observation. The tape method involves placing adhesive tape on surfaces, such as on food processing equipment, removing the tape, and placing it on a glass slide until processing. Tapes can be treated with a fixative to assist retention of organisms, and counterstained. For viewing, the tapes are treated with optical brighteners and mounted, adhesive side up, on glass slides. The procedures have been used in microbiological studies associated with food manufacture, agricultural research, and dermatological investigations.

INDEX TERMS: Bacteria, Yeasts, Sample preparation, Fluorescent microscopy.

AMIC-9573
"THE PRESENCE OF CLOSTRIDIUM BOTULINUM IN INDONESIAN WATERS", Mortojudo, J. W., Slagian, E. G., Suhadi, F., et al., Journal of Applied Bacteriology, Vol. 36, No. 3, September 1973, pp 437-440.

Samples of mud, sand, coral, gravel, snails, scallops, oysters, sea slugs, crabs, limpets, shrimps, starfish, octopus, and 13 species of bony fish were collected from Java and Bali and examined for Clostridium botulinum. The organism was detected in 10 percent of all enrichment cultures tested with types A and C predominating.

INDEX TERMS: Pollutant identification, Sediments, Marine animals, Clostridium botulinum.

See also: Category 2, AMIC-9402, 9419, 9436.

AMIC-9395
"DETERMINATION OF FATTY ACID COMPOSITION BY GAS CHROMATOGRAPHY: I. ANALYSIS WITH USE OF THERMAL CONDUCTIVITY DETECTOR", Watanabe, S., Hayano, S., Akiya, T., et al., Journal of the American Oil Chemists' Society, Vol. 50, No. 9, September 1973, pp 357-359.

Gas chromatographs with thermal detectors were used by a collaborative study team to carry out replicate analyses of fatty acids for the purpose of establishing standard methods. Statistical methods were used to determine: (1) the relationship between operating conditions of the equipment and deviation from real values or scattering of data, (2) whether the difficulty in making peak measurements accounted for scattering of values, (3) the effect of enlarging peak size by adjusting attenuator range or chart speed, and (4) the effect of using response correction factors. From the results of the four collaborative works it was found that deviation of analytical values from exact composition and interlaboratory scattering of data may be considerably decreased by the following means: (1) enlarging the size of narrow peaks (less than 5 mm at a half height) or peaks with low height by adjusting the attenuator range or chart speed; (2) correcting the analytical values by using correction factors determined from analysis of known mixtures having composition similar to that of an unknown sample.

INDEX TERMS: Gas chromatography, Standard methods, Collaborative studies, Accuracy.

AMIC-9396
"DETERMINATION OF FATTY ACID COMPOSITION BY GAS CHROMATOGRAPHY: II. ANALYSIS WITH USE OF FLAME IONIZATION DETECTOR", Watanabe, S., Nakasato, S., Hayano, S., et al., Journal of the American Oil Chemists' Society, Vol. 50, No. 9, September 1973, pp 360-363.

Gas chromatographs with flame ionization detectors were used in collaborative analyses of known mixtures of four or five fatty acid methyl esters. The resulting data were treated statistically to examine the inter - and intralaboratory scatter and the effect of using correction factors. Average values in some cases did not approach actual values even when only data with small deviations were accepted. In some laboratories a sort of regularity was observed in the deviation of analytical values from real values throughout the analyses of four samples. The application of correction factors to the analytical values obtained by these laboratories resulted in a considerable decrease of interlaboratory scattering and deviation from the real values. When a constant amount of sample was injected, intralaboratory scattering was decreased, whereas interlaboratory scattering was not. Injection of large sample sizes caused deviation. From this collaborative study it was recommended that 0.5-1.0 microliter of 20 percent solution be injected.

INDEX TERMS: Gas chromatography, Fatty acids, Collaborative studies, Sample size.

AMIC-9494
"TWO-LEVEL SKIP-LOT SAMPLING PLANS - OPERATING CHARACTERISTIC PROPERTIES", Perry, R. L., Journal of Quality Technology, Vol. 5, No. 4, October 1973, pp 160-166.

Skip-lot sampling plans are a system of lot-inspection plans which allow skipping inspection of a fraction of the samples when the quality history shows that the product is good. The operating characteristics of three two-level skip-lot sampling plans are described. Basically the procedures involve normal inspection until a certain number of lots are accepted at which time skip-lot sampling is effected. If a given number of additional lots are accepted, a second skip-lot sampling scheme is used. If an item is rejected, the sampling procedure reverts to the original inspection scheme. The three procedures tested were compared to show the shortcomings and benefits of each. The plans can reduce the amount of inspection required when quality is good and adjust the amount of reduction according to the level of submitted quality.

INDEX TERMS: Quality control, Sampling, Statistical methods, Skip lot sampling.

AMIC-9496
"ONE-WAY ANALYSIS OF VARIANCE", Olsson, D. M., Journal of Quality Technology, Vol. 5, No. 4, October 1973, pp 191-193.

A computer program for one-way analysis of variance is described. The advantages of the program are: (1) flexible, easy-to-use input; (2) averages and standard deviations of averages within treatment variances and residuals can be calculated; (3) analysis of variance can be tabulated and the treatment component of variance can be estimated; and (4) the probability of exceeding the calculated treatment F-ratio can be provided.

INDEX TERMS: Computer programs, Data processing, Analysis of variance.

See also: Category 1, AMIC-9288
Category 3, AMIC-9248, 9564.

AMIC-9247
"POTENTIOSTATIC COULOMETRIC DETERMINATION OF VANADIUM, VANADIUM-MANGANESE AND VANADIUM-IRON MIXTURES AND THE INFLUENCE OF CHROMIUM ON THE PROCESS", Bishop, E., Hitchcock, P. H., Analyst, Vol. 98, No. 1169, August 1973, pp 572-579.

A simple coulometric cell was constricted and a commercial potentiostat was adapted for use in determining V, V-Mn, and V-Fe in various media. Since current integration by strip-chart recorder was inadequate, an RC integration system was constructed from polystyrene capacitors. Pretreatments of electrolytes and electrodes are described. Vanadium (V) was determined at minus 0.128 V in acetate buffer and at plus 0.247 V in 2.0 M sulphuric acid, in the latter with a relative standard deviation of 0.27 percent and a 95 percent confidence level result of 0.1008 to 0.1011 M compared with 0.1012 M for a standard solution. Chromium(VI) suppressed all reduction at pH 4.0, and reduced simultaneously with vanadium in sulphuric acid. Manganese(VII) reduced to manganese(III) in the first step at plus 0.7 V at pH 3.5 and manganese(III) and vanadium(V) simultaneously reduced in second step at minus 0.12 V. The separation of iron(III) was possible at plus 0.9 V but inpracticable; simultaneous reduction at plus 0.25 V in 2.0 M sulphuric acid followed by re-oxidation of the iron(II) at plus 1.0 V is recommended.

INDEX TERMS: Vanadium, Voltammetry, Chemical interference, Vanadium, Voltammetry.

AMIC-9385
"AN INEXPENSIVE, FAST RESPONSE CURRENT SPEED INDICATOR", Byrne, R. J., Boon, J. D., III, Chesapeake Science, Vol. 14, No. 3, September 1973, pp 217-219.

A low cost, fast response current speed sensor consists of a bearing supported axial rotor inside a cylindrical duct. The rotation rate of the impeller is obtained by counting the number of closures of a magnetic proximity switch, mounted on the duct, which is actuated by the passage of small magnets bonded to the impeller. The signal is transmitted to a surface counter, a high-speed electromechanical counter and a solid state pulse generator, by the conductor suspension cable. The sensor output is linear over the calibration range of 0 to 150 cm/sec. Threshold speed is about 1.5 cm/sec. Field usage indicates the device will be useful for shallow water applications in hydraulics and ecology. Total cost to construct the unit is estimated to be about 200 dollars.

INDEX TERMS: Design, *Costs, Calibrations, Current meters, Detection limits.

AMIC-9489
"X-Y RECORDERS", Measurements and Data, Vol. 7, No. 5, September/October 1973, pp 99-103.

Accuracy, speed, dimensions, costs, manufacturers, and other pertinent information are listed for commercially available X-Y recorders operating with analog signals.

INDEX TERMS: Costs, X-Y recorders.

AMIC-9490
"EAGLE EYE - NEW FLOWMETER", Plache, K. O., Measurements and Data, Vol. 7, No. 5, September/October 1973, pp 104-106.

The Eagle Eye flowmeter uses an 'Annubar' primary flow element as the flow sensor and a new indicator designed specifically for use with the sensor. Basically, the sensor transmits a pressure signal to a diaphragm which converts axial motion to the pivotal motion of a range spring. The motion of the range spring is transmitted to the meter pointer by means of a permanent (stator) magnet on the range spring and a follower magnet on the pointer. Several advantages of the system are: readout is direct and close to linear; the sensor is available in sizes of 1/2 inch to 180 inches and does not require complicated engineering; pressure loss is low; accuracy and dependability are high; measurements can be made with dirty liquids; readings can be remote from the measurement site; and cost is competitive with those of other flowmeters.

INDEX TERMS: Design, Flowmeters.

AMIC-9576
"EVALUATION OF THE FERRIC LON SENSITIVE CHALCOGENIDE GLASS ELECTRODE", Jasinski, R., Trachtenberg, I., Journal of the Electrochemical Society, Vol. 120, No. 9, September 1973, pp 1169-1174.

Further information is presented on the preparation, composition, performance, and ferric ion sensing mechanism of chalcogenide glass FenSe60Ge28Sb12 (where n falls between 1.3 and 2). Properly prepared and activated electrodes responded to changes in ferric ion concentration in perchlorate, chloride, and nitrate solutions with an average Nernstian slope of 57.6 plus or minus 2.9 mV/decade, over the concentration range of 0.01-0.00001 M ferric ion (based on 16 electrodes). Useful response is found down to at least 0.000001 M Fe(3 plus). Details are presented on the activation and operating procedures. Although a complete evaluation of the sensing mechanism has not been made, it has been established that the activation process involves both an oxidation of the fresh surface as well as a chemical interaction of this surface with ferric iron from solution. The sensing process then involves exchange of ferric iron with this modified surface.

INDEX TERMS: Iron, Aqueous solutions, Ion selective electrodes, Detection limits, Ferric ions.

AMIC-9579
"GUIDE TO SELECTING DIGITAL MULTIPLEXERS", Krigman, A., Instruments and Control Systems, Vol. 46, No. 11, November 1973, pp 63-68.

Time division and frequency division multiplexing parameters for consideration in selecting multiplexing systems are discussed. A reference guide to multiplexers, their capabilities, and manufacturers are included.

INDEX TERMS: Data transmission, Multiplexers.

AMIC-9580
"DIGITAL MAGNETIC RECORDING OF WIDEBAND ANALOG SIGNALS", Spitzer, C. F., Computer Design, Vol. 12, No. 10, October 1973, pp 83-90.

Digitization of a signal offers significant advantages when that signal exceeds the analog bandwidth of the recorder or when unacceptable signal degradations occur due to noise contamination, crosstalk or spurious signals, limited dynamic range, and perturbations of the recorder's timebase. If the signal is sampled and digitized, an error is necessarily incurred since that signal will probably not have been at an exact quantizing level. The rms value of the resultant digitizing error, or quantization noise, results in a peak-to-peak signal to rms error ratio of S/N ratio equals (10.8 plus 6m) dB, where m is the number of bits per sample. This expression is valid for unstructured signals. In the case of structured signals (eg, TV), undesirable effects can be removed by artificially introducing white noise of a magnitude of two or three quantization steps. There are numerous methods for varying degrees of compression and signal deterioration. A factor of six seems feasible for image transmission. Proper selection of a recording code can also aid in minimizing bandwidth requirements. Care must be taken in ADC and DAC selection to prevent converter problems from degrading the system significantly. For many future recording applications, the advantages of pulse code modulation recording of analog signals are expected to outweigh the drawbacks of higher equipment complexity.

INDEX TERMS: Data processing, Electronic equipment, Signal conditioning.

AMIC-9581
"ENERGY SIGNATURE MEASURES SYSTEM CHANGES", Bailey, S. J., Control Engineering, Vol. 20, No. 10, October 1973, pp 45-46.

New equipment has been developed which follows system changes by monitoring changes in input power. The instrument captures transient data and displays it for field comparison, detects trends in process deviation from norm, and preprocesses frequency spectra for later detailed computer analysis. Its basic function is to aid in determination of frequency components whose telltale variation from proper to improper operation make them valuable in the performance of automatic 'machine minding.' Machining, forming, mixing, welding, and powder compression processes have been monitored by this procedure. Other potential applications exist where pumps, valves, or other mechanically driven devices are involved.

INDEX TERMS: Control systems, Process control.

AMIC-9582
"ON-LINE SIGNAL DIGITIZING FOR COMPUTER INPUT", Zarcades, P. A., Control Engineering, Vol. 20, No. 10, October 1973, pp 48-51.

Advantages, disadvantages, and problems of various techniques for conditioning, measuring, converting, and transferring analog data for input to digital computers are presented.

INDEX TERMS: Data processing, Signal conditioning, Analog-to-digital.

AMIC-9583
"LOW-COST DIGITAL DATA ACQUISITION SYSTEMS", Kompass, E. J., Control Engineering, Vol. 20, No. 11, November 1973, pp 58-61.

The capabilities of low-cost digital data acquisition systems from 40 manufacturers are reviewed. The equipment is categorized according to available features.

INDEX TERMS: Data processing, Data acquisition systems.

AMIC-9596
"COMPUTER ANALYSIS OF DATA FROM POTENTIOMETRIC TITRATIONS USING ION-SELECTIVE INDICATOR ELECTRODES", Isbell, A. F., Jr., Pecsok, R. L., Davies, R. H., et al., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2363-2369.

Although ion-selective electrode potentiometry simplifies end point determinations for many titrations and permits some previously impractical titrations, frequent electrode calibration is necessary. A computer program, TITRATE, has been developed which permits an accurate end-point determination for all titrations in which a few of the data points lie in a concentration region where meaningful potentials can be recorded. This computer technique locates the equivalence point in precipitation and complexation titrations in which either the analyte or titrant is electroactive. TITRATE analyzes only the meaningful data and computes the analyte concentration, the fraction of ideal Nernstian response, and the electrode formal potential. In addition, standard deviations, a comprehensive error analysis, and data which facilitate plotting both sigmoid and linear titration curves are computed. The versatility of ion-selective electrode potentiometry is enhanced by permitting the analysis of ions for which electrodes exist plus species which rapidly form precipitates or complexes with such ions. Examples of three argentometric titrations using a silver ion-selective electrode are presented. The analysis time is not extreme, and all data analysis is performed by computer. Execution time for the complete analysis of data for one titration is usually between 1 and 2 seconds on an IBM 360/65 computer making the cost for computer time minimal.

INDEX TERMS: Computer programs, Data processing, Ion selective electrodes, Ion selective electrodes, Potentiometric titration, Data interpretation, TITRATE, Electroactive species,

AMIC-9611
"COMPUTERIZED DIGITAL DATA ACQUISITION SYSTEM FOR THERMOGRAVIMETRY AND SIMILAR APPLICATIONS", Romeo, G., Lifshin, E., Ciccarelli, M. F., et al., Analytical Chemistry, Vol. 45, No. 14, December 1973, pp 2444-2445.

The data-recording method used in conjunction with continuous thermogravimetric analysis and precision electrobalances usually involves the use of a pen-recorder which can be coupled with an automatic range expander. The pen-recorder usually has a series of shortcomings which prove to be quite inconvenient to correct. As an alternativ to the use of pen-recorders, a package has been designed which consists of a digital voltmeter (DVM), an interval timer, an elasped time clock, and a teletype equipped with a digital data controller. A block diagram and the operation sequence of this digital system are presented. In addition to the application to thermogravimetry, the digital data acquisition system can be used for monitoring and recording a variety of phenomena which involve either time-dependent parameters or, in general, up to three independent variables. All system components are commercially available as building blocks. Assembling of the system using commercial modules should be done with minimal design by any competent electronic staff.

INDEX TERMS: Computer programs, Automatic control, Data transmission, Data collections, Fabrication, Programming languages, Electronic equipment, Thermogravimetric analysis, Data acquisition, FORTRAN, Digital display.