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No. 13

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NOTICE

This bulletin is prepared monthly by the staff of the Analytical Methodology Information Center (AMIC), Information Systems Section, Battelle, Columbus Laboratories, Columbus, Ohio, under EPA Contract No. 68-01-0166, 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, Mr. John Mortland, Miss Verna Holoman, Mr. Ronald Snyder, Mr. Michael Mackan, Mr. Ronald Byrd, and Mr. George Long, Abstractors.

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

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

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REVIEWS OF CURRENT LITERATURE ON

ANALYTICAL METHODOLOGY AND QUALITY CONTROL

No. 13

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. 13 October, 1972

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-3541
"PERCHLORATE DETERMINATION BY THERMOMETRIC ENTHALPY TITRATION", Carr, P. W., Jordan, J., Analytical Chemistry, Vol. 44, No. 7, June 1972, pp 1278-1281.

A simple and convenient procedure (Direct Injection Enthalpimetry) for the rapid and convenient quantitative analysis of perchlorate at millimolar concentration levels involves a precipitation titration to a thermometric end point using an organo-arsenic reagent, and is readily amenable to automation. Direct Injection Enthalpimetry provides an exploratory tool for determining heats of reaction and discriminating between slow and fast kinetics. Although only the automation of titrant addition and titration curves were utilized, even more complete automation (i.e., digital readout of the end point) is readily feasible using appropriate derivative electronic circuits.

INDEX TERMS: Volumetric analysis, Chemical analysis, Enthalpy, Chemical precipitation, Automation, Kinetics, Pollution identification, Automatic control, Perchlorates, Thermometric enthalpy titration, Direct Injection Enthalpimetry, Heats of reaction.

AMIC-3876
"PAPER AND ALLIED PRODUCTS", Gove, G. W., Gellman, I., Journal Water Pollution Control Federation, Vol. 44, No. 6, June 1972, pp 1046-1072.

A literature review is presented of the analysis and treatment of pulp and paper industrial wastes. Major areas discussed were: receiving waters, biological studies, instrumentation and analysis, pulping liquor disposal and recovery, physicochemical treatment, secondary treatment, and recycling.

INDEX TERMS: Pulp and paper industries, Pulp wastes, Waste water treatment, Reviews, Water pollution treatment, Industrial wastes, Water pollution sources, Water pollution effects, Pollution identification, Wood wastes, Instrumentation, Analytical techniques, Chemical analysis, Chemical reactions, Recycling, Separation techniques.

AMIC-5773
"OPTICAL SIGNATURES OF THE NEAR-SHORE WATERS OF SOUTHERN MONTEREY BAY", Potts, J. R., Naval Postgraduate School, Monterey, California, Master's Thesis, December 1971, 127 pp. NTIS Report No. AD 741 144.

A study was made to relate certain optical properties with other observed properties of water sampled in southern Monterey Bay, California. Dominant wavelength, percent purity, and visual efficiency were detemined for 65 near-shore water samples using a one-meter sample cell in a modified Beckman DU-2 spectrophotometer. Measurements made at the sample locations included salinity, surface temperature, phosphate, coliform count, oxygen, and particle size distribution in the 1.04 micron to 27.6 microns diameter range. Most of the sampling was done at or near the Monterey sewage outfall. Dominant wavelengths were found to vary between 520 nm and 585 nm. Percent purity was found to fluctuate between 2 and 40 percent. Neither variable seems to be strongly sensitive to variation in treated sewage concentration for the Monterey outfall. Dominant wavelength for each of the 21 Forel-Ule scale colors was measured spectrophotometrically and compared with the dominant wavelengths of the samples. It is concluded that dominant wavelength, percent purity, and particle area or volume are poor signatures of sewage effluent from the standpoint of observing (visually) effluent distributions and concentrations.

INDEX TERMS: Optical properties, Salinity, Phosphates, Coliforms, Dissolved oxygen, Particle size, Sewage effluents, Monitoring, Water analysis, Spectrophotometry, Regression analysis, Turbidity, Transmittance.

AMIC-5841
"THE RENAISSANCE IN POLAROGRAPHIC AND VOLTAMMETRIC ANALYSIS", Flato, J. B., Analytical Chemistry, Vol. 44, No. 11, September 1972, pp 75A-87A.

Chemical and modern techniques of polarographic and voltammetric analyses are presented as an update of the theoretical bases and capabilities of methods such as differential pulse polarography, alternating current polarography, fast linear sweep voltammetry, direct anodic stripping voltammetry, and differential pulsed anodic stripping voltammetry. The instrumentation and methodology of the above techniques provide significant improvements in resolution and sensitivity parameters over dc polarography. Sample polarograms and analytical methods are included.

INDEX TERMS: Instrumentation, Polarographic analysis, Methodology, Chemical analysis, Electrochemistry, Laboratory equipment, Zeta potential, Voltammetric analysis, Differential pulse polarography, AC polarography, Linear sweep voltammetry, Anodic stripping voltammetry, Differential pulse voltammetry, Potentiostatic control, Sensitivity, Reproducibility.

AMIC-5896
"THE CYCLING OF MERCURY THROUGH THE ENVIRONMENT", Gavis, J., Ferguson, J. F., Water Research, Vol. 6, No. 9, September 1972, pp 989-1008.

A review is presented of what is now known about the mercury cycle in the aquatic environment and where the gaps in our knowledge lie. It describes the aquatic chemistry of mercury in the presence of chloride ions and the sulfate-sulfide system, the affinity of mercury for the sulfhydryl group in proteinaceous matter, the formation of methylated mercury compounds by microbial mediation, and the tendency for mercury in solution to adsorb on suspended solids. The paper then describes how mercury behaves in a typical local aquatic system based on facts known from its chemistry. It presents, finally, an estimate of the global cycle of mercury, and concludes that although man has created serious local problems by his indiscriminate discharge of mercury into the environment, he has had but negligible effect on a global scale.

INDEX TERMS: Path of pollutants, Aquatic environment, Mercury, Adsorption, Anaerobic conditions, Aerobic conditions, Chemical properties, Physical properties, Water analysis, Chemical analysis, Ions, Heavy metals, Water pollution sources, Toxicity, Freshwater, Sea water, Oxidation-reduction potential, Mercury cycle, Mercury compounds, Biological magnification, Methylation, Inorganic mercury, Organomercury compounds, Fate of pollutants.

AMIC-5898
"THE DETERMINATION OF STABLE ORGANIC COMPOUNDS IN WASTE EFFLUENTS AT MICROGRAM PER LITER LEVELS BY AUTOMATIC HIGH-RESOLUTION ION EXCHANGE CHROMATOGRAPHY", Katz, S., Pitt, W. W., Jr., Scott, C. D., Water Research, Vol. 6, No. 9, September 1972, pp 1029-1037.

A technique is described for the determination of stable ultraviolet-absorbing organic compounds in water at microgram per liter levels by automatic high-resolution ion exchange chromatography. Samples were concentrated prior to analysis by vacuum distillation and freeze-drying. Seventy-seven peaks were obtained from a municipal primary sewage effluent; each constituent was present at less than 100 micrograms/l. Thirty-eight peaks were obtained from a municipal secondary sewage effluent, with each constituent at less than 20 micrograms/l. Thirteen compounds have been identified as relatively stable to primary treatment. The concentrations of compounds in industrial primary and secondary effluents were estimated at up to 1 milligram/l; the secondary treatment caused little degradation. Chromatograms of the effluents appear to depend upon sewage plant operating conditions as well as upon the type of feed sent to the treatment plant.

INDEX TERMS: Organic compounds, Sewage effluents, Pollutant identification, Automation, Distillation, Freeze drying, Waste water (pollution), Water pollution sources, Chemical properties, Reliability, Carbohydrates, Anion exchange, Separation techniques, Ion exchange chromatography, Vacuum distillation, Sample preparation, Reproducibility, Sensitivity, Ultraviolet absorption.

AMIC-5901
"A METHOD FOR ISOLATING SUSPENDED SOLIDS FROM SEWAGE EFFLUENTS FOR MEASUREMENT OF OXYGEN DEMAND", Montgomery, H. A. C., Water Research, Vol. 6, No. 9, September 1972, pp 1097-1100.

A rapid filtration method for isolating suspended solids from water samples has been devised as a means of measuring the oxygen demand and therefore the biological activity of sewage effluents. The filtration procedure made use of a mixture of a filter-aid such as Celite, with the sample, a filter paper cone overlain with a pad of moist filter-aid, and a gentle suction system. After filtration, the solids, filter-aid and paper were decanted into a breaker, the mix gently macerated, then suspended in a chosen medium. Results showed solids consumed O2 by (a) endogenous respiration, (b) biological oxidation of residual organic matter, and (c) nitrification. Oxygen uptake appeared nearly proportional to the concentration of suspended solids, suggesting application as a relatively rapid method of estimating the initial rate of O2 demand and the quality of the treated effluent. Another experiment attempted to establish the order of activity of the mechanics of O2 uptake. Endogenous respiration appeared to be most active, followed by nitrification by Nitrosomonas and Nitrobacter and finally oxidation of dissolved organic matter. It was concluded that the filtration procedure was valid as a means of isolating suspended solids from biologically treated sewage effluents for the measurement of oxygen demand for periods up to 24 h.

INDEX TERMS: Separation techniques, Suspended solids, Sewage effluents, Isolation, Filtration, Oxygen demand, Bacteria, Respiration, Nitrification, Oxidation, Biochemical oxygen demand, Water quality control, Monitoring, Organic matter, Biological treatment, Nitrobacter, Nitrosomonas.

AMIC-5909
"EFFECT OF TURBULENCE ON BOD TESTING", Ali, H. I., Bewtra, J. K., Journal Water Pollution Control Federation, Vol. 44, No. 9, September 1972, pp 1798-1807.

Samples were collected from raw, settled, and biologically treated wastewater to determine the influence of mixing (turbulence) on the biooxidation rate of substrates normally laboratory tested by 5-day BOD analysis. Two sets of standard BOD bottles were inoculated and all tests conducted utilized the "Standard Methods" procedure. The first set was kept under quiescent conditions while the second set was continuously mixed with magnetic stirrers. In order to maintain test validity, DO was measured by an oxygen probe and by the Winkler method. Continuous recording from an incubated bottle was also attempted with a fixed probe but poor readings resulted. The BOD progression studies showed a significant increase in 5-day BOD values if contents were continuously stirred during analysis. Rate constant values showed significant increases in all samples except the treated effluent, while increase in ultimate carbonaceous oxygen demand was significant only in the treated effluent samples. Data obtained under quiescent conditions should, therefore, be carefully interpreted especially in applying wastewater treatment techniques.

INDEX TERMS: Biochemical oxygen demand, Measurement, Turbulence, Sewage effluents, Evaluation, Water analysis, Waste water (pollution), Dissolved oxygen, Oxygen demand, Dissolved oxygen analyzers, Biological treatment, Waste water treatment, Winkler method.

AMIC-5930
"THE VARIABILITY OF OCEANOGRAPHIC OBSERVATIONS OFF THE COAST OF NORTH-WEST AFRICA", Jones, P. G. W., Deep-Sea Research, Vol. 19, No. 6, June 1972, pp 405-431.

During May-June 1969 two sections, 30 nautical miles apart, were worked off the coast of north-west Africa near Cape Blanc. Temperature, salinity, phosphate, silicate and nitrate were recorded to a depth of 500 meters using standard equipment and techniques. Both sections were worked on three occasions, separated by periods of 50 and 77 hours, respectively. Considerable variation in the distribution of the parameters was observed, both between successive surveys of the same section and also between the two sections of the same survey. Observations were also made over a period of 24 hours at two locations on the edge of the continental shelf, and marked variation with time in the distribution of the parameters was recorded at both locations. The nature of the variability is discussed in the light of the upwelling process operating throughout the period of observation.

INDEX TERMS: Coasts, Africa, Variability, Physiochemical properties, Upwelling, Saline water, Oceanography, Nutrients, Plankton, Chemical analysis, Water sampling, Computer programs, Water analysis, Salinity, Phosphates, Silicates, Nitrates, Dissolved oxygen, Chlorophyll, Water temperature, Cape Blanc, Shipboard measurements, Salinometers, Sample preservation.

AMIC-5932
"CHEMICAL ANALYSES OF SUSPENDED PARTICULATE MATTER COLLECTED IN THE NORTHEAST ATLANTIC", Copin-Montegut, C., Copin-Montegut, G., Deep-Sea Research, Vol. 19, No. 6, June 1972, pp 445-452.

Chemical analyses of suspended particulate matter have been carried out on samples from different depths between 0 and 4000 m, in the northeast Atlantic. The total mass of suspended matter, particulate organic carbon, silicon, iron, aluminum, and phosphorus were determined by standard chemical methods. In surface waters (0-150 m), the average concentration in particulate matter (mass per vol) is 3.8 higher than between 150 and 4000 m. For carbon the ratio is 4.5 and for phosphorus 10.8. On the other hand, silicon, aluminum and iron are often as abundant in deep water as in the surface layer.

INDEX TERMS: Chemical analysis, Atlantic Ocean, Sea water, Carbon, Iron, Aluminum, Phosphorus, Water pollution, Pollutant identification, Filtration, Organic matter, Depth, Phosphates, Water sampling, Surface waters, Particulate matter, Silicon, Sample preparation, Organic carbon.

AMIC-5933
"FATE AND BEHAVIOR OF FIVE CHLORINATED HYDROCARBONS IN THREE NATURAL WATERS", Oloffs, P. C., Albright, L. J., Szeto, S. Y., Canadian Journal of Microbiology, Vol. 18, No. 9, September 1972, pp 1393-1398.

Water samples removed from two rivers and from the subtidal zone of Georgia Strait in British Columbia were treated with either 0.025 ppm of DDT, lindane, alpha-chlordane, or gamma-chlordane, or 0.1 ppm Aroclor 1260 (PCB). The samples were incubated in the laboratory for up to 12 weeks at the temperatures of these natural waters at the time of sampling and the chlorinated hydrocarbons determined by gas-liquid chromatography and standard extraction techniques. Lindane persisted in all water samples throughout the experiment, but large proportions of the other compounds were transported into the atmosphere during incubation except when the containers were sealed. No metabolic breakdown could be demonstrated. As demonstrated with C-14-gamma-chlordane, uneven distribution of the pesticides occurred rapidly, but was prevented, or reversed, by addition of a surfactant to the water. Total bacterial counts were generally higher in treated than in untreated water samples.

INDEX TERMS: Chemical analysis, Natural streams, Water analysis, DDT, Water sampling, Polychlorinated biphenyls, Surfactants, Chlorinated hydrocarbon pesticides, Fate of pollutants, Chlorinated hydrocarbons, Gas liquid chromatography, Lindane, Chlordane, Aroclor 1260.

AMIC-5940
"A SIMPLE COMPUTER-SPECTROPHOTOMETER INTERFACE", Williams, R. C., Turner, T. J., The Review of Scientific Instruments, Vol. 43, No. 8, August 1972, pp 1207-1209.

A simple, inexpensive technique is presented for interfacing a spectrophotometer to a digital computer thereby providing a data acquisition system. The interface system includes a voltage divider for the production of an analog signal, a relay system which initiates the computer operation and detects a change in optical density, a differential amplifier, and an analog to digital converter.

INDEX TERMS: Electronic equipment, Digital computers, Automatic control, Spectrophotometry, Instrumentation, Laboratory equipment, Automation, Computer-spectrophotometer interface, Data acquisition, Analog to digital converters.

AMIC-5946
"THE SPECTRUM OF PARTICULATE ORGANIC MATTER OF SHALLOW-BOTTOM BOUNDARY WATERS OF JAMAICA", Reiswig, H. M., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 341-348.

In an attempt to determine absolute abundance of aggregates and other particulate fractions in terms of volume and calculated particulate organic carbon (POC), the author microscopically analyzed water samples collected near the water-solid-substrate interface in shallow Jamaican waters. Samples were also analyzed by wet ashing for total POC to determine any possible relationship between visible particulate material and carbon retained by glass-fiber filters. Parallel analyses were carried out on water samples collected from effluent streams of marine sponges to assess the availability of particle fractions and total POC to this group of filter feeders. It was concluded from the analyses that aggregates comprise less than 5 percent of discrete particulate material and less than 0.5 percent of total POC. About 88 percent of POC is not accounted for by discrete particulate material. Parallel analyses of exhalant water samples from marine sponges indicate that about 35 percent of the missing POC is available to these filter feeders and is probably colloidal in nature.

INDEX TERMS: Organic matter, Water analysis, Microscopy, Filtration, Suspended solids, Organic carbon, Particulates.

AMIC-5947
"DISTRIBUTION OF ORGANIC CARBON IN A GLACIAL ESTUARY IN ALASKA", Loder, T. C., Hood, D. W., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 349-355.

The distribution is described of organic carbon in a glacial estuary in Alaska. North Dawes Inlet was sampled for particulate organic carbon (POC), dissolved organic carbon (DOC), particulate nitrogen (PN), and total particulate matter (PM). POC was determined by infrared analysis, DOC by a wet oxidation method, PN by using a nitrogen analyzer, and PM by filtration. The POC in glacial runoff ranged from 0.24-1.24 mg/liter and DOC varied from 0.15-0.53 depending on the season and amount of local rainfall. Inlet waters ranged from 0.035-0.65 mg/liter of POC and 0.65-1.6 of DOC. Values of POC, PN, and PM decreased with depth in the top 20 m of the inlet and with distance from the mouth of the river. About half of the POC was deposited in the inlet; the remainder was carried out in suspension. During summer a biologically active layer just beneath the freshwater lens was characterized by high POC and DOC, low C:N ratios, and low PM. Adsorption or release of organic compounds by the glacial clays was not detected.

INDEX TERMS: Estuaries, Spatial distribution, Chemical analysis, Alaska, Adsorption, Sea water, Water sampling, Brackish water, Organic carbon, Glacial water, Particulate organic matter, Dissolved organic matter, Particulate organic carbon, Dissolved organic carbon, Particulate nitrogen.

AMIC-5951
"SEDIMENTS AND WATERS OF SOMES SOUND, A FJORDLIKE ESTUARY IN MAINE", Folger, D. W., Meade, R. H., Jones, B. F., Cory, R. L., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 394-402.

The characteristics of sediments and waters of Somes Sound, a fjordlike estuary in Maine, were studied in order to evaluate the effects of its physiography. The following were determined both by observation and standard chemical laboratory procedures: salinity, temperature, dissolved oxygen, bacterial activity, and suspended matter in the water; circulation of bottom water in the southern third of the estuary; the size distribution of soils; organic carbon, calcium carbonate; and mineral and major element composition of bottom sediments. Bottom sediments in the Somes Sound estuary coarsen progressively seaward from clay in the upper and middle parts through silt and sand to gravel at the mouth. Most contain less than 5 percent $CaCO_3$ except in the lower sound where shell fragments are abundant and the concentrations reach 20 percent. Organic carbon is most abundant (3-5 percent) in the clay of the upper sound, which smells strongly of H_2S. Epifauna, especially holothurians, cover most of the bottom near the mouth of the sound. Infauna predominate in the fine sediments of the middle and upper sound but are absent where H_2S is high. Anaerobic bottom waters were not observed. The movement of a bottom drifter suggests that the net direction of flow of bottom water is landward, and the distribution of some sediment components that bottom-water flow is counterclockwise. Particulate matter suspended in the water ranged from 0.6-4.1 mg/liter, with greatest concentrations in bottom waters above areas covered with fine-grained sediments.

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INDEX TERMS: Bottom sediments, Chemical analysis, Estuaries, Sea water, Water properties, Soil properties, Aquatic soils, Hypolimnion, Seston, Bottom sampling, Benthic fauna, Maine, Mineralogy, Geomorphology, Somes Sound, Organic carbon.

AMIC-5955
"FATTY-ACID ECOLOGY OF A TIDAL MARSH", Jeffries, H. P., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 433-440.

A study was made of the fatty-acid ecology of small tidal marsh, Bissel's Cove, located in Rhode Island. Samples of grasses, fish, and shrimp were collected and a quantitative estimation of fatty-acid methyl esters was obtained by either gas or thin-layer chromatography. A salt marsh has differing biochemical patterns: The grasses have a terrestrial pattern rich in 16-18 C fatty acids, the animals a marine pattern dominated by long-chain polyunsaturates. The patterns vary, but they remain far more distinct than at corresponding positions in the structure of an offshore community. Each pattern is reflected in the diet of two species of marsh fishes. Their most probable diet is a mixture of 5 parts detritus to 1 part marine invertebrates. This ratio is also a boundary condition; it cannot go any higher and still account for the patterns occurring in the digestive tracts. Food is so abundant during spring that despite identical diets the two species could avoid competition.

INDEX TERMS: Tidal marshes, Ecology, Chemical analysis, Salt marshes, Gas chromatography, Shrimp, Nutrients, Biodegradation, Marsh plants, Fatty acids, Spartina alterniflora, Spartina patens, Ruppia maritima, Fundulus majalis, Fundulus heteroclitus, Palaemonetes pugio, Thin layer chromatography, Macrophytes, Macroinvertebrates.

AMIC-5956
"RADIOECOLOGICAL INVESTIGATIONS IN A THERMAL SPRING REGION", Lovric, G., Strohal, P., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 441-444.

The possible accumulation of naturally occurring radioisotopes in aquatic organisms and sediments of a radioactive thermal spring area is investigated. Samples were collected over a period of two years with a benthos net, and radioactivities in water, plants, animals, and sediments due to lead, radium, protactinium, radon and bismuth radioisotopes were measured by means of gamma ray spectrometry. The data indicate that organisms living in the thermal spring area accumulate the radioisotopes investigated. Some of the radioisotopes are probably present in the biota only as daughter products of long-lived radioisotopes due to several radioactive equilibria. Most of the activities are alpha-emitting radioisotopes which produce intensive specific ionization. The level of radioactivity measured suggests the possibility of investigating the influence of small doses of radiation on biocenoses, since such conditions have existed for centuries.

INDEX TERMS: Radioecology, Thermal springs, Water analysis, Soil analysis, Path of pollutants, Radioactivity, Lead radioisotopes, Radium radioisotopes, Spring waters, Water pollution, Pollutant identification, Biota, Mud, Aquatic soils, Absorption, Physiochemical properties, Bioaccumulation, Radon radioisotopes, Gamma ray spectrometery.

AMIC-5964
"DETERMINATION OF HYDROCARBON RESIDUES IN WATER", Desbaumes, E., Imhoff, C., Water Research, Vol. 6, No. 8, August 1972, pp 885-893.

The pollution of waters by hydrocarbons and their halogenated derivatives presents numerous problems, such as the unpleasant taste which is conferred to drinking water by traces of fuel oil. The method of determination described permits the detection of traces of hydrocarbons using apparatus in which these are carried over by a current of purified air and then analyzed quantitatively by the 'Hydrocarbon Analyzer Beckmann' equipped with a flame ionization detector and qualitatively, by gas chromatography (GCM Beckmann) by two detectors, catharometer and flame ionization. This second analysis is carried out on the condensate of vapors collected at the outlet of the 'Hydrocarbon Analyzer'. The reproducibility of the method is about 100 percent if the recommended procedure is followed whereby 2 or 3 determinations are made for various concentrations so that variations resulting from the temperature of the solvent and the syringe, purity of the sample and accuracy of the syringe are taken into account. Those factors cause an error of about 4-5 percent.

INDEX TERMS: Pollutant identification, Gas chromatography, Water analysis, Organic compounds, Pollutants, Water pollution, Chemical analysis, Laboratory equipment, Research equipment, Hydrocarbon residues, Flame ionization gas chromatography, Reproducibility, Precision, Thermal conductivity detector, Sample preservation, Fuel oil, Catharometer, Hydrocarbon analyzer.

AMIC-5974
"MICROWAVE SPECTROSCOPY", Karasek, F. W., Research/Development, Vol. 23, No. 9, September 1972, pp 38-40.

Microwave rotational resonance spectroscopy (MRR) occurs in the high frequency, long wavelength spectral region where only purely rotational molecular changes are found. The spectra are unique, and such a high degree of resolution can be achieved that each compound of a complicated mixture has many specific, narrow absorption bands. This resolution of absorption bands allows chemical identification according to specific rotational and bond characteristics. Band intensity contains the quantitative information and is a function of the permanent dipole moment magnitude and the numbers of molecules in the lower energy state of transitions. Applications in trace-gas pollutant monitoring and the analysis of complex mixtures are now underway.

INDEX TERMS: Laboratory equipment, Pollutant identification, Chemical analysis, Microwave spectroscopy, Mixtures, Microwave rotational resonance, Chemical composition.

AMIC-6007
"CHEMICAL ANALYSES OF WATER SAMPLES COLLECTED ON AMCHITKA ISLAND, ALASKA", Beetem, W. A., Young, R. A., Washington, C. L., Schroder, L. J., U. S. Geological Survey, Federal Center, Denver, Colorado, Report No. Amchitka-29, 1971, 23 pp. NTIS Report No. USGS 474 135.

This report presents the chemical data from the Amchitka Island study area obtained from water samples collected for and analyzed by the U. S. Geological Survey between October 1965 and November 1970. Samples were taken from springs, lakes, streams, the ocean, and precipitation as roof runoff or fresh snow. Water samples from deep test holes were collected by swabbing or by use of a submersible pump. Water samples from small-diameter test holes were collected by the use of a thief sampler. The samples were subjected to general chemical or spectrographic analyses. Analyses of water samples from test holes are tabulated by increasing latitude and increasing depth of sampling zone. Analyses of water samples other than test holes are tabulated by increasing latitude and decreasing longitude of sampling points. The study area from which samples are reported lies within latitude 51 degrees 21 minutes and 51 degrees 39 minutes North and longitude 179 degrees 24 minutes and 178 degrees 38 minutes East.

INDEX TERMS: Water properties, Chemical analysis, Water analysis, Chemical properties, Physical properties, Water sampling, Freshwater, Salt water, Spectroscopy, Heavy metals, Alkaline earth metals, Alkali metals, Dissolved solids, Salts, Amchitka Island, Sample preparation.

AMIC-6008
"SURVEY OF ENVIRONMENTAL RADIOACTIVITY", Voss, M. D., Iowa State University, Ames Laboratory - USAEC, Ames, Iowa, Report No. IS-2791, Contract No. W-7405-ENG-82, February 1972, 37 pp.

As part of the environmental monitoring program, the Ames Laboratory of the USAEC is monitoring the environmental effects of the Ames Laboratory Research Reactor (ALRR) by determining gross alpha and beta in air, soil, vegetation, river water, ALRR outfall, bottom sediment, precipitation, well water, and pond samples. A Sharp Low Beta-Matic three-inch system is used for the alpha and beta determinations. Data collected from 1962 (ca. 3 years before start up of the reactor) to 1971 indicate that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames area.

INDEX TERMS: Rain, Soil, Sediments, Ponds, Wells, Vegetation, Nuclear powerplants, Radioactivity, Soil analysis, Water analysis, Alpha rays, Beta rays.

AMIC-6009
"DETERMINATION OF MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT", De Goeij, J. J. M., Interuniversity Reactor Institute, Delft, Netherlands, Report No. CONF-710818-4, 1971 (Paper presented at the American Nuclear Society Topical Meeting on Nuclear Methods in Environmental Research, August 23-24, 1971, University of Missouri, Columbia, Missouri). 21 pp. NTIS Report No. IRI-133-71-17.

Samples of sediments; biological tissues and fluids (birds, fishes, and man); human hair; foodstuffs; industrial products and pharmaceuticals; and plants and water were analyzed for mercury by neutron activation analysis. These samples, ranging from 100 mg-1g, were irradiated in quartz vials, automatically decomposed and oxidized by sulfuric acid and hydrogen peroxide, and volatilized at 200 C with HBr into a sodium acetate solution. Inactive mercury was added to the solution and stirred for 1 hr to break the mercury into small droplets to ensure isotopic exchange. The Hg was then collected on a sintered glass filter, washed with water then acetone, and finally dissolved in nitric acid and counted in a well type sodium iodide crystal. A sensitivity and an accuracy of 1.0-0.1 ppb/gram sample and 97-98 percent yield were achieved, respectively. Results showed that (1) one quarter of the birds tested had been killed by methylmercury; (2) in the food chain: sediments - grass - cow - milk, cumulative effects were absent; (3) Rhine River sediments showed increases of 18-23 ppm compared to previous tests; and (4) while Dutch fish, seals and coastal marine organisms were generally contaminated, imported canned fish and cod liver oil were in low ranges. Separate measurements showed not only that tuna had higher concentrations but that about 80 percent of the mercury in all fish was present as lipophilic methylmercury.

INDEX TERMS: Mercury, Neutron activation analysis, Chemical analysis, Heavy metals, Body fluids, Industrial wastes, Pollutant identification, Water pollution sources, Irradiation, Separation techniques, Biological samples, Methyl mercury, Environmental samples.

AMIC-6011
"SEASONAL CHANGES IN PARTICLE SIZE DISTRIBUTION, COMPOSITION, AND STRONTIUM EXCHANGE CAPACITY OF PARTICULATE MATTER SUSPENDED IN THE COLUMBIA RIVER", Wildung, R. E., Routson, R. C., Schmidt, R. L., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington, Report No. BNWL-1638, Contract No. AT (45-1)-1830, January 1972, 26 pp.

A centrifugation method was employed to fractionate particulate matter suspended in the Columbia River in order to determine seasonal changes in particle size distribution, composition and strontium exchange capacity. The largest seasonal increase in the concentration of suspended matter (over 100 fold) occurred during the spring freshet; this increase was accompanied by a change in particle size distribution with the clay fraction accounting for approximately 63 percent of the total solids as compared to a range of 14-30 percent for other periods of the year. Whereas seasonal changes in the primary mineral composition were not pronounced, the relative concentrations of the layer silicate minerals commonly present in soils increased during spring and summer corresponding to the periods of spring runoff and the return of irrigation water to the river. Mineral composition also differed between size fractions. The Sr exchange capacity of materials isolated in the spring increased with decreased particle size likely reflecting relative differences in mineral type as well as increased reactive surface area. Increases in suspended particulate concentration due to the spring runoff and the return of irrigation waters resulted in a large capacity for cation sorption and transport during the spring and summer months. In fact, the Sr exchange capacity of particulate matter in equivalent volumes of river water amounted to 6 to 26 times higher in the spring than during other periods of the year.

INDEX TERMS: Columbia River, Particle size, Spatial distribution, Freshwater, Clays, Mineralogy, Silicates, Montmorillonite, Pollutant identification, Strontium exchange capacity, Particulate matter, Seasonal changes, Mica-illite, Chlorite.

AMIC-6012
"PRELIMINARY RADIATION SURVEILLANCE OF AN AQUATIC SYSTEM NEAR THE NEVADA TEST SITE JUNE - JULY, 1967", Klein, W. L., Brechbill, R. A., Environmental Protection Agency, Western Environmental Research Laboratory, Las Vegas, Nevada, Report No. SWRHL-65r, Memorandum of Understanding No. SF 54 373, February 1972, 23 pp.

This report is the culmination of a three-month preliminary radiation surveillance study of an aquatic system in Upper Pahranagat Lake near the Nevada Test Site. The objectives of this study were to determine the concentrations of fission products in selected samples and to establish the necessary methodology for radiation surveillance in an aquatic ecosystem. Biological samples from a freshwater lake near the Nevada Test Site (NTS) were analyzed for the presence of selected radionuclides in order to establish a base line for this particular system and to develop methodology necessary for any further definitive studies of this type. Radionuclide concentrations were found to be insignificant in water, aquatic plant, and fish samples. Sediment samples had detectable levels of Cs-137, K-40, Sr-90, and U. Strontium-90 levels in fishbone were low (2.38 pCi/g bone ash) compared to those found in bovine femur samples (6.9 pCi/g bone ash) collected during the same period.

INDEX TERMS: Surveys, Aquatic environment, Radioecology, Radiochemical analysis, Measurement, Nevada, Aquatic plants, Water pollution sources, Sediments, Aquatic soils, Plant tissues, Freshwater fish, Aquatic algae, Biological samples, Sr-90, K-40, Cs-137, Pahranagat Lake, Gamma ray spectrometry, Animal tissues, Macrophytes.

AMIC-6015
"DETERMINATION OF MANGANESE, COPPER, AND IRON IN HUMAN BLOOD BY NEUTRON ACTIVATION ANALYSIS", Das, H. A., Hoede, D., Kroon, J. J., Zonderhuis, J., Reactor Centrum Nederland, Petten, Netherlands, Report No. RCN-155, September 1971, 20 pp.

Procedures are given for the determination of manganese, copper, and iron in blood. Manganese and copper were determined by thermal neutron activation, followed by chemical separation. The iron-concentration was obtained by instrumental fast neutron activation analysis. The average concentrations of Mn and Cu in human blood were 16 plus or minus 5 ng/g and 0.9 plus or minus 0.2 microgram/g, respectively. The Fe concentration ranged from 240-400 micrograms/g.

INDEX TERMS: Manganese, Copper, Iron, Neutron activation analysis, Heavy metals, Pollutant identification, Chemical analysis, Separation techniques, Methodology, Blood, Biological samples, Body fluids.

AMIC-6025
"WATER QUALITY CRITERIA DATA BOOK, VOLUME 2. INORGANIC CHEMICAL POLLUTION OF FRESHWATER", Davis, T. R. A., Burg, A. W., Butters, K. M., Wadler, B. D., Arthur D. Little, Inc., Life Sciences Division, Cambridge, Massachusetts, Water Pollution Control Research Series 18010 DPV 07/71, July 1971, 280 pp.

A survey of the literature dealing with inorganic chemical compounds was conducted to obtain and reference data relevant to the establishment of water quality criteria. More than 5,000 publications were reviewed. While nearly 300 inorganic species may exist in freshwater only 87 were identified in the literature. A wide distribution in concentrations in potable and polluted water was found. Data on acute toxicity, chronic toxicity, carcinogenicity, mutagenicity, and teratogenicity of inorganic chemicals have been tabulated. Due to the design of most of these toxicological determinations, it is difficult to extrapolate from this data to human health. This inability is furthered in that the concentrations of many materials in freshwater are reported in terms of elemental analysis alone without reference to the ionic or complex form of the material. However, toxicity varies with the complex ion and oxidation state. Correlations have been made of minimum lethal oral dose versus maximum concentrations reported in freshwater, and of minimum chronic toxic dose versus maximum concentration reported in drinking water. Examples of inorganic species which approach a safety limit have been observed.

INDEX TERMS: Inorganic compounds, Chemicals, Water quality standards, Freshwater, Water pollution, Water pollution sources, Animal pathology, Toxicity, Bioassay, Chemical analysis, Lethal limit, Water pollution effects, Water quality control, Public health, Potable water, Teratogenicity, Carcinogenicity, Mutagenicity, Rare earth elements.

AMIC-6030
"AUTOMATED SEPARATIONS IN ROUTINE ACTIVATION ANALYSIS OF MERCURY", de Goeij, J. J. M., Interuniversity Reactor Institute, Delft, Netherlands, Report No. CONF-710626-1, 1971 (Paper presented at the 2nd Symposium on the Recent Developments in Neutron Activation Analysis, 28 June - 1 July 1971, Churchill College, Cambridge), 9 pp. NTIS Report No. I.R.I.-311-71-5.

A procedure has been adopted for an automated chemical separation of mercury from those samples which require such for a nondestructive measurement of the metal by neutron activation analysis. The problems of loss and adsorption of radioactive Hg while processing irradiated samples are avoided. The automated instrument devised carries out the destruction, oxidation, and distillation of the irradiated samples. This automation includes introduction of chemicals at appropriate times, control of the temperature in various stages of the treatment, and passage of air through the instrument during complete treatment. This instrument handles 6 samples simultaneously and produces 30-36 samples daily. Mercury analysis has a sensitivity of 1-0.1 ppb using a 1 g sample, an accuracy 3-4 percent in the ppm-range and 10-15 percent in the ppb-range, and a chemical yield of 97-98 percent. In one 5-day week about 90 irradiated samples (including standards and blanks) can be chemically processed, measured, and computed. The sensitivity and chemical procedure were satisfactory for nearly all of 2500 samples analyzed - sediments; mammalian, avian, and fish tissues; biological fluids; human hair; foodstuffs, industrial products and pharmaceuticals; plants and water.

INDEX TERMS: Separation techniques, Automatic control, Neutron activation analysis, Mercury, Methodology, Instrumentation, Plant tissues, Biological samples, Biological materials, Sensitivity, Precision, Chemical recovery, Sample preparation, Animal tissues, Detection limits.

AMIC-6031
"PHYSICAL CHEMISTRY OF EXTRACTION PROCESSES", Siekierski, S., Institute of Nuclear Research, Warsaw, Poland, Report No. CONF-700540-1, 1971 (Presented at the Polish-Italian Seminar on Some Chemical, Ceramic, and Metallurgical Aspects of Nuclear Fuels held in Zakopane, Poland, 29 May 1970), 8 pp. NTIS Report No. INR-P-1339.

The thermodynamics of the extraction process, based on the modern theory of the structure of liquid water has been discussed. A significant increase in the entropy of the system due to the removal of an uncharged organic molecule from the aqueous phase, connected with the change of the structure of water, is a main factor determining the transfer of the molecule from the aqueous to the organic phase. The model described can be applied to the description of the extraction mechanism of metals in the forms of chelates, solvated salts and ion-pairs.

INDEX TERMS: Separation techniques, Solvent extractions, Thermodynamic behavior, Salts, Entropy, Ions, Mathematical models, Electrolytes, Physicochemical properties, Chemical analysis, Free energy, Pollutant identification, Solvation, Ion pairing, Metal chelates, Lanthanum, Tributylphosphate, Sample preparation, Chemical structure.

AMIC-6037
"DEVELOPMENT OF A MATHEMATICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWATER FLOW IN OVERFERTILIZATION OF SURFACE WATERS", Johnson, J. D., University of Minnesota, Minneapolis, Minnesota, Dissertation Abstracts No. 72-361, 1972, 284 pp.

Automatic pump samplers were used to collect over 800 water samples from a watershed and a city drainage channel for identification and quantification of various sources of the nutrients N and P. The water samples were analyzed for four components of N, total and soluble P, and four components of solids. Streamflow was determined at the time of sampling. These data were used to develop a mathematical model of surface runoff and groundwater flow as factors in overfertilization of surface waters. The model included nutrient sources from precipitation, feedlots, municipal sewage treatment effluent, industrial effluent, septic tank effluents, forest and wildland runoff, and a conglomerate of surface runoff and groundwater flow. The results of regression on streamflow were utilized to obtain an equation for the base flow. Such information is essential for development of effective control techniques.

INDEX TERMS: Mathematical models, Surface runoff, Base flow, Forecasting, Eutrophication, Surface waters, Mathematical studies, Equations, Watersheds, Nutrients, Nitrogen, Phosphorus, Pollutant identification, Automation, Minnesota, Instrumentation, Precipitation (atmospheric), Feed lots, Municipal wastes, Industrial wastes, Effluents, Septic tanks, Water sampling, Sewage effluents, Water pollution sources, Water quality control.

AMIC-6046
"EFFECT OF BUFFER INTENSITY AND ORGANIC MATTER ON THE OXYGENATION OF FERROUS IRON", Jobin, R., Ghosh, M. M., Journal American Waterworks Association, Vol. 64, No. 9, September 1972, pp 590-595.

Research was initiated to determine the effect of buffer intensity and the organic content of water on the rate of conversion of soluble Fe(II) to insoluble Fe(III). The effect of buffer intensity was determined by varying the alkalinity of synthetic water using different concentrations of sodium carbonate and bubbling carbon dioxide and air through the water. The results indicate that oxygenation of Fe(II) in aqueous medium is a first-order reaction, and that buffer intensity affects the Fe(II) oxygenation rate at values higher than .004 e/pH. To test the effects of organic compounds on oxygenation of Fe(II), various concentrations of humic and tannic acid were added to test waters. The results show that both acids retard the rate of oxygenation, with tannic acid having more effect than humic acid. In the presence of organic matter, the Fe(II)-Fe(III) redox couple acts as a catalyst for the oxidation of organic matter. In such systems, both complexation of Fe(II) and reduction of Fe(II) by organic matter are possible. A model was also developed to show the efficiency of iron removal processes.

INDEX TERMS: Iron, Oxygenation, Reduction (chemical), Hydrogen ion concentration, Chemical reactions, Tannic acid, Humic acids.

AMIC-6048
"AUTOMATED REACTION-RATE METHODS OF ANALYSIS", Malmstadt, H. V., Cordos, E. A., Delaney, C. J., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 26A-32A, 36A, 38A, 40A-41A.

The inherent advantages and possible limitations of reaction-rate methods of analysis as compared to equilibrium methods are reviewed, and the general concepts of encoding reaction-rate information are presented. Much of the discussion is focused on the automated systems that make it possible to perform hundreds of accurate, sensitive, and selective quantitative determinations per hour via rate data and to develop new methods more rapidly.

INDEX TERMS: Automation, Spectrophotometry, Computers, Instrumentation, Phosphates, Reaction rate analysis, Blood, Glucose, Sample preparation.

AMIC-6050
"COMPUTER CONTROLLED STOPPED-FLOW STUDIES - APPLICATION TO SIMULTANEOUS KINETIC ANALYSES", Sanderson, D., Bittikofer, J. A., Purdue, H. L., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 1934-1939.

Kinetic data are used to develop analytical methodology for the simultaneous, computer controlled, stopped-flow spectrophotometric determination of cysteine and thiolactic acid in mixtures of the two. The design and construction of a fully automatic stopped-flow instrument featuring a computer controlled sample preparation unit, a newly designed sampling system, and real time data collection and treatment are described. The instrument is used for a kinetic study of the exchange reaction between a Ni(II)-citrate complex and thiol acids. Information obtained from this study is used to develop an analytical procedure for the simultaneous determination of two thiol acids, cysteine and thiolactic acid in mixtures. Samples of thiol acids were determined quantitatively in the concentration range of .00001 M to .0001 M. Results for the two-component systems are included.

INDEX TERMS: Computers, Automatic control, Heavy metals, Control systems, Data collections, Aqueous solutions, Pollutant identification, Data processing, Nickel, Organic acids, Amino acids, Cations, Chemical reactions, Stopped-flow spectrophotometry, Exchange reaction kinetics, Thiolactic acid, Cysteine, Metal complexes, Metal chelates, Mixtures.

AMIC-6051
"CONVERSATIONAL MASS SPECTRAL RETRIEVAL SYSTEM AND ITS USE AS AN AID IN STRUCTURE DETERMINATION", Heller, S. R., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 195-1961.

An interactive, conversational mass spectral retrieval system consisting of a collection of computer programs designed to give immediate retrieval of mass spectral data is described. The system options include a peak/intensity search, a molecular weight search, a complete molecular formula search, an imbedded molecular formula search, and printout of the peaks and intensities of the entire spectrum. The programs used to generate and search the files, as well as the file structure, are described. (Reprinted from Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 1951-1961. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Data storage and retrieval, Design criteria, Automation, Computers, Computer programs, Control systems, Pollutant identification, Physical properties, Mass spectra, Molecular weight, Chemical structure, Molecular structure, Data acquisition, Data interpretation.

AMIC-6052
"COMPUTER ACQUISITION AND ANALYSIS OF GAS CHROMATOGRAPHIC DATA", Landowne, R. A., Morosani, R. W., Herrmann, R. A., King, R. M., Jr, Schmus, H. G., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 1961-1971.

A computerized system for a multiple instrument gas chromatographic laboratory is described. Simultaneous operation of all chromatographs is possible in real time even while the computer performs other functions. A set of resident programs controls the entire process which requires a minimal amount of operator interaction regardless of the complexity of the chromatographic analysis. In either method, development or routine analysis, only a few input parameters are required to choose several modes of data handling, with each instrument capable of operating in its own independent fashion. A teletypewriter is used almost exclusively for outputs of results, while most sample information and mode selection is entered through simple data switch boxes. Peak resolution and baseline determination is accomplished for almost all situations encountered without resorting to special routines. (Reprinted from Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 1961-1971. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Computers, Automatic control, Gas chromatography, Automation, Computer programs, Control systems, Data collections, Electronic equipment, Pollutant identification, Data acquisition, Data interpretation.

AMIC-6054
"PHOTOELECTRON SPECTRA OF PHOSPHORUS HALIDES, ALKYL PHOSPHITES AND PHOSPHATES, ORGANO-PHOSPHORUS PESTICIDES, AND RELATED COMPOUNDS", Betteridge, D., Thompson, M., Baker, A. D., Kemp, N. R., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2005-2010.

The photoelectron spectra of 15 phosphorus-containing compounds including the pesticides Dichlorvos, Disulfoton, and Butonate, have been substained by UV-photoelectron spectroscopy. The spectra of the compounds are sufficiently different to allow qualitative identification based on the molecular orbital theory, the symmetry of phosphorus and ligand orbitals, and by comparison of the spectra of less complex molecules such as simple phosphorus halides. Instrument memory and side reaction effects were observed during measurement. Compound involatility and molecular complexity increased the difficulty of investigation.

INDEX TERMS: Pollutant identification, Organophosphorus pesticides, Chemical analysis, Phosphorus compounds, Halides, Agricultural chemicals, Phosphates, Ultraviolet photoelectron spectroscopy, Spectrochemical analysis, Dichlorvos, Disulfoton, Butonate, Photoelectron spectra, Phosphites.

AMIC-6055
"CURCUMIN METHOD FOR SPECTROPHOTOMETRIC DETERMINATION OF BORON EXTRACTED FROM RADIOFREQUENCY ASHED ANIMAL TISSUES USING 2-ETHYL-1,3-HEXANEDIOL", Mair, J. W. Jr., Day, H. G., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2015-2017.

Work on the nutritional significance of boron in animals required the development of a sensitive and accurate method for its determination at the submicrogram level. The method developed (Curcumin method) requires gentle combustion of animal tissues in a low temperature radiofrequency excited oxygen plasma followed by extraction from a 1 N HCl solution of the ash using 2-ethyl-1,3-hexanediol in chloroform (10 percent v/v). Boron in the organic phase is converted to the highly absorbing rosocyanin complex using glacial acetic acid (0.375 percent w/v) followed by concentrated sulfuric acid. The concentrate is diluted with 95 percent ethanol and subsequently analyzed spectrophotometrically. Beer's law was obeyed down to 0.002 microgram/ml, and the method exhibits a total error of about 10 percent over concentrations ranging between 0.002 and 0.020 microgram/ml. Data show that 100.3 plus or minus 5.1 percent of the standard Borax added to the unashed tissue samples was recovered. The use of XE-243 boron-specific resin proved to be a convenient, quantitative means for concentrating as little as 1 microgram of boron from large volumes of solution.

INDEX TERMS: Spectrophotometry, Boron, Chemical analysis, Resins, Separation techniques, Pollutant identification, Methodology, Trace elements, Curcumin method, Radiofrequency ashing, Animal tissues, Biological materials, Sample preparation, 2-ethyl-1 3-hexanediol, Sodium tetraborate decahydrate, Borax.

AMIC-6056
"MAXIMIZATION OF SENSITIVITIES IN TANTALUM RIBBON FLAMELESS ATOMIC ABSORPTION SPECTROMETRY", Hwang, J. Y., Mokeler, C. J., Ullucci, P. A., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2018-2021.

Four parameters, composition of purge gas, temperature, flow rate of purge gas, and height of measurement, which affect the sensitivity of atomic absorption spectrometry were studied with the aim of maximizing performance. An Instrument Laboratory Inc. Model 253 double beam AA spectrophotometer modified with an atomization chamber containing a tantalum ribbon as a heating element was used to analyze aqueous solutions of 37 metals. Argon, helium, nitrogen and hydrogen were used as purge gases. Data from the analyses show that detection limits for the metals range from 10 to .0001 ng. It is concluded that it is important to optimize the temperature and height of measurement and the chemical composition, thermal characteristics, and flow rate of the purge gas to achieve maximum sensitivity in the flameless technique reported. The technique is easy to use, sensitive, and has good precision (2-4 percent rel std dev) at the nanogram level. It will be useful in the analysis of the trace and ultratrace elements in biological samples and air particulate samples since the technique provides excellent sensitivities and consumes only a few microliters of sample solutions. Applications of the technique to directly determine Cr, Ni, Mn, Be, and Pb in human sera and blood samples are available.

INDEX TERMS: Heavy metals, Aqueous solutions, Gold, Beryllium, Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Mercury, Potassium, Cesium, Magnesium, Manganese, Lead, Strontium, Titanium, Zinc, Biological samples, Detection limits, Flameless atomic absorption spectrophotometry, Blood, Vanadium, Thallium, Antimony, Barium, Indium.

AMIC-6057
"REDUCTION OF A MATRIX EFFECT IN SPARK SOURCE MASS SPECTROMETRY USING A SOLUTION DOPING TECHNIQUE", Guidoboni, R. J., Evans, C. A., Jr., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2027-2030.

A sensitive and comprehensive method is developed for the analysis of major, minor and trace species using spark source mass spectrographic techniques when a comparative standard is not available. The technique employs simple solution doping, which permits quantitative analysis through the use of synthetic standards. The method was applied to the analysis of several NBS standards with precision of plus or minus 8-10 percent and average deviations from certified values of plus or minus 10 percent. The technique can be employed for the analysis of a wide variety of materials including metals, minerals, semiconductors and powders. Easily prepared standards can be used for the quantitative analysis of aqueous solutions such as might be encountered in water pollution analysis.

INDEX TERMS: Chemical analysis, Aqueous solutions, Water pollution, Pollutant identification, Solution doping, Matrix effect, Spark source mass spectrometry.

AMIC-6058
"EQUILIBRIUM AND KINETIC SIMULTANEOUS DETERMINATION OF SULFONEPHTHALEIN DYE MIXTURES BY THE METHOD OF PROPORTIONAL EQUATIONS", Ellis, G. L., Mottola, H. A., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2037-2043.

Equilibrium and kinetic absorptiometric methods based on proportional equations have been developed and compared for the determination of binary and ternary mixtures of sulfonephthalein dyes. The kinetic determinations are based on the rather selective oxidation of sulfonephthalein dyes by periodate ion in basic medium (pH 7 to 10) catalyzed by manganese(II) and the difference in rate of oxidation exhibited by the individual dyes. A selective determination of Cresol Red is also included. The kinetic determinations compare well with the equilibrium determinations and show an advantage in the case of an unreactive absorbing background. (Reprinted from Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2037-2043. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Dyes, Water analysis, Spectrophotometry, Absorption, Phenols, Sample preparation, Cresols.

AMIC-6061
"USE OF THE MICROWAVE-EXCITED EMISSIVE DETECTOR FOR GAS CHROMATOGRAPHY FOR QUANTITATIVE MEASUREMENT OF INTER-ELEMENT RATIOS", Dagnall, R. M., West, T. S., Whitehead, P., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2074-2078.

The detector system of a gas chromatograph was modified by the use of a narrow, water-cooled, three-quarter wave microwave cavity for use in determining inter-element ratios. Two apertures on opposite sides of the cavity were used for monitoring the discharge with a Beckman DU monochromator fitted with a 960IB photomultiplier and a low resolution Hilger and Watts monochromator fitted with an R166 solar blind photomultiplier. The responses of the two photomultipliers were recorded simultaneously. In the investigation of compounds of carbon and chlorine, iodine, phosphorus, sulfur, or bromine, one monochromator was set to the emission wavelength of atomic carbon and the other set for the emission characteristics of the particular heteroatom. The results showed that the use of the simple expedient of simultaneously monitoring emission from two atomic lines can be used to determine the quantitative relationship between the heteroatoms and the number of carbon atoms in the compound. In each instance the measured ratio was found to be independent of carrier gas flow rate and concentration. The results obtained from chlorine- and bromine-containing compounds can be satisfactorily explained on the basis that the emitting species are diatomic (Cl2 and Br2). The ratios of chlorine or bromine emission to atomic carbon emission were both carrier gas flow rate and concentration dependent. The analytical utility of this technique is clearly limited by the sensitivities of the detectors to the elemental emissions monitored and by the relative interference of other elements at these wavelengths. The use of microwave-excited atomic emissions for the determination of inter-element ratios is considered to offer a valuable aid in the identification of unknown eluates in gas chromatography.

AMIC-6061 (Continued) 2/2

INDEX TERMS: Gas chromatography, Organic compounds, Organophosphorus compounds, Sulfur compounds, Instrumentation, Chlorides, Iodides, Phosphates, Sulfides, Bromides, Iodine, Phosphorus compounds, Laboratory equipment, Microwave emission detectors, Iodine compounds, Bromine compounds, Chromatographs, Inter-element ratios, Phosphites, Carbon tetrachloride, Coloroform, Methyl iodine, Dichloromethane, Trichloroethylene, Tetrachloroethylene, Ethyl chloride, Chlorobenzene, Dichloroethane, Ethyl iodine, n-propyl iodide, Amyliodide, Iodobenzene, Triethylphosphite, Trimethylphosphate, Trimethylphosphite, Triethylphosphate, Tributylphosphate, Triphenylphosphate, Carbon disulfide, Dimethylsulfoxide, Thiophen, Dibutylsulfide, Dibutyldisulfide, Bromoform, Bromobenzene, Ethyl-2-bromopropionate, Dibromoethane, n-Amyl bromide, Ethyl bromide, Propyl bromide.

AMIC-6062
"CALCULATION OF RETENTION VOLUMES IN GRADIENT ELUTION ADSORPTION CHROMATOGRAPHY", Popl, M., Dolansky, V., Mosteeky, J., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2082-2084.

A simple method is presented for calculating the retention volumes of solute components in the gradient elution of mixtures. This calculation is advantageous for consideration of the separability of individual components thereby allowing for adjustment of the gradient course, without experimental data, to achieve maximum separation in adsorption elution chromatography. The equations of Snyder and his co-workers are used as the basic relationship for the calculation. Experimentally, model mixtures of benzene-naphthalene-anthracene and benzene - biphenyl - para-terphenyl were used on either neutral or acid alumina with a gradient of n-pentane-ethyl ether for measured and calculated volumes for the mixture components analyzed.

INDEX TERMS: Organic compounds, Estimating equations, Adsorption, Chemical analysis, Retention volumes, Mixtures, Gradient elution adsorption chromatography, Benzene, Naphthalene, Biphenyl, Anthracene, Alumina, Adsorbents, Eluents, Organic solvents, p-Terphenyl.

AMIC-6064
"INFRARED SPECTROPHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF LACTIC AND PYRUVIC ACIDS", Riva, A., Bisognani, Analytical Chemistry, Vol. 44, No. 12, October 1972, p 2101.

Due to the problem of detection and quantitative analysis of lactic and pyruvic acids using the Dolinsky and Wilson IR absorption method, a more suitable method has been devised based on the IRS (Internal Reflection Spectroscopy) technique. A known quantity of either acid was dissolved in distilled water and a volume of an ethanolic solution of Amberlite LA-2 was added. The solvents were then distilled under reduced pressure. With this procedure the spectrum of Amberlite as well as the spectra of combined Amberlite and either acid was tested. Quantitative and qualitative spectra were recorded with a Perkin-Elmer IR spectrophotometer equipped with an FMIR unit (Frustrated Multiple Internal Reflection). Reproducibility of the method was found to be fully satisfactory and the smallest absolute amount detected was 2.5 mg of either acid. Sensitivity may be further improved by reducing the amount of resin for each initial concentration of acid and employing micro internal reflection accessories.

INDEX TERMS: Organic acids, Chemical analysis, Aqueous solutions, Organic compounds, Infrared spectrophotometry, Lactic acid, Pyruvic acid, Reproducibility, Detection limits, Sensitivity, Amberlite resin, Internal reflection spectroscopy.

AMIC-6065
"SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(IV) WITH POTASSIUM IRON(III) CYANIDE", Gayer, K. H., Lifshitz, H. T., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2104-2107.

A fast spectrophotometric procedure which alleviates the need for extraction has been developed for the determination of U(IV) in aqueous solution in the presence of a large excess of uranyl ion and organic reagents. With this method the aqueous U(IV) solution is reacted with the ferric ion (ferric chloride) in acid medium to yield the ferrous ion which is then reacted with potassium ferricyanide to produce a small dark complex. This complex has the characteristics of a bluish solution and is subject to reproducible spectrophotometric absorption of visible light. Solutions of U(IV) or Fe(II) concentrations higher than 0.01 mM and 0.425 M, respectively, have a tendency to form an aggregate precipitate rather than the dilute colloidal suspension needed for accurate spectroscopic determination. Chemical interference by the cations Ca, Mg, and Pb was observed; any species that reduces Fe(III) under the conditions of this method will interfere.

INDEX TERMS: Spectrophotometry, Aqueous solutions, Color reactions, Chemical reactions, Cations, Organic compounds, Reduction (chemical), Uranium, Potassium ferricyanide, Chemical interference, Uranyl, Organic reagents.

AMIC-6067
"A SIMPLIFIED SEPARATION OF STRONTIUM, RADIUM, AND LEAD FROM ENVIRONMENTAL MEDIA BY PRECIPITATION FOLLOWED BY FRACTIONAL ELUTION", Gregory, L. P., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2213-2215.

Successful separations of strontium, radium, and lead from biological and environmental samples have been achieved with nitric acid at about the strength of the common laboratory reagent, 16 N (70 percent w/w). A report is given of how the difficulties inherent in multiple separations using fuming nitric acid and in the alternative ion exchange methods have been overcome by a simple and reliable two-stage procedure. In the first stage, the insoluble alkaline earth carbonate or phosphate precipitate is separated from the sample and dried. A single treatment using laboratory reagent 70 percent HNO_3 reduces the calcium content to about the same amount as the added strontium carrier. In the second stage, the resulting dilute solution of calcium, strontium, and impurities is sorbed on a small column of cation exchange resin. Fractional elution of the strontium using ammonium lactate solution at room temperature gives radiochemically pure strontium in high yield. A logical development of this method is the procedure for determining the three long-lived bone-seeking radionuclides, Pb-210 ($t_{1/2}$ 22 yr), Sr-90 ($t_{1/2}$ 28 yr), and Ra-226 ($t_{1/2}$ 1600 yr) in the one sample of bone ash. Advantage is taken of the insolubility of lead, radium, and barium (used to carry the radium) in 70 percent HNO_3. The nitric acid separation thus becomes a preparatory step for the sequential separation of these radionuclides from the same column by fractional elution using ammonium acetate, ammonium lactate, and alkaline EDTA eluents, respectively.

INDEX TERMS: Chemical precipitation, Separation techniques, Strontium, Lead, Heavy metals, Water analysis, Soil analysis, Foods, Chemical analysis, Radioactivity techniques, Environmental samples, Biological materials, Radium, Chemical recovery, Sample preparation.

AMIC-6068
"DETERMINATION OF SILVER IN PRECIPITATION DOWN TO 10 TO THE MINUS 11 POWER M CONCENTRATIONS BY ION EXCHANGE AND NEUTRON ACTIVATION ANALYSIS", Warburton, J. A., Young, L. G., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2043-2045.

Thermal neutron activation analysis has been used to determine the concentration of silver in precipitation. The (n, gamma) reaction for Ag-109 and Ag-110 was used, the determinations being made by gamma-ray spectrometry using the 24-second half-life Ag-110 radioisotope. The silver content of precipitation in the eastern Sierra of the United States was generally in the concentration range of 0.2-0.6 picomoles. Evidence indicates that this natural 'background' concentration of silver increases by about a factor of 10 east to the Rockies. Samples collected in mountainous areas where silver iodide is being released for weather modification purposes contained silver in concentrations as much as 0.2-0.6 picomoles. To effect detection of silver at these low concentrations, sample enrichment by ion-exchange was used prior to activation.

INDEX TERMS: Precipitation (atmospheric), Ion exchange, Neutron activation analysis, Water analysis, Chemical analysis, Stable isotopes, Silver iodide, Chemical reactions, Water pollution, Pollutant identification, Snow, Radioactivity techniques, Silver, Gamma ray spectrometry, Detection limits, Silver radioisotopes, Radioactive decay.

AMIC-6069
"KINETIC BEHAVIOR OF ENZYMES IMMOBILIZED IN ARTIFICIAL MEMBRANES", Blaedel, W. J., Kissel, T. R., Boguslaski, R. C., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2030-2037.

Steady state flux and distribution equations are presented to show how enzymes fixed in gels may be used for analysis or for the study of immobilized enzyme kinetics. Experimental support of the equations has been obtained with urease in three systems: a membrane-covered sensor, a membrane separating two solutions, and a membrane immersed in a solution. The relative merits of the three systems for analysis and for the determination of rate constants for the immobilized enzyme are examined. It has been shown in the past that one use of immobilized enzymes in analytical devices is for assaying organophosphorus insecticides through their inhibition of the hydrolysis of a fluorogenic ester with chlorinesterase immobilized in a starch gel.

INDEX TERMS: Membrane processes, Enzymes, Organophosphorus pesticides, Assay, Kinetics, Sample preparation.

AMIC-6070
"ULTRATRACE LEVEL DETECTION OF MERCURY BY AN X-RAY EXCITED OPTICAL FLUORESCENCE TECHNIQUE", D'Silva, A. P., Fassel, V. A., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2115-2116.

A new technique is reported which has the capability of quantitatively determining Hg at nanogram (ppb) levels. Observations made in earlier experiments concerning the behavior of the Hg spectrum under X-ray excitation and in an argon-nitrogen gas mixture were used in developing this technique. A Hg vapor generation system similar to that used in atomic absorption analysis was continuously flushed by an Ar-1 percent N2 gas mixture. The Hg vapor released into this gas was fed to a 2-mm i.d. quartz tube placed in a Pb-shielded enclosure. The wide open end of the discharge tube at the top was sealed with a Mylar film to facilitate X-ray irradiation of the gases. A tungsten target X-ray tube (OEG-50, Machlett Laboratories, Springdale, Connecticut) operated at varying power levels was used in these experiments. A 5-cm length of the 2-mm i.d. discharge tube was focused on the slit of a 0.25-meter Jarrel-Ash grating spectrometer. The spectral features were recorded using instrumentation already described. The fluorescent signals obtained from 3 different 10-ppb level (10 ng/ml) experiments indicate that the method is reproducible. The detection limit of this technique is expected to be at the fractional ppb level since a number of experimental variables remain to be optimized.

INDEX TERMS: Mercury, X-ray fluorescence, Irradiation, Methodology, Heavy metals, Optical fluorescence, Environmental samples, Optical spectra, Detection limits, Reproducibility.

AMIC-6071
"INTERFERENCE BY COPPER(II) IN DETERMINATION OF MOLYBDENUM(VI) USING TOLUENE-3,4-DITH DITHIOL", Milham, P. J., Maksvytis, A., Barkus, B., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2102-2104.

An experiment was conducted to examine the effect of copper, in the absence of masking agents, on the determination of molybdenum using dithiol. Individual and combined effects caused by variations in the concentration of Cu, Mo, and HCl were separated. The ratios of Cu to Mo cover the range most often encountered during analysis of biological and mineral materials. One hundred sixty-eight unique combinations of Cu, Mo, HCl were prepared in duplicate; each solution was mixed with dithiol and allowed to stand, with occasional shaking, at 20 plus or minus 5 C, for an hour. Reagent grade isoamyl acetate was added, the mixture shaken, and the liquid phases separated by centrifugation. Mo was spectrophotometrically determined in the isoamyl extract and Cu in the filtered aqueous phase using atomic absorption spectrophotometry. The precipitate was digested to dryness with HNO_3 and $HClO_4$ and the residue dissolved in dilute HCl. The resulting solution was analyzed for molybdenum and copper. Copper(II) reduces the amount of extractable MoD_3 only if copper dithiolate is precipitated. The resulting loss of molybdenum was analytically significant for Cu to Mo ratios (w/w) as small as 1/1 in 0.5-5 M HCl. Higher acid concentrations increase the copper tolerance and with 10 M HCl the interference was negligible at the highest Cu-to-Mo ratio tested (400/1).

INDEX TERMS: Copper, Molybdenum, Chemical analysis, Heavy metals, Pollutant identification, Cations, Aqueous solutions, Methodology, Spectrophotometry, Solvent extractions, Toluene-3 4-dithiol, Chemical interference, Biological materials, Sample preparation, Atomic absorption spectrophotometry.

AMIC-6083
"DELTA COD GET NOD OVER BOD TEST", Gaudy, A. F., Jr., Gaudy, E. T., Industrial Water Engineering, Vol. 9, No. 5, August/September 1972, pp 30-38.

Delta COD represents the most straightforward measurement of the amount of organic matter available in a biological treatment facility. The BOD test estimates what delta COD actually measures. Moreover, since ultimate BOD can only approach delta COD as an upper limit, the latter parameter gives a more conservative estimate of the ultimate biochemical oxygen demand of a waste sample. The determination of delta COD is a measuremnt of only that portion of the COD of the waste which is available as biological substrate for acclimated microorganisms (or which may be otherwise removed due to the presence of the biomass, e.g., the small amount of colloidal COD which could be adsorbed on the cell surfaces). The residual COD, if sufficient aeration time has been allowed, is composed of material not utilizable by a microbial population. Thus one can employ delta COD to assess the amount of biochemical oxygen-demanding organic matter present, regardless of the presence of some non-biodegradable COD in the waste. The use of delta COD as the primary operational parameter in biological treatment should do much to enhance intelligent and careful daily control of the process, since information on plant efficiency is available immediately rather than 5 days later as it would be if BOD sub 5 is used. The COD test run on the effluent does not distinguish between metabolizable and non-metabolizable organic matter remaining in the effluent, and it is therefore absolutely necessary that frequent checks on the metabolizable organic content of the effluent be made.

INDEX TERMS: Chemical oxygen demand, Biochemical oxygen demand, Organic matter, Aerobic treatment, Biological treatment, Activated sludge, Aerobic conditions, Pollutant identification, Water purification, Microbial degradation, Water pollution sources, Sewage effluents, Metabolism, Substrate removal, Substrate utilization.

AMIC-6085
"NOTE ON THE FLAMELESS ATOMIC ABSORPTION RESPONSE OF MERCURY WITHOUT ADDED REDUCING AGENT", Gutenmann, W. H., Lisk, D. J., Grier, N., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 3, September 1972, pp 138-139.

Results are reported on the analysis of mercury in a 1 N sulfuric acid solution by flameless atomic absorption spectrophotometry without the addition of stannous chloride as a reducing agent. It was observed that a positive AA response to mercury was obtained although it was of somewhat lower magnitude than when stannous chloride was added. Mercury response with this method required a sulfuric acid concentration of 0.1 to 6 N. A somewhat similar but lower mercury response was also noted when phosphoric acid was substituted for sulfuric. However, response was more erratic with phosphoric acid. When no reducing agent was used, a longer aeration time was required. The mechanism for this observation is discussed.

INDEX TERMS: Mercury, Reduction (chemical), Heavy metals, Chemical reactions, Flameless atomic absorption spectrophotometry, Sample preparation, Atomic absorption spectrophotometry.

AMIC-6087
"UV IRRADIATION OF AROCLOR 1254", Herring, J. L., Hannan, E. J., Bills, D. B., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 3, September 1972, pp 153-157.

Solutions of Aroclor 1254 in acetone were diluted with distilled water, hexane, and benzene and irradiated with an UV light and sunlight to study the breakdown mechanism of PCB's. Benzene and hexane samples were concentrated with a rotary evaporator. Water samples were extracted with hexane in a separatory funnel. A gas chromatograph with a tritium electron capture detector was used to follow the degradation of the first 10 peaks which represent tetra-, penta-, and hexachlorobiphenyls. In general, the PCB's degraded fastest in hexane, then water, and slowest in benzene. Some peaks increased in size suggesting that more highly chlorinated PCB's were dechlorinated to form PCB's with lower molecular weights and shorter retention times. Results with sunlight and the UV lamp agreed fairly well. Differences in degradation rates with different solvents are discussed.

INDEX TERMS: Degradation (decomposition), Polychlorinated biphenyls, Gas chromatography, Water analysis, Ultraviolet radiation, Sample preparation, Aroclor 1254, Electron capture gas chromatography, Chlorinated hydrocarbons, Fate of pollutants.

AMIC-6089
"CONFIRMATION OF PESTICIDE RESIDUE IDENTITY, PART III. DERIVATIVE FORMATION IN SOLID MATRIX FOR THE CONFIRMATION OF ENDRIN BY GAS CHROMATOGRAPH", Chau, A. S. Y., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 3, September 1972, pp 169-176.

A simplified method employing a solid matrix for analysis of pesticides has been extended to the confirmation of endrin. The method involves a chemical derivation-gas chromatographic technique. The solid matrix consists of an alumina/sulfuric acid mixture. Extraction and clean-up procedures were described in Part I of the paper. Acid-catalyzed isomerization of endrin in solid matrix is accomplished by adding the sample to a pipette containing sodium sulfate, letting it stand, eluting with benzene, and collecting the eluate in a Kontes concentrator tube for analysis. Application of the method to water, fish, and mud extracts has been routinely used in the author's laboratory. As little as 1 ng of endrin in a cleanup sample can be confirmed with the method.

INDEX TERMS: Water analysis, Endrin, Mud, Gas chromatography, Fish, Pollutant identification, Separation techniques, Methodology, Chlorinated hydrocarbon pesticides, Pesticide residues, Sample preparation, Cleanup, Biological samples, Chromatograms, Detection limits, Isomerization, Chemical interference.

AMIC-6091
"MERCURY LEVELS IN MUSCLE TISSUES OF PRESERVED MUSEUM FISH", Evans, R. J., Bails, J. D., D'Itri, F. M., Environmental Science and Technology, Vol. 6, No. 10, October 1972, pp 901-905.

Flameless atomic absorption spectrophotometry was used to establish the total mercury levels in 57 preserved fish specimens of various species collected in the Lake St. Clair-Western Lake Erie region of the Great Lakes between the years of 1920-65. Only five fish were found to contain mercury levels in excess of 0.5 ppm-three large muskellunge collected in Lake St. Clair in 1939 (2.38, 1.57, and 1.58 ppm) and two adult sea lampreys collected in the Clinton River tributary to Lake St. Clair in 1938 (0.90 and 1.29 ppm). A trend was established relating the mercury content of selected categories of fishes with the year and location of collection for the fish specimens. The 1970-71 mercury levels in fish from the two study areas were found to average more than those preserved museum specimens in the same categories taken from the same area.

INDEX TERMS: Fish, Mercury, Absorption, Lake Erie, Lake St. Clair, Freshwater fish, Biological samples, Atomic absorption spectrophotometry, Museum specimens, Sample preparation.

AMIC-6092
"SEPARATION OF OIL DISPERSIONS FROM WATER BY FIBROUS BED COALESCENCE", Langdon, W. M., Naik, P. P., Wasan, D. T., Environmental Science and Technology, Vol. 6, No. 10, October 1972, pp 905-910.

A 1 sq ft coalescer unit using commercially available phenol formaldehyde-coated glass fibers of 3.2 micron diam has been designed for removing a trace quantity of dispersed oil from water. It was tested on both a synthetic stream and on an actual industrial effluent stream. The influent stream contained 85-100 ppm by volume of oil, and the effluent contained an average of 1 ppm by volume of oil. Thus oil removal efficiency of essentially 100 percent was obtained at a superficial velocity of 1 ft/min. The influent and effluent oil concentrations were measured by both light transmission and light reflectance apparatus. The pressure drop increased from 2 to 25 psi over run times which varied from 14 to 305 hr, owing mainly to accumulation of oil in the bed. Consequently, the removal efficiencies were obtained under unsteady-state conditions. The present design is suitable for large-scale operation by the use of both multiple cells and larger individual cells.

INDEX TERMS: Oil, Separation techniques, Effluent streams, Coalescence, Removal, Kerosene.

AMIC-6093
"FATE OF DDT IN SEVERN ESTUARY SEDIMENTS", Albone, E. S., Eglinton, G., Evans, N. C., Hunter, J. M., Rhead, M. M., Environmental Science and Technology, Vol. 6, No. 10, October 1972, pp 914-919.

The functions of estuarine sediments as pollutant sink and as pollutant bank are assessed in relation to the fate of DDT in the environment. Carbon-14 labeled p,p'-DDT was exposed to estuarine mud in situ and in the laboratory and to anaerobic sewage sludge. After incubation, samples were extracted and analyzed by scintillation counts, electron capture gas chromatography, thin-layer chromatography, gc-mass spectrometry, and autoradiography or radioscanning to determine ratios of DDT to DDD. The determinations show that p,p'-DDT was degraded more slowly when incorporated in situ in Severn estuary sediments than when incubated in sediment samples maintained under hydrogen in the laboratory. These transformations are compared with the more extensive degradation of DDT on incubation in anaerobic sewage sludge. In all incubations, metabolites included p,p'-DDD. The wider application of the techniques developed is discussed.

INDEX TERMS: DDT, Biodegradation, Sediments, Activated sludge, DDD, Radioactivity techniques, Gas chromatography, Degradation (decomposition), Estuaries, Sewage bacteria, Tracers, Incubation, Separation techniques, Water pollution effects, Sewage treatment, Sample preparation, Fate of pollutants, p p' DDT, p p' DDD, C-14, Electron capture gas chromatography, Mass spectrometry, Thin layer chromatography, Radioscanning, Autoradiography, Metabolites.

AMIC-6094
"EFFECT OF DISSOLVED SALTS ON WATER SOLUBILITY OF LINDANE", Masterton, W. L., Lee, T. P., Environmental Science and Technology, Vol. 6, No. 10, October 1972, pp 919-921.

Since it is sometimes necessary to estimate equilibrium concentrations of pesticides in marine and brackish waters, tests were conducted using lindane to determine the effects of salt concentration on pesticide solubilities. Fourteen different 1:1 salts at four concentrations were added to solutions of chlordane, analyzed by electron capture gas chromatography, and the results compared with those from control samples. In 10 cases, salting out was observed; the greatest decrease in solubility was found with the alkali fluorides, KF and NaF. The four electrolytes that salt in lindane (NaI, KI, $(CH_3)_4NCl$, $(C_2H_5)_4NCl$) are ones containing large ions. The order of the Setschenow parameters calculated from solubility data for lindane parallels that for benzene. Except for the fluorides, the extent of salting out is less for lindane than for benzene.

INDEX TERMS: Solubility, Sea water, Fluorides, Chlorides, Bromides, Iodides, Brackish water, Salts, Water analysis, Chlorinated hydrocarbon pesticides, Halides, Electron capture gas chromatography, Lindane, Potassium fluoride, Sodium fluoride, Sodium chloride, Potassium chloride, Lithium chloride, Sodium bromide, Rubidium chloride, Cesium chloride, Ammonium chloride, Potassium bromide, Sodium iodide, Potassium iodide, Tetramethyl ammonium chloride, Tetraethyl ammonium chloride.

AMIC-6095
"NERVE GAS-ISOPROPYL METHYLPHOSPHONOFLUORIDATE (GB)-DECOMPOSITION AND HYDROSTATIC PRESSURE ON THE OCEAN FLOOR", Adams, W. A., Environmental Science and Technology, Vol. 6, No. 10, October 1972, p 928.

Previous calculations of the rate of decomposition of nerve gas disposed in the oceans have not considered the effects of increases in hydrostatic pressure. The authors show that the half-life of hydrolysis of isopropyl methylphosphonofluoridate (GB) increases by approximately 25 percent at a depth of 4000 meters and 69 percent at 10,000 meters. Consequently, it is important to consider these effects with respect to disposal of toxic substances, including radioactive materials, in the sea or in deep wells since their fate is dependent on the high pressures in the environment.

INDEX TERMS: High pressure, Degradation (decomposition), Radioactive wastes, Injection wells, Radioactive waste disposal, Oceans, Waste disposal wells, Waste disposal, Water pollution effects, Isopropyl methylphosphonofluoridate, Nerve gas.

AMIC-6098
"A SURVEY OF THE TOTAL CADMIUM CONTENT OF 406 FISH FROM 49 NEW YORK STATE FRESH WATERS", Lovett, R. J., Gutenmann, W. H., Pakkala, I. S., Youngs, W. D., Lisk, D. J., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1283-1290.

Fish from New York State fresh waters were surveyed for total cadmium. Ten gram samples were dry ashed at 485 C using the procedure of Bandemer and Evans, but without the addition of magnesium nitrate. The ash was then dissolved in 0.8 N HCl and analyzed by atomic absorption spectrophotometry using a tantalum boat accessory. The majority of samples contained 20 ppb or below. The remainder showed concentrations up to 100 ppb with only few above this concentration. Fishes from central New York waters rarely contained cadmium greater than 20 ppb. Fish from Adirondack waters contained cadmium above 20 ppb most consistently. These higher concentrations may be related to generally higher background cadmium levels in this Adirondack area where many metallic ore deposits are located with which cadmium is typically associated. Cadmium accumulation only occasionally appeared species-dependent. No relation was obvious between total residues of the metal and size or sex of fish or age of lake trout. The cadmium concentrations observed are comparable to those commonly present in many other foods.

INDEX TERMS: Heavy metals, Pollutant identification, New York, Cadmium, Freshwater fish, Chemical analysis, Trace elements, Sport fish, Separation techniques, Commercial fish, Pan fish, Atomic absorption spectrophotometry, Ashing, Sample preparation, Biological magnification, Bioaccumulation.

AMIC-6107
"BUNKER C OIL IN SEDIMENTS AND BENTHIC ANIMALS FROM SHALLOW DEPTHS IN CHEDABUCTO BAY, N.S.", Scarratt, D. J., Zitko, V., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1347-1350.

A survey is presented of the distribution and possible effects of Bunker C fuel oil on sublittoral biota in Chedabucto Bay 26 months after the wreck of the tanker 'Arrow'. Sediment samples were collected and the concentration of Bunker C oil determined by U.V. spectrophotometry, while the oil content of whole animals or separate organs was determined by standard techniques. Soft sediments showed considerable fluctuations in Bunker C oil content but little evidence of diminution of Bunker C concentration following the wreck. Coarse sediment samples and most benthic species showed maximum oil concentrations about 1 year after the wreck and some reduction since then. Herbivorous or browsing species had higher oil content than carnivorous or omnivorous species. There is evidence from fluorescence emission spectra that some carnivorous or omnivorous species are able to assimilate and partly metabolize Bunker C oil, but no evidence that Bunker C or its fluorescent derivatives and fractions were being concentrated in higher parts of the food chain.

INDEX TERMS: Benthic fauna, Sediments, Oil spills, Shallow water, Path of pollutants, Soil analysis, Oil pollution, Herbivores, Carnivores, Omnivores, Metabolism, Chemical analysis, Food chains, Bottom sampling, Crabs, Mussels, Lobsters, Water pollution effects, Bioassay, Aquatic soils, Absorption, Bunker C oil, Starfish, Sea urchins, Periwinkles, Fuel oil, Assimilation, Macroinvertebrates, Biological magnification.

AMIC-6111
"POLYCHLORINATED BIPHENYL RESIDUES: ACCUMULATION IN CAYUGA LAKE TROUT WITH AGE", Bache, C. A., Serum, J. W., Youngs, W. D., Lisk, D. J., Science, Vol. 177, No. 4055, September 29, 1972, pp 1191-1192.

Trout were taken from Cayhuga Lake, Ithaca, New York in October, 1970 and analyzed for the presence of PCB's. The fish were mechanically chopped, ground, and thoroughly mixed without evisceration and samples were dried and extracted with hexane for 3 hr. The extracts were concentrated and the PCB's separated from DDT residues and other constituents using sulfuric acid partitioning and column chromatog raphy on silica gel. Analysis was made by electron capture gas chromatography; the concentration was estimated by the method of Risebrough in which the response of each PCB isomer is taken as equal to that of the corresponding weight of p,p'-DDE. Combined gas chromatography-mass spectrometry was used to verify the presence of various PCB isomers in a 12-yr old lake trout. The method described above was sensitive to about 0.25 ppm of PCB's. PCB concentration was shown to progressively increase with maturity. That there exists a relationship between fish age and PCB concentrations was highly significant.

INDEX TERMS: Polychlorinated biphenyls, Lake trout, Growth stages, Mass spectrometry, Pollutant identification, Separation techniques, Solvent extractions, Gas chromatography, Freshwater fish, Water pollution effects, Cold-water fish, Bioaccumulation, Cayuga Lake, Electron capture gas chromatography, Chlorinated hydrocarbons, Column chromatography, Biological magnification, Sample preparation, Sensitivity, Detection limits, p p' DDE, Mass spectra.

AMIC-6113
"FINGERPRINTING OIL SLICKS", Water and Pollution Control, Vol. 110, No. 9, September 1972, pp 31-36.

Computer analysis of the fluorescence of oil under ultraviolet light has provided a 'fingerprinting' technique for rapid identification of oils in an oil slick. Five different types of crude oil, including Kuwait, North African, Middle Eastern and Venezuelan, have been identified based on markedly different fluorescence patterns. Detection at levels as low as one ppb of oil in sea water has been accomplished. The use of a xenon instead of mercury lamp has increased accuracy of identification by production of up to 20 different wavelengths of light for examination.

INDEX TERMS: Pollutant identification, Oil spills, Computers, Oil pollution, Ultraviolet radiation, Chemical analysis, Crude oil, Fingerprinting, Fluorescence spectra, Oil characterization, Fluorescence spectrophotometry, Data interpretation.

AMIC-6127
"NEUTRON ACTIVATION ANALYSIS OF MERCURY IN FISH, FLOUR, AND STANDARD REFERENCE ORCHARD LEAVES BY ELECTRODEPOSITION RADIOCHEMISTRY", Heitzman, M. W., Simpson, R. E., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 960-965.

A method for neutron activation analysis of mercury is described in which electrodeposition is used to isolate the mercury carrier in the recovery step. Although the recovery of mercury carrier is variable, the results yielded by this technique are comparable to those obtained using sulfide precipitation in neutron activation analysis. The method was also compared to gas chromatography and atomic absorption techniques and similar results were obtained. No interferences were evident in the samples analyzed: fish, flour, and standard orchard leaves. The method can detect ppb levels of mercury.

INDEX TERMS: Mercury, Neutron activation analysis, Radiochemical analysis, Freshwater fish, Chemical analysis, Electrolysis, Methodology, Radioactivity techniques, Pollutant identification, Electrodeposition, Chemical recovery, Orchard leaves, Biological materials, Flour, Chemical interference, Detection limits, Sample preparation.

AMIC-6140
"CAMPESTEROL AND BETA-SITOSTEROL CONTENT OF SOME VEGETABLE OILS", Thorpe, C. W., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 1085-1087.

A digestion precipitation technique, coupled with conversion of the digitonides to the sterol acetates for gas liquid chromatography, was used to determine the free and total campesterol and beta-sitosterol content of 48 samples of crude and refined corn, cottonseed, soybean and peanut oils. The results show that the ratio of beta-sitosterol to campesterol may be used to identify an individual oil and tend to confirm that sterols are lost during refining of the crude oils. It is recommended that the official method, 28.081-28.088, modified for the analysis of campesterol and beta-sitosterol be collaboratively studied.

INDEX TERMS: Pollutant identification, Chemical precipitation, Oil seed crops, Soybeans, Peanuts, Organic compounds, Separation techniques, Corn (field), Sterols, Vegetable oils, Gas liquid chromatography, Campesterol, Beta-sitosterol, Corn oil, Cottonseed oil, Digitonin, Chemical composition.

AMIC-6141
"STUDY OF THE SILICIC ACID PROCEDURE OF ARMOUR AND BURKE FOR THE SEPARATION OF POLYCHLORINATED BIPHENYLS FROM DDT AND ITS ANALOGS", Masumoto, H. T., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 1092-1100.

The silicic acid procedure of Armour and Burke for the separation of polychlorinated biphenyls from DDT and its analogs produces an adequate separation of Aroclor 1260. However, the procedure cannot completely separate p,p'-DDE from Aroclors 1221, 1232, 1242, and 1254. Factors causing variable column properties such as room humidity, silicic acid activation and deactivation, and column preparation were examined. The 7 hr minumum period for silicic acid activation was found to be inadequate for reproducible water-silicic acid preparations. A 24 hr minimum period is suggested. The use of Celite in column preparation often results in improperly prepared columns and should be eliminated. Nonreproducible columns might also be due to a heterogeneous water-silicic acid adsorbent which is a result of an irregular distribution of water molecules onto the silicic acid particles.

INDEX TERMS: Separation techniques, Polychlorinated biphenyls, DDT, Aqueous solutions, Chlorinated hydrocarbon pesticides, DDE, Chemical analysis, Silica, Inorganic compounds, Gas chromatography, Pollutant identification, Methodology, Metabolites, Silicic acid procedure, p p' DDE, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1254, Aroclor 1260, Adsorbents, Chemical interference, Column preparation, Reproducibility, Isomers.

AMIC-6142
"IDENTIFICATION OF POLYCHLOROBIPHENYLS BY HIGH RESOLUTION PROTON MAGNETIC RESONANCE", Bartle, K. D., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 1101-1103.

Mass spectrometry allows the number of chlorine atoms per polychlorobiphenyl molecule to be determined but not the positions of substitution. A method of identifying PCB components from high resolution proton magnetic resonance spectra is illustrated by application to 2,5,2',5'-tetrachloro- and 2,3,4,2',4',5'-hexachlorobiphenyls separated by gas chromatography from a commercial PCB mixture.

INDEX TERMS: Polychlorinated biphenyls, Pollutant identification, Mass spectrometry, Methodology, Separation techniques, Proton magnetic resonance, Mass spectra, 2 3 4 2' 4' 5'-hexachlorobiphenyl, Chlorinated hydrocarbons, PMR spectra, Gas liquid chromatography, 2 5 2' 5'-tetrachlorobiphenyl, Mixtures, Electron capture gas chromatography.

AMIC-6145
"QUANTITATIVE DETERMINATION OF CADMIUM IN WATER-SOLUBLE COLOR ADDITIVES BY ATOMIC ABSORPTION SPECTROSCOPY", Moten, L., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 1145-1149.

A quantitative method is presented for the determination of cadmium at low levels (5-20 ppm) in water-soluble color additives by atomic absorption spectroscopy. Absorption measurements were made on aqueous solutions of typical color additives to which known amounts of cadmium had been added. These measurements were made in order to determine (1) the reproducibility of the absorption measurements of cadmium in aqueous solutions of color additives; (2) the effects of variations in pure dye contents on absorption measurements (samples of color additives submitted for certification vary in pure dye content from 85 to 97 percent); (3) the effects of sodium chloride on sodium sulfate on absorption signals during cadmium measurements. The method requires no pretreatment of sample and should be applicable to all water-soluble color additives.

INDEX TERMS: Cadmium, Aqueous solutions, Pollutant identification, Heavy metals, Methodology, Solubility, Sodium chloride, Sodium sulfate, Dye concentrations, Atomic absorption spectrophotometry, Color additives, Detection limits, Fluorescein, Triphenylmethane, Azo dyes, Absorbance, Chemical interference, Reproducibility.

See also: Category 2, AMIC-5899, 5945, 6013, 6029, 6044, 6110
Category 4, AMIC-6049, 6060, 6063, 6132
Category 5, AMIC-5950, 6003.

AMIC-3259
"A GRAPHIC COMPUTATION PROCEDURE FOR KENDALL'S TAU SUITED TO EXTENSIVE SPECIES-DENSITY COMPARISONS", Ghent, A. W., The American Midland Naturalist, Vol. 87, No. 2, April 1972, pp 459-471.

A rapid computation for Kendall's tau is presented in the context of a species-density comparison involving 53 bird species (with extensive tied frequencies) in two spruce-fir communities. Paired ranks are plotted in the manner of a conventional correlation diagram, with the Q score obtained as the sum of points below and to the right of each point. Cumulative species frequencies, entered retrogressively along the abscissa, permit (P plus Q) scores to be obtained after subtracting tied values appearing to the right of each point at the same height. The S score is then obtained as the summation of P plus Q minus 2 times the summation of Q. A simplified ranking procedure is incorporated, which serves mainly to reduce the graph to its minimal size since, in fact, the method works equally well when the raw frequencies are plotted directly. This method extends the range of feasible noncomputer tau computation to comparisons of 100 or more paired ranks.

INDEX TERMS: Population, Correlation analysis, Statistical methods, Data interpretation, Kendall's tau.

AMIC-3263
"THE CONTRIBUTION OF LEPTODORA AND OTHER ZOOPLANKTON TO THE DIET OF VARIOUS FISH", Costa, R. R., Cummins, K. W., The American Midland Naturalist, Vol. 87, No. 2, April 1972, pp 559-564.

The gut contents of various fish were examined to determine what effect fish had upon the removal of Leptodora kindtii (Focke) and other zooplankton species of Sanctuary Lake, Crawford Co., Pa. Fish caught at any time, but particularly those collected during regular zooplankton tows, were examined. They were identified, measured and their gut contents removed and stained in Congo Red. The entire contents were identified, and particular attention was given to the zooplankton component, especially the fluid-feeding predator, Leptodora kindtii (Focke). A total count of each identifiable species was made and its percentage composition determined. The relative quantity of an item present in the gut was then compared to the relative quantity of that same item in the food complex. In this manner an index of selectivity (Ivlev's (1961) index) was determined.

INDEX TERMS: Fish, Food habits, Food chains, Fish food organisms, Zooplankton, Population, Rotifers, Waterfleas, Copepods, Crustaceans, Leptodora kindtii.

AMIC-3264
"AN ESTIMATE OF PRIMARY PRODUCTIVITY IN A PENNSYLVANIA TROUT STREAM USING A DIURNAL OXYGEN CURVE TECHNIQUE", McDiffett, W. F., Carr, A. E., Young, D. L., The American Midland Naturalist, Vol. 87, No. 2, April 1972, pp 564-570.

Primary productivity and community respiration were determined for a relatively unpolluted trout stream in Pennsylvania by using an upstream-downstream diurnal oxygen curve technique. Two diurnal oxygen curves were constructed from analyses of water samples collected on different days at 2-hour intervals in the day and at 3-hour intervals at night. Water temperatures were also recorded at the sampling times. From the data obtained, the rate of change of oxygen (X) between stations and diffusion rate (D) were calculated. Since the rate of change of dissolved oxygen at night can be attributed only to community respiration (R) and diffusion, an estimate of respiration within the reach was obtained by subtracting nighttime values of diffusion from the observed rates of change. Gross primary productivity was then estimated using the equation P equal to X minus D plus R. Values of 4.92 and 6.32 g oxygen/sq. m/day were obtained. Community respiration was 2.30 and 2.02 g oxygen/sq m/day for the same days. These values are compared with community metabolism data from other streams.

INDEX TERMS: Primary productivity, Respiration, Analytical techniques, Diurnal, Streams, Diffusion, Photosynthesis, Dissolved oxygen, Water analysis, Pennsylvania, Data interpretation.

AMIC-3321
"EFFECTS OF ACCLIMATION AND ACUTE TEMPERATURE EXPERIENCE ON THE SWIMMING SPEED OF JUVENILE COHO SALMON", Griffiths, J. S., Alderdice, D. F., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 3, March 1972, pp 251-264.

Juvenile coho salmon were studied to determine the effects of acclimation and acute temperature experience on swimming speed. Swimming performance of juvenile coho salmon (Oncorhynchus kisutch), 7.5-9.5 cm in total length, was investigated in a stamina tunnel, generally at 3 C intervals of temperature over the range of thermal tolerance. Optimum (ultimate maximum) performance (5.8 lengths/sec) occurred at a combination of acclimation and test temperatures near 20 C. A declining ridge of sub-optimum performance (test temperature ridge) was found at acclimation temperatures below 20 C; maximum performance at each acclimation temperature level was found on the ridge at test temperatures higher than those of acclimation. Conversely, maximum performance at given test temperatures occurred on a second ridge (acclimation temperature ridge) at acclimation temperatures near those of testing. There was an apparent shift in location of the acclimation temperature ridge, indicative of seasonal performance compensation and improved capacity to perform at low acclimation temperatures during the winter period. At test temperatures below 5 C, maximum performance occurred at acclimation temperatures of about 6-8 C. Lowest performance within the zone of thermal tolerance was associated with acclimation and test temperatures of 2 C.

INDEX TERMS: Swimming, Velocity, Adaptation, Water temperature, Water pollution effects, Mortality, Juvenile growth stage, Smolt, Thermal stress, Acclimization, Oncorhynchus kisutch, Thermal tolerance, Coho salmon.

AMIC-3628
"NOTES ON A MANGROVE LAGOON AND MANGROVE CHANNELS AT LA PARGUERA, PUERTO RICO", Almodovar, L. R., Pagan, F. A., Nova Hedwigia, Vol. 21, No. 1, 1971, pp 241-253.

The high salinity lagoon and mangrove swamp areas near La Parguera, Puerto Rico were studied to elucidate some aspects of the biology, distribution, ecology, and other factors related to benthic marine algae. Algae were collected by placing concrete blocks in the lagoon for a six-month period. Fish were also collected and their stomach contents analyzed. The algal collections showed that submerged vegetation in the lagoon is restricted to four green algae, Acetabularia crenulata, Batophora oerstedi, Anadyomene stellata, and Udotea flabellum. Due to the limited number of species present, attempts were made to transplant other species. However, all except one (Halimeda opuntia) died within two weeks. Analysis of fish showed that algae found in the stomachs were eaten outside the lagoon. It is concluded that fish do not account for the absence of a greater variety of algae in the lagoons; instead, factors such as salinity and water temperature are higher than normal for optimum growth. Salinity and temperature in the channels were found to be at normal levels and algal vegetation attached to rhizophores was plentiful, although limited to a few species.

INDEX TERMS: Salinity, Water temperature, Marine algae, Food chains, Distribution patterns, Mangrove swamps, Ecology, Water quality, Chlorophyta, Sessile algae, Species diversity, Acetabularia crenulata, Batophora oerstedi, Anadyomene stellata, Udotea flabellum.

AMIC-5827
"PARTICULATE BIOLUMINESCENCE IN DINOFLAGELLATES: DISSOCIATION AND PARTIAL RECONSTITUTION", Fuller, C. W., Kreiss, P., Seliger, H. H., Science, Vol. 177, No. 4052, September 8, 1972, pp 884-885.

With the same extraction conditions used for Gonyaulax polyedra, soluble and particulate bioluminescence can be isolated from two additional species, Pyrodinium bahamense and Pyrocystis lunula. Soluble luciferin and luciferase were dissociated from the particulate systems of all three species. Cells were grown at 25 C using a photoperiod of 12 hours light followed by 12 hours darkness with illumination of 8800 lu/sq m (2000 lu/sq m for P. lunula). The particulate system was extracted from harvested cells by previously described methods. Soluble bioluminescence was assayed by adding a sample to a solution of 0.1 M phosphate buffer, ammonium sulfate, 0.001 M 2-mercaptoethanol and 1 mg of bovine serum albumin, and luciferase by the maximum rate of light emission with a saturating amount of luciferin. Luciferin was assayed by measuring the total light emitted with exogenous luciferase added to increase sensitivity. Particulate bioluminescence was assayed by injection of 0.1 ml of a sample into 1.9 ml of citrate-phosphate buffer (final pH 5.7, the optimum for all three species). In all three species the addition of exogenous luciferin to a particulate system that had been stimulated by acid and resuspended at pH 8.2 recharged the system, so that it again emitted a flash of light when the pH was lowered to 5.7. The activity of the luciferin-recharged particles in the presence of soluble luciferin was always higher than the activity of these particles after centrifugation and resuspension in buffer free of luciferin. Comparison of kinetics, profiles of activity as a function of pH, and emission spectra for 'native' and recharged particulate systems offer evidence that recharging may be a physiological event.

AMIC-5827 (Continued) 2/2

INDEX TERMS: Pyrrophyta, Bioluminescence, Dinoflagellates, Physiological ecology, Assay, Bioassay, Protozoa, Animal physiology, Plant physiology, Marine algae, Phytoplankton, Kinetics, Separation techniques, Gonyaulax polyedra, Pyrodinium bahamense, Pyrocystis lunula, Luciferin, Luciferase, Particulate matter, Biochemical properties, Sample preparation.

AMIC-5828
"ABANDONED LARVACEAN HOUSES: A UNIQUE FOOD SOURCE IN THE PELAGIC ENVIRONMENT", Alldredge, A. L., Science, Vol. 177, No. 4052, September 8, 1972, pp 885-887.

Direct field and laboratory observations are reported of copepods feeding on the clogged filters of abandoned larvacean (tunicates) houses in the open ocean. Field observations were made at 10-15 m in the Florida Current 6-10 km west of Bimini, Bahamas using conventional scuba techniques. Abandoned houses were identified to species according to their size, shape, and the presence of a filtering apparatus. Those of greatest abundance were of Oikopleura longicauda, Oikopleura fusiformis, and Megalocercus abyssorum. Up to 33 percent of the abondoned larvacean houses observed on 15 dives had one to five Oncaea mediterranea (Copepoda: Cyclopoida) resting on the incurrent filters or darting about on the inner apparatus, where particles are collected. Abandoned house filters contain naked dinoflagellates, coccolithophores, unidentified organic particles, and a few diatoms, silicoflagellates, and tintinnids. An examination of the copepod fecal pellets revealed coccolith fragments and unidentified organic matter. This discovery of the use of concentrated nannoplankton on abandoned larvacean houses by pelagic copepods, as either a major or a supplementary food source, reveals avenues in the pelagic food web, of the form: nannoplankton from larvacean houses to copepods and other crustacea to carnivores. Techniques were also developed for photographing the larvacean houses in the field for the first time.

INDEX TERMS: Copepods, Food webs, Path of pollutants, Nannoplankton, Scuba diving, Zooplankton, Invertebrates, Foods, On-site data collections, Photography, Tunicates, Food sources, Particulate organic matter, Pelagic animals, Ostracods, Marine environment.

AMIC-5829
"CALCIUM OXALATE CRYSTALS IN THE ARAGONITE-PRODUCING GREEN ALGA PENICILLUS AND RELATED GENERA", Friedmann, E. I., Roth, W. C., Turner, J. B., McEwen, R. S., Science, Vol. 177, No. 4052, September 8, 1972, pp 891-893.

Calcium oxalate crystals occur in the marine green algae Penicillus, Rhipocephalus, and Udotea, known as producers of sedimentary aragonite needles. In contrast to the externally deposited aragonite crystals which are generally less than 15 micrometers long, the oxalate crystals are larger (up to 150 micrometers) and are located in the vacuolar system of the plant. Under the light microscope the crystals appear as single acicular structures. In the transmission electron microscope the crystals appear to be encased in a chamberlike structure within the granular vacuolar material. Their appearance is similar to the electron microscopic image of calcium oxalate crystals in higher plants. For x-ray diffraction analysis the intracellular crystals were isolated from specimens of P. dumetosus, collected in the Florida Bay, by dissolution of the aragonite sheath in warm 65 percent acetic acid and subsequent digestion of the organic matter in 5.25 percent commercial sodium hypochlorite solution at 70 C. The acetone washed and dried sample was mounted in a Lindemann glass capillary and photographed with Ni-filtered CuK sub alpha radiation in a Debye-Scherrer powder camera of 57.3 mm radius. The diffraction pattern corresponds to that of one of the tetragonal monohydrates reported in the powder diffraction file of the American Society for Testing and Materials. No calcium oxalate was found in the related but noncalcifying genera Avrainvillea and Cladocephalus.

INDEX TERMS: Chlorophyta, Crystals, Marine algae, Sedimentation, X-ray diffraction, Electron microscopy, Crystallography, Calcium oxalate, Aragonite, Marine sediments, Sample preparation, Light microscopy, Calcification.

AMIC-5893
"PHTHALATE EFFECT ON HEALTH STILL NOT CLEAR", Chemical and Engineering News, Vol. 50, No. 38, September 18, 1972, pp 14-15.

A review is presented of medical research on the effects of phthalate on health. Animal studies have shown phthalic acid esters (PAE) are relatively inert and generally have a low order of chronic toxicity. Human ingestions of the most widely used PAE, di-(2-ethylhexyl) phthalate (DEHP), have resulted in symptoms of nausea and vertigo. Analysis of patients who have been treated with blood stored in blood bags made out of DEHP revealed significant quantities of the plasticizer in the spleen, lung, liver, and abdominal fat; research by others has confirmed these results as well as the absence of PAE's, as determined by gas chromatography-mass spectrometry, in the blood of normal volunteers who have not undergone transfusion. More recent research has shown that 98 percent of DEHP accumulated in liquid stored whole blood can be washed out with continuous-flow centrifugation. PAE's have also been detected in rivers, such as in the Charles River, where a total phthalate concentration of 0.9 - 1.9 ppb was found employing high-pressure liquid-solid chromatography. DEHP residue levels from 0.2 to 10.0 micrograms per gram (whole fish basis) have been detected in fish from various locations, with the higher levels associated with industralized areas. Embryo-fetal toxicity was manifested in fetal malformations in rats given intraperitoneal doses in varying amounts of the six least toxic PAE compounds. Naturally occurring sources of the phthalate moiety include cigar smoke, tobacco leaves, grapes, cranberries, poppies, oxidized corn oil, soil, and crude oil. The significance for man of these toxicological results is still largely unknown. The use of substitute materials where possible for the plasticizer is highly recommended.

INDEX TERMS: Toxicity, Water pollution effects, Public health, Animal pathology, Water pollution sources, Phthalate, Phthalic acid, Plasticizers, Phthalate esters.

AMIC-5897
"ACUTE TOXICOLOGY OF SODIUM NITRILOTRIACETIC ACID (NTA) AND NTA-CONTAINING DETERGENTS TO MARINE ORGANISMS", Eisler, R., Gardner, G. R., Hennekey, R. J., et al., Water Research, Vol. 6, No. 9, September 1972, pp 1009-1027.

Static acute toxicity tests were conducted at 20 C and 2.0 percent salinity with (CH2-COONa)3N.H2O (NTA) and two NTA-containing commercial household synthetic detergents (syndets), using adults or juveniles from eleven species of marine fishes and invertebrates. Concentrations of NTA in the medium allowing 50 percent survival of individual test species in 168 h, equal TL50 (168 h) values, ranged between 1800 mg per l for grass shrimp, Palaemonetes vulgaris, and greater than 10,000 mg per l for the quahaug clam, Mercenaria mercenaria. The two syndets tested were considerably more toxic than NTA to marine organisms under identical assay conditions. Fishes were the least resistant group of organisms tested to syndets; TL50 (168 h) values for teleosts ranged between 4.6 and 36.0 mg per l total packaged product. Histopathology was investigated for grass shrimp, hermit crab, quahaug clam, sandworm, scup, striped bass and mummichog that survived high concentrations of NTA or syndets for 168 h. The effect of biomass, water temperature and salinity on acute toxicity of NTA and syndets to mummichogs was also investigated. Mixtures of NTA and salts of cadmium or mercury were evaluated for toxicity to mummichog. An observed decrease in biocidal properties of Cd (2 plus) was observed with increasing levels of NTA. Results of studies with NTA-Hg (2 plus) mixtures were inconclusive. Tests with mixtures of syndet and Cd (2 plus) or Hg (2 plus) demonstrated that toxicity to mummichog of these mixtures could be expressed as a simple summation of the toxicity of individual components. It is concluded that NTA might be hazardous to marine fishes and macroinvertebrates when used as a partial replacement for sodium tripolyphosphate in household syndets.

AMIC-5897 (Continued) 2/2

INDEX TERMS: Toxicity, Nitrilotriacetic acid, Detergents, Marine fish, Cadmium, Mercury, Animal pathology, Bioassay, Striped bass, Biomass, Water temperature, Salinity, Macroinvertebrates, Starfish, Sandworms, Hermit crab, Mud snail, Grass shrimp, Mummichogs, Quahaug, Scup, Bay mussel.

AMIC-5899
"BIOCHEMICAL OXIDATION OF VOLATILE ORGANIC ACIDS BY ACTIVATED SLUDGE", Sato, T., Water Research, Vol. 6, No. 9, September 1972, pp 1059-1072.

Biochemical oxidation of the sodium salts of formic, acetic, propionic, butyric, valeric, and caproic acids by activated sludge was investigated using Warburg manometers. A series of experiments were conducted to determine the relation between sludge concentration and uptake rate; oxygen uptake using various acetates as substrates; the effect of substrate concentration; the percentage oxidation, and oxygen uptake rates and substrate removal rates with volatile acid salts; the change in oxygen uptake rates with volatile acid salts; oxygen uptake with simultaneous addition of formate and acetate; oxygen uptake and substrate removal; and respiratory quotient (RQ). The conclusions were as follows: (1) The oxygen uptake of activated sludge was proportional to the sludge concentration with endogenous respiration as well as after the addition of substrate. (2) No difference was observed among the oxygen uptake of sodium, potassium, calcium and ammonium salts of acetic acid. (3) The volatile acid salts were utilized by activated sludge, but inhibition was observed at high substrate concentrations. (4) The percent oxidation of formate was higher than those of other acid salts. (5) The oxygen uptake rate of activated sludge in a state of endogenous respiration and in the presence of formate decreased with time but increased with other acid salts. (6) When formate and acetate were added simultaneously, no interaction between them was observed. (7) When acetate was added to activated sludge, adsorption occurred initially followed by approximately linear increases in substrate removal and oxygen uptake. (8) The RQ values of endogenous respiration, acetate, formate and skim milk were respectively 0.9, 1.13, 1.61 and 1.00.

INDEX TERMS: Biochemical oxygen demand, Biodegradation, Activated sludge, *Organic acids, Warburg respirometer.

AMIC-5900
"PARAMETERS INFLUENCING PHOSPHORUS ELIMINATION BY ALGAE", Hunken, K.-H., Sekoulov, I. D., Water Research, Vol. 6, No. 9, September 1972, pp 1087-1096.

A detailed study of the most important parameters involving algal P-elimination has shown that intensification of the process is possible when optimizing algal P-precipitation. The most suitable algae for this process are the filamentous blue-green algae because they can be easily settled in just over half an hour. To maintain a pH above 9 throughout the reaction time continuous artificial illumination is required. Light and thermal efficiency is improved if the lamps are installed in the water and operated automatically by pH control. The optimal algal concentrations under light intensities between 7000 and 15,000 lx are approximately 0.8 g per l. The relationship between the algal concentration in mg per l (dry wt.), eliminated nitrogen, and eliminated phosphorus was determined. At pH levels above 9, the photosynthetic reaction obtained averaged 11 mg CO2 per l per hr and the C sub t (total carbonate carbon) value fell at a rate of 0.25 mVal per l per hr. This rate can be used for determining the retention time of P-elimination in purified or unpurified sewage. The Ca- ion concentration in sewage is usually sufficient for calcium phosphate precipitation. For a full calcium phosphate precipitation an excess of 10 mg per l calcium over the phosphorus concentration was necessary. The C sub t value decreases during photosynthesis in the same manner as the P-elimination. For an algae free effluent a combination of an algal filter and a settling basin was satisfactory. Parallel to P-elimination we observed a decrease up to 98 percent of the total bacterial numbers in the effluent during a 24-hr detention period.

INDEX TERMS: Phosphates, Absorption, Chemical precipitation, Cyanophyta, Waste treatment, Hydrogen ion concentration, Light intensity, Nutrient removal.

AMIC-5931
"A NEW TYPE OF PLANKTON PUMP ON THE VACCUM PRINCIPLE", Lenz, J., Deep-Sea Research, Vol. 19, No. 6, June 1972, pp 453-459.

A new type of vacuum plankton pump is described including its advantages over existing sampling gear. This new model consists of three separate units: power and winch, tank, and filter units. In biomass studies, the pump as one type of gear for quantitative plankton sampling is in some respects superior to the water bottle and net, singly or in combination. The pump is used to suck sea water into two 500-litre tanks, which can be alternately filled to permit continuous sampling. The application of a vacuum offers several advantages, the chief being that the pumped organisms, not being forced to pass through the rotating mechanism of an impeller or centrifugal pump, are obtained in an undamaged state. There are three main limitations to the application of the plankton pump. The first, concerning sampling depth, is the difficulty of handling pipes longer than 100-200 m. The second drawback lies in the considerably smaller amount of water delivered by a pump when compared to the volume filtered by a larger net in the same time. Lastly, delicate organisms such as medusae and chaetognaths are often damaged by the rotating parts of an impeller or centrifugal pump. An additional cause of damage may lie in the strong frictional forces prevailing in the water while passing through the hose and pump at high speed.

INDEX TERMS: Plankton, Biomass, Sampling, Pollutant identification, Sea water, Filters, Copepods, Salinity, Depth, Daphnia, Data collections, Zooplankton, Water temperature, Efficiencies, Invertebrates, Evaluation, Equipment, Vacuum pumps, Pleurobrachia, Acartia clausi, Calanus helgolandicus, Sarsia tubulosa, Halitholus cirratus, Ctenophores, Macroinvertebrates, Vacuum plankton pump.

AMIC-5936
"PHOTOOXIDATIVE DEATH IN BLUE-GREEN ALGAE", Abeliovich, A., Shilo, M., Journal of Bacteriology, Vol. 111, No. 3, September 1972, pp 682-689.

Investigations on photooxidative death in blue-green algae are presented and its possible ecological significance is discussed. when incubated in the light under 100 percent oxygen, wild-type blue-green algae (Anacystis nidulans, Synechococcus cedrorum) die out rapidly at temperatures of 4 to 15 C, and at 35 C (or at 26 C in the case of S. cedrorum) in the absence of CO2. Photosynthesis is impaired in these cells long before they die. Blocking of photosystem II at high temperatures in the presence of CO2 sensitizes the algae to photoxidative death. Photooxidative death and bleaching of photosynthetic pigments are separable phenomena. Photooxidative conditions were demonstrated in Israeli fish ponds using A. nidulans as the test organism during dense summer blooms, when dissolved CO2 is low, and in winter, when water temperatures generally drop below 15 C. This finding suggests that photooxidative death may be responsible for the sudden decomposition of blue-green blooms in summer, and may be a factor in the absence of blue-green blooms in winter.

INDEX TERMS: Cyanophyta, Mortality, Photosynthesis, Light intensity, Oxygen, Carbon dioxide, Ponds, Water pollution effects, Water temperature, Plant pigments, Aquatic algae, Thermal stress, Physiological ecology, Plant physiology, Viability, Cultures, Degradation (decomposition), Eutrophication, Photooxidation, Anacystis nidulans, Synechococcus cedrorum, Carotenoids, Chlorophyll a, Potassium cyanide, 3-(3 4-dichlorophenyl)-1 1-dimethylurea.

AMIC-5945
"THE SIZE DISTRIBUTION OF PARTICLES IN THE OCEAN", Sheldon, R. W., Prakash, A., Sutcliffe, W. H., Jr., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 327-340.

Surface- and deep-water samples were collected from various grographical locations in the Atlantic, Pacific, and Southern Oceans, and particle sizes determined with a model T Coulter counter. Frequency distributions were determined for particles sizes of 1-100 microns. Plots of frequency distributions versus geographic location and depth show that there were definite geographic variations in the distribution of particle size spectra, and certain areas of the ocean can be characterized simply by the size-frequency distribution of the suspended particulate material. Perhaps the clearest case is that of the subtropical areas. Particle spectra from temperate waters are also quite characteristic. Not every sample from the equatorial and polar waters was characteristic. The form of the particle size distributions in the surface waters varied from place to place but at depth it was remarkably uniform and resembled that of the subtropical surface water except that the total concentration of particulate material was less. In the subtropical areas the particle size spectra of the surface waters showed roughly equal amounts of material in each size grade, and at depth the form of the size spectra was similar except that the concentration level was lower. In other areas there was no definite similarity between the form of the spectra at the surface and at depth. In the deep water the total concentration of material was moderately variable even though the size distributions were of more or less constant form. By extrapolating the data to larger and smaller particle sizes, a hypothesis is derived to show that, to a first approximation, roughly equal concentrations of material occur at all particle sizes within the range from 1 micron to about 1,000,000 microns, i.e. from bacteria to whales.

INDEX TERMS: Suspended solids, Standing crops, Particle size, Distribution patterns, Sea water.

AMIC-5948
"LIFE CYCLE AND SEASONAL ABUNDANCE OF THE COPEPOD LIMNOCALANUS MACRURUS SARS IN A HIGH ARCTIC LAKE", Roff, J. C., Carter, J. C. H., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 363-370.

The population structure, life cycle, and abundance of the copepod Limnocalanus macrurus, one of the two multicellular zooplanktonic species in Char Lake, Northwest Territories, has been studied for 18 months. The population is univoltine, taking about 9 months to develop from egg to adult. Total population density was lower in 1970 than in 1969, whereas the phytoplankton biomass and productivity were virtually identical in both years. The life cycle of L. macrurus was very similar in both years of study and also showed close similarity to that of a southern Ontario population. (Reprinted from Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 363-370. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Life cycles, Copepods, Seasonal, Animal populations, Zooplankton, Crustaceans, Biomass, Primary productivity, Environmental effects, Biological communities, Arctic, Water temperature, Aquatic animals, Secondary productivity, Limnocalanus macrurus, Population density, Char Lake, Stenothermal.

AMIC-5949
"A COMPARISON OF CHEMICAL, ISOTOPIC, AND ENZYMATIC METHODS FOR MEASURING NITROGEN ASSIMILATION OF MARINE PHYTOPLANKTON", McCarthy, J. J., Eppley, R. W., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 371-382.

Shipboard cultures of natural seawater enriched with nitrate, ammonium, or urea were used to compare different techniques for measuring nitrogen assimilation by phytoplankton and to measure the rates of uptake of these nutrients when more than one was present. Increases in particulate nitrogen, decreases of nitrogenous nutrients, and the uptake by phytoplankton (using the N-15 isotope technique) balanced rather well and for the nitrate-enriched culture were in good agreement with the estimate of nitrogen assimilation from nitrite reductase activity. Glutamic dehydrogenase activity was present with both NADH and NADPH in all three cultures; either singly or as a sum it agreed poorly with ammonium uptake estimated by the N-15 isotope technique. The presence of ammonium almost totally suppressed the uptake of nitrate and urea over a wide range of concentrations. The suppression of nitrate uptake in the presence of urea was nearly the same as the suppression of urea uptake in the presence of nitrate. Comparisons between the isotopic and enzymatic techniques were also made in seawater samples. Nitrite reductase activity was usually much greater than the rate of nitrate uptake estimated by the N-15 isotope technique. Comparisons with chlorophyll a and ATP analysis indicate that chlorophyll-containing cells were primarily responsible for the nitrite reductase activity. The rate of pyridine nucleotide oxidation with both NADH and NADPH was more consistent with the ATP than with the chlorophyll a content of seawater samples, suggesting that this enzymatic activity was not restricted to the phytoplankton. (Reprinted from Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 371-382. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

AMIC-5949 (Continued) 2/2

INDEX TERMS: Nitrogen, Phytoplankton, Cultures, Sea water, Measurement, Reduction (chemical), Methodology, Chemical analysis, Radiochemical analysis, Nutrients, Nitrates, Ammonium salts, Ureas, Enzymes, Nitrites, Absorption, Radioactivity techniques, Nitrogen compounds, Assimilation, Enrichment, Particulate nitrogen, Shipboard measurements, Enzymatic inhibitors, Culturing techniques.

AMIC-5952
"TEMPERATURE, TRANSPARENCY, AND PYTOPLANKTON PRODUCTIVITY IN CRATER LAKE, OREGON, Larson, D. W., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 410-417.

A limnological investigation was conducted in Crater Lake, Oregon, in order to obtain information on transparency, thermal gradients, and the phytoplankton. Sampling proceeded from a single index station at maximum depth. Water temperature was determined with an electrical resistance thermistor for every meter to 20 m and every 10 m below that. Transparency was measured with a submarine photometer and two Secchi disks. Water samples were collected at depths of 0, 20, 40, 70, 110, 200, and sometimes 500 m for measuring total alkalinity, dissolved oxygen, pH, and chlorophyll a. Phytoplankton primary productivity was measured in situ with C-14. Maximum productivity and the largest concentration of chlorophyll a in Crater Lake during summer 1968 and 1969 occurred at depths where temperatures were near 4 C and measurable light less than 4 percent of surface illumination. It is suggested that the phytoplankton in the lake consists mostly of oligothermal-oligophotic populations that are limited to depths greater than 70 m in summer, but occupy the 0 - 70-m stratum in winter, so that a rather constant rate of production per unit area is maintained throughout the year.

INDEX TERMS: Phytoplankton, Thermal stratification, Water temperature, Limnology, Physicochemical properties, Instrumentation, Water analysis, Water sampling, Primary productivity, Oregon, Radioactivity techniques, Water properties, Standing crops, Transparency, Crater Lake, C-14, Chlorophyll a.

AMIC-5953
"PHYTOPLANKTON IN LAKE TAHOE: DEEP-LIVING POPULATIONS", Kiefer, D. A., Holm-Hansen, O., Goldman, C. R., Richards, R., Berman, T., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 418-422.

Most of the phytoplankton biomass in Lake Tahoe is located below the euphotic zone. Chlorophyll concentration was low (0.1-0.2 microgram/liter) in the upper 50 m, reached a maximum (0.7 microgram/liter) at 100 m, and then dropped rapidly to 0.2 microgram/liter at 200 m. Below this it decreased slowly except for two peaks at 320 and 350 m. The vertical distribution of phytoplankton volume agreed with that of chlorophyll. The six dominant species in cell numbers were: Asterionella formosa, Fragilaria crotonensis, Melosira crenulata, Stephanodiscus rotula, Dinobryon sociale and Elakatothrix gelatinosa. There were no qualitative differences in species composition throughout the water column, although the surface samples contained many small thecate dinoflagellates. The amount of pheophytin between 100-475 m ranged from 15-25 percent of the total chlorophyll a pigment, similar to values found in the euphotic zone. This indicated that the chlorophyll in the aphotic zone derived from live algal cells rather than detritus, a conclusion supported by the healthy appearance of the cells and by their demonstrated photosynthethic capacity of being capable of fixing. CO2 at significant rates when exposed to near-surface illumination. The relationship between the distributions of phytoplankton standing crop and production is best explained by passive sinking of cells out of the euphotic zone and accumulation in deep waters. This recruitment of deep phytoplankton from surface waters may be an important feature of deep oligotrophic lakes, limiting primary production and nutrient regeneration in the euphotic zone.

INDEX TERMS: Phytoplankton, Biomass, Spatial distribution, Primary productivity, Standing crops, Euphotic zone, Lake Tahoe.

AMIC-5954
"GROWTH INTERACTIONS BETWEEN CHLAMYDOMONAS GLOBOSA SNOW AND CHLOROCOCCUM ELLIPSOIDEUM DEASON AND BOLD: THE ROLE OF EXTRACELLULAR PRODUCTS", Kroes, H. W., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 423-432.

Extracellular substances were isolated from Chlorococcum culture filtrates and the four salt-free groups of substances obtained tested separately on Chlamydomonas growth. The extracellular substances were separated by a combination of freeze-drying and solvent extraction-evaporation techniques coupled with water distillation for steam volatile substances, ether extraction-evaporation for lipophilic substances, and column separation-colorimetry for separation of water soluble pigment substances. For separation of higher molecular weight substances the filtrate was not freeze dried but subjected to ultrafiltration and a membrane-pressure process. The group of steam-volatile substances had an overall promoting effect. The lipophilic group inhibited growth initially but had no lasting effect. The yellow, water-soluble pigments (phenolic compounds) could act as chelating substances. The high molecular weight fraction (proteins and polysaccharides) promoted growth in the initial phase but had an inhibiting effect later on. These effects observed were mostly small but statistically significant. In algal interactions, inhibition phenomena are not likely to be caused by strong 'antibiotic' substances. Factors such as pH may be more important than extracellular compounds as such.

INDEX TERMS: Cultures, Growth rates, Environmental effects, Competition, Aquatic plants, Proteins, Phenols, Lipids, Carbohydrates, Aquatic algae, Organic acids, Chlorococcus ellipsoideum, Chlamydomonas globosa, Growth interactions, Polysaccharides, Sample preparation, Extracellular substances, Metabolites.

AMIC-5958
"ALGAL POPULATIONS IN ARCTIC SEA ICE: AN INVESTIGATION OF HETEROTROPHY", Horner, R., Alexander, V., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 454-458.

A description is given of the population composition, metabolism and heterotrophy problem of arctic sea ice algae. Samples of sea ice were taken (organisms occur as a brown layer, 2-3 cm thick on the underside of year-old sea ice) with corers. Three sections about 15 cm long were taken from the top, middle, and bottom of the core and allowed to melt at temperatures of 8-10 C or 15-20 C. Microscopic examination of melting ice showed that salinity changes caused no physical damage to the organisms but rapid temperature increases during examination caused the flagellates to disintegrate. Tracer kinetic experiments were carried out according to the method of Wright and Hobbie (1965). Complex algal populations in the bottom few centimeters of arctic sea ice were accompanied by bacteria, protozoans, and other organisms. Community uptake of dissolved organic substances, assayed with C-14-glycine, C-14-glucose, and H-3-acetate was slow. Microscopic examination of autoradiographs suggests that heterotrophic metabolism by the algae was negligible and that assimilation of the added substrate was almost exclusively by bacteria.

INDEX TERMS: Arctic Ocean, Marine algae, Sea ice, Protozoa, Metabolism, Chrysophyta, Pyrrophyta, Marine bacteria, Euglenophyta, Chlorophyta, Plant populations, Absorption, Sampling, Core drilling, Heterotrophy, Heterotrophic nutrition, Cryptomonads, Light microscopy, Dissolved organic matter, Assimilation.

AMIC-5959
"DATA ON THE COMPOSITION AND DARK SURVIVAL OF FOUR SEA-ICE MICROALGAE", Bunt, J. S., Lee, C. C., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 458-461.

Changes in cell numbers, carbon and pigment content of four species of microalgae isolated from antarctic sea ice were followed over a period of 6 months, the first 3 in the light and the last 3 in complete darkness. Cell carbon and pigments were determined by standard techniques, and cell counts using phase contrast microscopy. With one exception, all organisms retained their viability throughout even though the medium was not supplemented with organic substances capable of serving as nutrients. In another series of experiments, growth responses to organic supplements were variable and pigment composition was also affected.

INDEX TERMS: Marine algae, Sea ice, Photoperiodism, Carbon, Cultures, Antarctic Ocean, Growth rates, Organic matter, Nutrients, Chrysophyta, Plant pigments, Limiting factors, Chlorophyll a, Phase contrast microscopy, Survival, Carotenoids, Flagellates.

AMIC-5962
"UNDERESTIMATION OF STANDING CROP BY THE SURBER SAMPLER", Kroger, R. L., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 475-478.

Before the flow of water rom Jackson Lake into the Snake River was stopped by closure of a dam, invertebrates were collected in five Surber samples from a down-stream riffle. After the water had receded from the riffle, five 0.093-sq m areas of the exposed streambed substrate were hand-collected and the invertebrates removed. Predrawdown samples contained 4,286 invertebrates weighing 6.3 g while post-drawn samples contained 15,490 weighing 13.6 g. Large differences between submerged and exposed samples resulted from passage of smaller insects through the fine mesh of the Surber sampler and from backwash created by the sampler. The Surber sampler collected only about one-fourth of the invertebrates present in the 0.093-square meter areas.

INDEX TERMS: Standing crops, Aquatic insects, Estimating, Biomass, Sampling, Surber sampler, Jackson Lake, Snake River, Arachnids, Macroinvertebrates, Underestimation.

AMIC-5963
"EFFECT OF TEMPERATURE ON THE REMOVAL OF NTA (NITRILOTRIACETIC ACID) DURING SEWAGE TREATMENT", Eden, G. E., Culley, G. E., Rootham, R. C., Water Research, Vol. 6, No. 8, August 1972, pp 877-883.

The biodegradation of nitrilotriacetate has been studied using activated-sludge units of the porous-pot type. At 20 C, after acclimatization, degradation was complete, but at temperatures below 10 C degradation was less complete until at 5 C it passed through the treatment process virtually unchanged. It is concluded that in the United Kingdom in winter an appreciable proportion of any NTA in sewage would pass through sewage treatment works into rivers.

INDEX TERMS: Biodegradation, Nitrilotriacetic acid, Sewage treatment, Temperature, Biochemical oxygen demand, Removal.

AMIC-5967
"EFFECT OF LIME NEUTRALIZED IRON HYDROXIDE SUSPENSIONS ON JUVENILE BROOK TROUT (SALVELINUS FONTINALIS, MITCHILL)", Sykora, J. L., Smith, E. J., Synak, M., Water Research, Vol. 6, No. 8, August 1972, pp 935-950.

The experimental dosing apparatus was a modified proportional diluter equipped with a neutralization device and with a series of detention and oxygenation tanks. Ferric hydroxide was obtained by neutralization of ferrous sulfate using calcium hydroxide. After neutralization, oxygenation, and detention, suspended iron was released automatically at regular intervals into the test aquaria. Four concentrations of iron were maintained, each containing 10 young brook trout (3 months old). The data on length of brook trout revealed a definite trend toward smaller size with increasing concentration of suspended ferric hydroxide, with the largest trout in 6 mg Fe per liter and in the control. The average weight of brook trout was much lower in high iron concentrations than in the control and 6 mg Fe per liter. The final mean weight of fish in 50 mg Fe per liter represented only 16 per cent of the control, with gradually increasing percentage proportions occurring in lower iron concentrations. The final mean weights of the fish in 6 mg Fe per liter and in the control were almost identical. The average growth rate computed for five different size groups of fish revealed a sudden decline in growth of brook trout exposed to 12, 25, and 50 mg Fe per liter. The growth rate of brook trout in 6 mg Fe per liter and in the control shows only a leveling trend as of the thirty-fifth week. It is assumed that impaired visibility due to high turbidity prevented the fish from feeding which in turn resulted in slow growth in high iron concentrations - 12, 25 and 50 mg Fe per liter.

INDEX TERMS: Bioassay, Water pollution effects, Growth rates, Brook trout, Turbidity, Size, Toxicity, Iron, Heavy metals, Freshwater fish, Ferric hydroxide, Lime.

AMIC-5973
"SYNCHRONY INDICES BASED ON COMPUTER-CORRECTED ALGAL CELL DATA", Rooney, D. W., Mathematical Biosciences, Vol. 14, Nos. 1/2, June 1972, pp 59-64.

A method is described that utilizes the decision-making capability of a digital computer to detect and correct probable errors in algal cell counts used for synchrony index computations. The computer uses appropriate criteria to identify and alter points on a log cell number versus time plot incongruous with neighboring points. Repeated simulations have been employed to test the effectiveness of the method in eliminating the positive bias in index values computed from imprecise counts. The effectiveness of the method has been found to vary inversely with the degree of synchrony in an algal culture--the less the synchrony, the more the remaining bias.

INDEX TERMS: Algae, Digital computers, Equations, Computer programs, Computer models, Cultures, Automation, Automatic control, Data processing, Efficiencies, Synchrony index.

AMIC-6013
"Zn-65 IN BENTHIC INVERTEBRATES OFF THE OREGON COAST", Carey, A. G., Jr., Oregon State University, Department of Oceanography, Corvallis, Oregon, Report No. RLO-1750-55, Contract No. AT (45-1)-1750, 1970, 27 pp.

Radioecological studies of benthic invertebrate fauna off central and northern Oregon demonstrate that Zn-65 entering the Northeast Pacific Ocean via the Columbia River is concentrated by the sublittoral, bathyal, and abyssal fauna. The Zn-65 (pci/g ash-free dry wt) and specific activity (microcuries Zn-65/g Zn) in the fauna decreases fairly regularly with distance from the river and markedly with depth within the first 400 m. The major route of the isotope to the fauna appears to be through the food web. The radioecology of the benthic organisms differs from that of the pelagic fauna.

INDEX TERMS: Zinc radioisotopes, Benthic fauna, Path of pollutants, Food chains, Columbia River, Heavy metals, Invertebrates, Marine animals, Depth, Pacific Ocean, Sampling, Equipment, Annelids, Mollusks, Chemical analysis, Zn-65, Atomic absorption spectrophotometry, Porifera, Bioaccumulation, Sample preparation, Macroinvertebrates, Smith-McIntyre grab, Gamma ray spectrometry, Echinoderms, Arthropods, Brachiopods, Coelenterates, Allocentrotus.

AMIC-6014
"ECOLOGICAL OBSERVATIONS ON THE BENTHIC INVERTEBRATES FROM THE CENTRAL OREGON CONTINENTAL SHELF", Carey, A. G., Jr., Oregon State University, Department of Oceanography, Corvallis, Oregon, Report No. RLO-1750-57, 1970, 33pp.

The distribution and abundance of benthic invertebrates have been characterized on the continental shelf west of Newport, Oregon by standard techniques. The infauna was collected by deep-sea anchor dredge and anchor-box dredge from a transect of five stations across the shelf, and the macro-epifauna by quantitative three meter beam trawl from four stations. The composition and abundance of the fauna changes with increasing depth and distance from shore. The macro-epifauna is comprised of a sparse molluskan assemblage inshore, while at the shelf edge it consists of numerous echinoderms and crustacea. The infaunal composition exhibits a seaward trend, changing from a nearshore filter-feeding arthropod assemblage to a burrowing polychaete dominated one. Abundance increases seaward with the largest numerical density and biomass supported at the 200 m depth at the shelf edge. Polychaete worms were demonstrated to form closely associated species groups at the inner, middle, and outer portions of the continental shelf. These faunal trends can be correlated with various aspects of the benthic environment that are changing with increasing depth and distance from shore. Sediment may play a major role in determining the distribution and abundance of fauna; it is, however, but one of an interacting complex of environmental features that affect the fauna.

INDEX TERMS: Ecology, Invertebrates, Oregon, Continental shelf, Ecological distribution, Benthic fauna, Mollusks, Nematodes, Deep-water habitats, Distribution patterns, Infauna, Echinoderms, Arthropods, Polychaetes, Macroinvertebrates, Epifauna.

AMIC-6018
"TECHNIQUES FOR SAMPLING BENTHIC ORGANISMS", Carey, A. G., Jr., Oregon State University, Department of Oceanography, Corvallis, Oregon, Report No. RLO-1750-58, Contract Nos. AT (45-1)-1750 and AT (55-1)-1758, 1968, 19 pp.

A brief description is given of sampling gear and of field methods devised for obtaining quantitative benthic samples and environmental information. An anchor-box dredge, Smith-McIntyre grab with integrated water bottle and pinger, and a beam trawl with odometer wheels are described with the appropriate techniques for gear operation and shipboard sample processing. Shipboard procedures for otter trawling and coring with Bouma-Reineck and Fowler-Kulm corers are described.

INDEX TERMS: Sampling, Equipment, Benthic fauna, Methodology, Trawling, Core drilling, Cores, Dredging, On-site data collections, Water sampling, Data collections, Marine animals, Otter trawl, Smith-McIntyre grab, Infauna, Epifauna, Anchor-box dredge.

AMIC-6020
"A COMPARISON OF BENTHIC INFAUNAL ABUNDANCE ON TWO ABYSSAL PLAINS IN THE NORTHEAST PACIFIC OCEAN WITH COMMENTS ON DEEP-SEA FOOD SOURCES", Carey, A. G., Jr., Oregon State University, Department of Oceanography, Corvallis, Oregon, Report No. RLO-1750-67, Contract No. AT (45-1)-2227, 1970, 40 pp.

Benthic infauna was sampled in the Northeast Pacific Ocean at twelve stations on an east-west transect across Cascadia and Eastern Tufts Abyssal Plains to determine the effects of continental influences and depth. The two plains, separated by the East Pacific Rise, differ in depth, distance from the continental margin, and presumably therefore in the supply of food material available to organisms on the sea floor. Five benthic ecological zones were distinguished: Cascadia Plain Slope Base, Eastern Cascadia Plain, Cascadia Deep-Sea Channel, Western Cascadia Plain, and Eastern Tufts Plain. These differ in faunal biomass, numerical density, and gross composition of the fauna by phyla. The Slope Base environment supports the most abundant fauna, undoubtedly because of its proximity to the continent. The numerical density of infauna on Eastern Tufts Plain is similar to that on Eastern and Western Cascadia Plain; however, the biomass is significantly lower in the deeper, more distant environment. It is concluded that these differences in the benthic fauna are caused by different levels of food supply. Faunal densities, biomass, and composition are similar to those found in other upper abyssal environments. The mean numerical abundance ranges from 176/sq m to 1053/sq m, and the mean biomass from 0.78 g/sq m to 7.89 g/sq m. Polychaeta and Arthropoda together comprise 65.6 to 93.5 percent of the fauna of the 12 stations. Food sources of the abyssal fauna are discussed.

INDEX TERMS: Benthic fauna, Ecological distribution, Animal populations, Biomass, Deep-water habitats, Marine animals, Food abundance, Annelids, Primary productivity, Pacific Ocean, Species density, Infauna, Cascadia Plain, Tufts Plain, Food sources, Polychaetes, Arthropods.

AMIC-6021
"NON-BIOLOGICAL UPTAKE OF ZINC-65 FROM A MARINE ALGAL NUTRIENT MEDIUM", Tomlinson, R. D., Renfro, W. C., Oregon State University, Department of Oceanography, Corvallis, Oregon, Report No. RLO-2227-T-129, Contract No. AT (45-1)-2227, 1970, 21 pp.

The nature and magnitude of experimental errors due to Zn-65 adsorption on inorganic surfaces were examined in a laboratory system designed to measure Zn-65 uptake by marine phytoplankton. In the pH range, 6.3 to 7.5, a precipitate formed in the algal nutrient medium and accumulated up to 70 percent of the Zn-65 in the medium within 24 hours. It was concluded that Zn-65 adsorption by undetected precipitates could result in serious errors in measurements of Zn-65 uptake by marine phytoplankton. The relationship between the percent adsorption of Zn-65 in the contained sample and wetted glass surface area/pipette sample volume was shown to be linear for volumetric pipettes of 1-15 ml. At a pH value of 8.0, glassware with surface area/sample volume ratios as small as those of 20 ml volumetric pipettes adsorbed 7-11 percent of the contained sample activity. Use of polypropylene apparatus reduced zinc adsorption during experimental transfers.

INDEX TERMS: Adsorption, Marine algae, Free surfaces, Zinc radioisotopes, Phytoplankton, Physicochemical properties, Chemical precipitation, Hydrogen ion concentration, Zinc, Experimental error, Culture media, Zn-65, Orthophosphates.

AMIC-6022
"SOME SPECIES OF PHYLLODOCIDAE, SYLLIDAE, NEPHTYIDAE, GONIADIDAE, APISTOBRANCHIDAE AND SPIONIDAE (POLYCHAETA) FROM THE NORTHEAST PACIFIC OCEAN", Banse, K., Washington University, Department of Oceanography, Seattle, Washington, Report No. RLO-1725-203, Contract No. AT (45-1)-1725, (No Date), 81 pp.

Polychaetous annelids were studied in collections from various museums and from Washington waters. The study of the types of incompletely described specimens is reported along with the description of two new species. Additions to the descriptions of other species were made, and seven new records are for the cool-temperate northeast Pacific Ocean are given.

INDEX TERMS: Annelids, Pacific Ocean, Systematics, Marine animals, Ecological distribution, Spatial distribution, Speciation, Polychaetes, Macroinvertebrates.

AMIC-6026
"SCATTERING LAYERS AND VERTICAL DISTRIBUTION OF OCEANIC ANIMALS OFF OREGON", Pearcy, W. G., Mesecar, R. S., Oregon State University, Department of Oceanography, Corvallis, Oregon, Report No. RLO-1750-65, Contract Nos. AT (45-1)-1750 and NOOO-14-67-A-0369-007, 1971, 16 pp.

This paper reviews some of the distributional features of vertically migrating micronekton off Oregon, describes a new conducting cable-midwater trawl system using an eight net opening-closing codend unit, and gives some preliminary results on trawl catches relative to sound scattering layers. A variable complex of organisms, including euphausiids, a sergestid shrimp, and mesopelagic fishes were often common in 12 and 38.5 kHz scattering layers. The depth range of many species was broad, and sometimes largest catches were made at depths above or below scattering layers. Variability was large among nets fished either horizontally or vertically during single tows.

INDEX TERMS: Marine animals, Oregon, Sounds, Biomass, Depth, Electronic equipment, Spatial distribution, Sampling, Nekton, Vertical migration, Scattering layers, Vertical distribution, Lanternfishes, Stenobrachius leucopsarus, Diaphus theta, Tarletonbeania crenularis, Melanostomiatidae, Tactostoma macropus, Sergestes similis, Euphausia pacifica, Euphausiids, Echosounders.

AMIC-6027
"SURVEY OF TECHNIQUES USED TO PRESERVE BIOLOGICAL MATERIALS", Feinler, E. J., Hubbard, R. W., Stanford Research Institute, Menlo Park, California, NASA Contract Report No. 114422, Contract No. NAS2-6201, January 1972, 390 pp. NTIS Report No. N72-18080.

The purpose of this report was to document and summarize existing techniques used to preserve biological materials. This information is presented in a handbook format that categorizes the most important preservation techniques available, and includes a representative sampling of thousands of applications of those techniques to biological materials and organisms. The handbook is divided into four main sections: (1) a review of reviews, (2) tables of techniques of preservation, (3) indexes, and (4) a comprehensive bibliography.

INDEX TERMS: Surveys, Methodology, Freeze drying, Refrigeration, Incubation, Dialysis, Chemicals, Drying, Freezing, Radiation, Cytological studies, Plant tissues, Algae, Microorganisms, Bacteria, Invertebrates, Fungi, Enzymes, Animal parasites, Viruses, Biological materials, Biological samples, Sample preservation, Chemical preservation, Lyophilization, Animal tissues, Histological studies, Body fluids, Vertebrates, Heat sterilization, Fixation, Embedding, Ashing, Histochemistry.

AMIC-6028
"SURFACE ZOOPLANKTON FROM AUKE BAY AND VICINITY, SOUTHEASTERN ALASKA, AUGUST 1962 TO JANUARY 1964", Wing, B. L., Reid, G. M., National Marine Fisheries Service, Auke Bay Fisheries Laboratory, Auke Bay, Alaska, Report No. NOAA-NMFS-DR-72, March 1972, 765 pp. NTIS Report No. COM 72 10447.

A detailed study was conducted of zooplankton of an inshore area of southeastern Alaska. The purpose of the study was to (1) make a species checklist and (2) determine seasonal patterns of occurrence and abundance of planktonic animals in the surface waters (0-20 m) of the area. The data presented include both qualitative and quantitative information on collections made from August 1962 - August 1964 in and near Auke Bay (an estuary). A list of species, counts of each species per cubic meter, and the volume of zooplankton per 1000 cubic meters from the surface waters of Auke Bay and vicinity are included in the data. Descriptions are also given of meteorology (seasonal rainfall, air temperature, wind patterns), oceanography (density stratification, density currents), and cycles of phytoplankton productivity as related to cyclic nutrient concentrations (nitrates, phosphates, silicates). A table for converting from counts to volume, wet weight, and dry weight for selected species has been abstracted from the literature.

INDEX TERMS: Zooplankton, Systematics, Alaska, Surveys, Estuaries, Sampling, Phytoplankton, Primary productivity, Sea water, Surface waters, Oceanography, Invertebrates, Meteorology, Cycling nutrients, Plankton nets, Protozoa, Larvae, Rotifers, Nematodes, Molluska, Annelids, Insect eggs, Marine fish, Fish eggs, Data collections, Water properties, Seasonal variation, Auke Bay, Coelenterates, Ctenophores, Platyhelminthes, Bryozoa, Phoronids, Sipunculids, Macroinvertebrates, Arthropods, Chaetognaths, Echinoderms, Tunicates.

AMIC-6029
"RADIOACTIVITY TRANSPORT IN WATER--CONTINUOUR RELEASE OF RADIONUCLIDES IN A SMALL SCALE ECOSYSTEM", Gloyna, E. F., Yousef, Y. A., Padden, T. J., The University of Texas at Austin, Center for Research in Water Resources, Austin, Texas, Technical Report-21, EHE-71-1, CRWR-75, Contract No. AT(11-1)-490, September 30, 1971, 66 pp. NTIS Report No. ORO 490-21.

Model rivers were simulated in two channels of a research flume equipped with oxidation-reduction, DO, fluorometric, radiation, temperature, luminescence, and pH sensing probes. The control channel of the model river system contained a typical bottom sediment and received a potable water supply. The second channel, in addition to bottom sediment, contained a lush community of rooted aquatic plants in one end and received water which was rich in phytoplankton. Both channels were subjected to a continuous release of Cs-134 and Sr-85 for periods up to thirty-five days. The distribution of the radionuclides in the bottom sediment, plants, algae and water was determined. Under the conditions of the release, less than maximum permissible concentration, the radioactivity continued to increase on the surface of bottom sediments until a quasi-equilibrium level was reached at approximately 25 days after initiation of release. At this condition or saturation, the specific activity of bottom sediments associated with Cs-134 and Sr-85 approached 55 picocuries/sq cm and 3.34 picocuries/sq cm, respectively, and sediment concentration factors were 275 ml/sq cm and 85 ml/sq cm. In the case of rooted plants, quasi-equilibrium for Cs-134 (89 picocuries/gm of plant) and for Sr-85 (25 picocuries/gm of plant) was reached within two days. The plant weight was based on oven-dried mass. Plant concentration factors averaged 400 and 600 ml/gm, respectively for Cs-134 and Sr-85. In the

AMIC-6029 (Continued) 2/2

phytoplankton rich water, it was found that as much as 27 percent of the radioactivity of the water was actually contained on or in the phytoplankton. The rate of Cs-134 uptake by the phytoplankton was related to net photosynthetic oxygen production.

INDEX TERMS: Radioactivity, Model studies, Path of pollutants, Strontium radioisotopes, Retention, Distribution patterns, Dispersion, Transfer, Water pollution effects, Radioactive wastes, Bottom sediments, Absorption, Radioecology, Phytoplankton, Aquatic plants, Equipment, Mathematics, Estimating equations, Rooted aquatic plants, Cesium radioisotopes, Mass transfer coefficients, Data acquisition.

AMIC-6032
"COLUMBIA RIVER THERMAL EFFECTS STUDY. VOLUME I: BIOLOGICAL EFFECTS STUDIES", Environmental Protection Agency, Seattle, Washington, Report No. TID-25902, January 1971, 102 pp.

The purpose of this report is to present the available knowledge on temperature requirements and tolerances of anadromous fish in the Columbia River. The information and data presented are limited to conditions and species found in the main stem Columbia River in those areas remaining accessible to anadromous fish. The material includes information from the literature and from the files of Northwest fisheries agencies, with particular emphasis on new knowledge developed by the research studies conducted as part of the Columbia River Thermal Effects Study (CRTES). The research studies conducted as a part of the CRTES were designed to develop immediate answers to the needs of water quality agencies of the Northwest in considering the adequacy of water quality criteria limits and goals for water temperatures in the Columbia River. The field studies were limited to the most critical aspects of the lethal and sublethal thermal effects on various life stages of the anadromous fish. By their nature, many of the projects conducted as a part of the study are site-specific to conditions in the lower Columbia River near Prescott, Oregon, and in the Hanford reach of the Columbia River. Prescott is the proposed site of the first privately-developed nuclear power plant in the Northwest; the Hanford reach is the last unimpounded reach of the river above the estuary and the site of the only existing nuclear plants in the Region, operated by the Atomic Energy Commission.

INDEX TERMS: Columbia River, Anadromous fish, Thermal stress, Water pollution effects, Fish physiology, Mature growth stage, Juvenile growth stage, Heat resistance, Environmental effects, Thermal pollution, Secondary productivity, Fish diseases, Fish production, Commercial fish, Salmon, Yellow perch, Sticklebacks, Smelts, Shad, Crustaceans, Protozoa, Insects, Bacteria, Water temperature, Sturgeon.

AMIC-6033
"COMPARISON OF SAMPLES OF STREAM BOTTOM FAUNA COLLECTED DURING THE DAY AND AT NIGHT", Clifford, H. F., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 479-481.

Bottom samples were taken throughout the year at 1600 and 2300 hours from a riffle region of a brown-water stream of Alberta, Canada. For the abundant taxa, the variance of numbers was much greater than the mean for both day and night samples. For the entire study period, there were no significant differences between day and night samples for total numbers, total number of taxa, and total volume-biomass. (Reprinted from Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 479-481. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Biomass, Streams, Benthic fauna, Bottom sampling, Freshwater, Pollutant identification, Photoperiodism, Diurnal distribution, Aquatic insects, Systematics, Immature growth stage, Oligochaetes, Ostracods, Macroinvertebrates.

AMIC-6034
"SEPARATING CONSTITUENTS OF NATURAL PHYTOPLANKTON POPULATIONS BY CONTINUOUS PARTICLE ELECTROPHORESIS", Bayne, D. R., Lawrence, J. M., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 481-489.

A continuous particle electrophoresis (CPE) system was used to isolate components of mixed phytoplankton suspensions. Twenty-one freshwater phytoplankton genera were tested. All algal cells examined migrated toward the anode and different mobilities frequently resulted in fractionation of mixtures of different genera. Organic debris, clay particles, and bacteria often exhibited distinct mobilities that led to their separation from other constituents. Tris (hydroxymethyl) amino methane, pH 9.2, provided greater particle mobility and better resolution than sodium diethylbarbiturate, pH 8.6. Increase in buffer pH tended to make algal particles more negative and increased mobility. A direct relationship existed between applied field gradient and particle mobility. Resolution generally improved at higher field gradients. The effectiveness of the separation was limited by such algal properties as motility, size, formation of aggregates, and buoyancy. (Reprinted from Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 481-489. Copyright 1972 by the American Society of Limnology and Oceanography, Inc. Reprinted by permission of the copyright owner.)

INDEX TERMS: Phytoplankton, Aquatic algae, Plant populations, Separation techniques, Organic matter, Clays, Bacteria, Hydrogen ion concentration, Movement, Size, Aggregates, Buoyancy, Cyanophyta, Chlorophyta, Euglenophyta, Chrysophyta, Aquatic populations, Pollutant identification, Continuous particle electrophoresis.

AMIC-6035
"A NEW METHOD FOR CONCENTRATING PHYTOPLANKTON BY FILTRATION WITH CONTINUOUS STIRRING", Morris, I., Yentsch, C. S., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 490-493.

Phytoplankton (both natural populations and cultures) have been concentrated 20-fold to 200-fold by passage through an ultrafiltration cell with continuous magnetic stirring. Conditions yielding maximum recovery of physiologically active phytoplankton have been developed. Recovery of C-14-dioxide assimilation activity was comparable to that of chlorophyll, generally varying from 55-75 percent for natural populations and from 70-95 percent for cultures. Modification of the apparatus to give a continuous flow of seawater into the filtration cell would make this method suitable for concentrating 50-60 liters to 100 ml, possibly yielding suspensions which would allow study of the activity of enzymes in cell-free extracts, pathways of carbon dioxide assimilation, rates of respiration, rates of assimilation of inorganic nitrogen compounds, and so on.

INDEX TERMS: Filtration, Phytoplankton, Cultures, Carbon dioxide, Pollutant identification, Photosynthesis, Marine algae, Sea water, Radioactivity techniques, Separation techniques, Methodology, Chlorophyta, Continuous magnetic stirring, Concentration, C-14, Ultrafiltration, Phaeodactylum tricornutum, Tetraselmis, Aphanizomenon holsaticum, Dunaliella tertiolecta, Nannochloris atomus.

AMIC-6036
"SIZE SEPARATION OF MARINE SESTON BY MEMBRANE AND GLASS-FIBER FILTERS", Sheldon, R. W., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 494-498.

A method is presented for the size separation of marine seston by both membrane and glass-fiber filtration. The average minimum sizes of particles retained by metal membranes and perforated polycarbonate membranes were similar to the stated pore sizes when relatively small seawater samples with moderate concentrations of particles were filtered. When large samples or high concentrations were filtered, the average retention size was less than the stated pore size. All cellulose ester membranes (Millipore) retained particles much smaller than the stated pore size, even from small samples with low particle concentrations. Glass-fiber filters had retention characteristics similar to membrane filters.

INDEX TERMS: Marine microorganisms, Size, Separation techniques, Pollutant identification, Sea water, Shape, Retention, Seston, Glass-fiber filters, Membrane filters.

AMIC-6038
"DIFFERENTIAL EFFECT OF CHLORAMPHENICOL AND ACTINOMYCIN D ON PROTEIN SYNTHESIS IN THE DECAPOD CRUSTACEAN UPOGEBIA LITTORALIS", Pataryas, H. A., Mylonas, N., Papachatzakis, T., Hydrobiologia , Vol. 40, No. 1, August 31, 1972, pp 19-23.

A study has been made of the effect of chloramphenicol (CAP) and actinomycin D on the in vivo incorporation of radioactive leucine by the hepatopancreas of the crustacean Upogebia littoralis in an effort to determine what effect the antibiotics have on protein synthesis in a crustacean. Freshly collected animals were injected with 0.026 microcuries of C-14-leucine and divided into groups. The animals were killed by deep freezing after 1, 3, 6, 8 and 12 hr, the hepatopancreas homogenized with TRIS buffer at pH 7.5, the homogenate boiled with NaOH, and the mixture centrifuged for 20 min at 1510 g. The protein was precipitated from the supernatant with 3 M TCA, and the ether dried sample was extracted with acetone, dried, and the radioactivity measured with an automatic Nuclear Chicago gas flow counter. Inhibition of protein synthesis was noted within 6 hours after administration of chloramphenicol; maximum inhibition occurred 8 hours after treatment. No inhibition was noted after administration of actinomycin D; on the contrary, this antibiotic appeared to slightly stimulate protein synthesis as measured by the rate of C-14-leucine incorporation, within 6 to 8 hours after treatment.

INDEX TERMS: Antibiotics (pesticides), Proteins, Crustaceans, Water pollution effects, Industrial wastes, Absorption, Radioactivity techniques, Methodology, Chemical analysis, Shrimp, Biosynthesis, Upogebia littoralis, Chloramphenicol, Pharmaceuticals, Actinomycin D, Sample preparation, Hepatopancreas, Leucine.

AMIC-6039
"AN ECOLOGICAL STUDY OF THE MACROPHYTIC VEGATION OF DOODHADHARI LAKE, RAIPUR, M.P. 3 CHEMICAL FACTORS", Unni, K. S., Hydrobiologia, Vol. 40, No. 1, August 31, 1972, pp 25-36.

A study was conducted in order to determine the influence of chemical constituents of water on the distribution of aquatic plants in Doodhadhari Lake. Every month a collection was made in early morning and in late afternoon in order to gain an understanding of the monthly variations. Water samples were taken at every half meter depth interval; the factors estimated were dissolved oxygen, free carbon dioxide and alkalinity, pH, total hardness, magnesium, calcium, sodium, potassium and specific conductvity. Seasonal change in chemical composition of the water was quite significant, the most prominent being the fluctuation of dissolved oxygen, both in the vertical and horizontal directions. The macrophytic vegetation was found to exert a profound influence on the restricted volume of water and on the environment through photosynthesis and respiration. The concentration of dissolved oxygen, free carbon dioxide, hydrogen ion concentration and alkalinity have been found to be greatly influenced by the macrophytic vegetation.

INDEX TERMS: Aquatic plants, Ecological distribution, Physicochemical properties, Water analysis, Freshwater, Seasonal, Aquatic environment, Chemical analysis, Water quality, Spatial distribution, Sampling, Variability, Macrophytes, Doodhadhari Lake,

AMIC-6040
"A METHOD FOR DETERMINING THE SURFACE AREAS OF STONES TO ENABLE QUANTITATIVE DENSITY ESTIMATES OF LITTORAL STONEDWELLING ORGANISMS TO BE MADE", Calow, P., Hydrobiologia, Vol. 40, No. 1, August 31, 1972, pp 37-50.

Due to the difficulty encountered when attempting to make quantitative density estimates of stone-dwelling littoral fauna, a detailed description of a method which allows the accurate determination of the surface areas of irregularly shaped stones is given. Since this method would be difficult to accomplish in the field, practical and statistical procedures are described for correlating surface area with some more easily measured linear, stone parameter. Stones were obtained from a 200-m shoreline with a solid limestone base of a variable depth of glacial drift and weathering debris over it. In order to obtain a truly representative sample of stones from the 'Ha Mire' shore, a random sample was made. This was achieved by dividing the shore on a map into a number of equally spaced longitudinal and lateral divisions. The positions for stone collection were then fixed by a series of 50 random co-ordinates. Stones so collected were taken back to the laboratory where their greatest length and longest perimeters were mensured (cm). Surface areas of irregularly shaped stones were determined by coating the stones with a rubber latex solution, removing the mould and calculating the weight of an even film of water which covered the surface of the mould which mirrored the stone surface. Similar work on standard bodies of known surface area revealed that .0020 (plus or minus .00012) g of water film covered 1 sq cm of mould. This factor was then used in estimating the surface areas of the stones. A relationship was found to exist between surface area and the product of the stones longest length and largest perimeter. The statistical treatment of raw data which would be obtained from the sampling described was discussed.

AMIC-6040 (Continued) 2/2

INDEX TERMS: Methodology, Littoral, Benthic fauna, Statistical methods, Aquatic animals, Periphyton, Data collections, Species density, Surface area, Stones.

AMIC-6041
"REARING AND MAINTENANCE OF PLECOPTERAN NYMPHS", Kapoor, N. N., Hydrobiologia, Vol. 40, No. 1, August 31, 1972, pp 51-53.

A device for the rearing and maintenance of Plecopterans was designed and constructed. This apparatus is satisfactory for rearing other aquatic species. A desired water temperature and current velocities can be achieved in the apparatus. A description and diagram of the apparatus are included.

INDEX TERMS: Stoneflies, Growth chambers, Laboratories, Design, Growth stages, Immature growth stage, Caddisflies, Mayflies, Aquatic insects, Larval growth stage, Animal growth, Nymphs, Plecoptera, Arthropods.

AMIC-6042
"DIRECT OBSERVATIONS ON THE SUBLITTORAL MARINE ALGAE OF ARGYLL, SCOTLAND", Norton, T. A., Milburn, J. A., Hydrobiologia, Vol. 40, No. 1, August 31, 1972, pp 55-68.

Diving surveys were made off Argyll, on the west coast of Scotland, June 1966 - May 1968, in order to obtain a general qualitative description of the major components of the flora as related to depth. Divers collected algae from 3-m depth zones at 11 sites, some of which were exposed to the full force of the Atlantic while others were extremely sheltered. More than half of the algal species found were confined to the sublittoral zone. The greatest variety of species was found in shallow water at sites sheltered from excessive turbulence. With increasing depth the number of species found steadily decreased. There was no evidence of a specifically distinct algal flora confined to deeper water. No algae were found deeper than 36 m below ELWS at any site, but the lower limit of algal growth was reduced to 9 m in a turbid water loch and to 3 m at a site where the herbivorous echinoderm Ophiocomina nigra was abundant. Fairly distinct algal communities were found on different substrates. The major communities recognized underwater were algae attached to stable substrata, algae attached to unstable substrata and epiphytic on other algae, especially on the stipes of Laminaria hyperborea. On stable rock in areas subject to water movement L. hyperborea forest was the dominant vegetation whereas on unstable substrata and in sheltered localities L. saccharina was dominant.

INDEX TERMS: Marine algae, Phaeophyta, Chlorophyta, Sessile algae, Marine plants, Rhodophyta, Littoral, Sublittoral, Scotland, Epiphytes, Epilithic.

AMIC-6043
"CAUSES OF MORTALITY IN THE ENDEMIC TILAPIA OF LAKE CHIWA (MALAWI)", Morgan, P. R., Hydrobiologia, Vol. 40, No. 1, August 31, 1972, pp 101-119.

During 1966 and 1967 extensive mortalities of Tilapia shirana chilwae took place in Lake Chilwa, Malawi. By collating field observations and physico-chemical data from the lake with experimental evidence from the laboratory, it has been possible to predict what the most likely causes of mortality of Tilapia might have been. High winds caused bottom erosion in October, 1966, and the released mud deoxygenated the water. Total deoxygenation of the water results if the level of suspended matter is raised to 12,860 ppm. Tilapia are able to survive levels of oxygen as low as 0.6 mg/l, but become distressed below this figure. The median lethal alkalinity for T. s. chilwae in artificial lake water is 61.6 meq/l. This concentration was reached in the lake in December, 1966, and probably caused further mortalities. T. s. chilwae is remarkably tolerant of high temperature, and this factor alone is unlikely to have caused natural mortalities. Elevated temperatures can cause decreased resistance to low oxygen and high ionic concentration, however, and the dense blooms of Anabaena may have caused sufficient deoxygenation of the water at night to cause further mortalities. T. s. chilwae is more resistant to high alkalinity and high temperature than T. melanopleura. This undoubtedly reflects the long history of stress in the endemic Tilapia. No doubt the heightened resistance of T. s. chilwae has enabled it to sucessfully populate Lake Chilwa, despite its characteristic instability.

INDEX TERMS: Mortality, Tilapia, Water quality, Environmental effects, Fish populations, Physiochemical properties, Water pollution effects, Freshwater fish, Lethal limit, Lake Chilwa, Tilapia shirana chilwae, Tilapia melanopleura.

AMIC-6044
"NITROGEN AND PHOSPHORUS DYNAMICS IN THREE CENTRAL TEXAS IMPOUNDMENTS", Hannan, H. H., Young, W. C., Mayhew, J. J., Hydrobiologia, Vol. 40, No. 1, August 31, 1972, pp 121-129.

In order to investigate the role of man-made impoundments in nutrient entrapment, nitrogen and phosphorus budgets were calculated for 3 central Texas impoundments: Lake Dunlap, Lake McQueeney, and Lake Gonzales. Each impoundment was sampled at 4-hr intervals over a diel period during February, May, August, and November, and at mid-afternoon and between 2 A.M. and dawn during the other months. The water samples were taken with a 2-l Kemmerer water sampler 0.5 m below the surface and 1 m above the bottom and analyzed by previously described methods for nitrate, nitrite, Kjeldahl nitrogen, ammonia, dissolved inorganic phsophate, total organic phosphate, total phosphate, and chlorophyll a. Annual nitrogen budgets for the three lakes show they all serve as nutrient traps. All three lakes lost phosphorus on an annual basis. This loss was attributed to the small demand by autotrophs and the addition of phosphorus from allochthonous sources around the lakes and from sewage plant effluents upstream. Based on nitrogen-phosphorus ratios, it is postulated that nitrogen is the nutrient factor which limits algal growth in all three impoundments.

INDEX TERMS: Nitrogen, Phosphorus, Limiting factors, Impoundments, Essential nutrients, Kinetics, Water sampling, Water analysis, Chemical analysis, Nitrates, Nitrites, Phosphates, Ammonia, Growth rates, Freshwater algae, Lake Dunlap, Lake Gonzales, Lake McQueeney.

AMIC-6045
"SPECIAL LAKE WATER TREATMENT PROBLEMS", Vaughn, J. C., Journal American Water Works Association, Vol. 64, No. 9, September 1972, pp 585-589.

Water treatment plants depending on surface water for filtration treatment are liable to many intake delivery problems. Icing up of intakes can be avoided by design techniques, backflushing, temperature control, and cleaning by blasting. Blockage of intakes by fish (alewives) has been remedied by protective nets and screens. Algal collections on screens or nets require positive pressure for removal (Dichotomosiphon, Cladophora) or installation of revolving screens and pulverizing equipment. Plankton (Fragilaria, Tabellaria, Asterionella, and Synedra) can best be gotten rid of by a good surface-wash system so that broken-up mats can be removed from filters by backwashing. Problems with tastes and odors can result from microorganisms (Dinobryon) or chemicals. Treatment usually involves oxidation by excess chlorine treatment and/or adsorption onto activated carbon. Microstrainers and sludge blanket devices required normal maintenance and some supplementation. The most difficult and expensive problem involves wintertime diatoms (Melosira). A side issue of their proliferation is development of colloidal turbidity; doubling coagulant dosage appears somewhat remedial. Calcium carbonate and pH changes appear related to Melosira blooms.

INDEX TERMS: Water treatment, Water pollution effects, Treatment facilities, Influent streams, Great Lakes, Aquatic algae, Ice, Fish, Microorganisms, Odor, Taste, Plankton, Chemicals, Phenols, Chlorine, Oxidation, Adsorption, Activated carbon, Sludge treatment, Diatoms, Coagulation, Calcium carbonate, Hydrogen ion concentration, Filtration, Plankton nets, Nuisance algae, Cladophora, Dinobryon, Interference, Alewives, Dichotomosiphon, Fragilaria, Tabellaria, Asterionella, Synedra, Melosira.

AMIC-6084
"EFFECTS OF AROCLOR 1242 (A POLYCHLORINATED BIPHENYL) AND DDT ON CULTURES OF AN ALGA, PROTOZOAN, DAPHNID, OSTRACOD, AND GUPPY", Morgan, J. R., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 3, September 1972, pp 129-137.

In laboratory bioassays, Aroclor 1242 appeared to temporarily inhibit the growth rate of Chlamydomonas as evidenced by cell counts and C-14 uptake, while DDT did not appear to have any effect. A greater concentration of PCB was found in the algal cells than in the media, indicating that concentration and passage of the biphenyl compounds through the food chain may take place. Neither Aroclor 1242 nor DDT in the amounts tested appeared to have any effect on the growth or cell density of Tetrahymena vorax cultures. Daphnia pulex were quite sensitive to additions of Aroclor 1242 as low as 0.02 ppm. The toxicity of PCB and DDT to the ostracod Cypridopsis vidua appeared to be approximately the same. Young guppies died in concentrations of 2 ppm Aroclor 1242. Aroclor 1242 appears to have a much lower toxicity to cladocerans and guppies than p,p'-DDT. Although the effect of PCB on algal growth appeared to be temporary, in view of its evident capability to be passed through the food chain and its selective toxicity to certain zooplankton, it would be unwise to attempt to predict its effect on the ecosystem without further study.

INDEX TERMS: Bioassay, Growth rates, Daphnia, Protozoa, Chlamydomonas, Ostracods, Population, DDT, Path of pollutants, Toxicity, Food chains, Aroclor 1242, Guppy, Biological magnification, Daphnia pulex, Cypridopsis vidua, Poecilia reticulata, Tetrahymena vorax.

AMIC-6086
"INHIBITION OF MITOCHONDRIAL ELECTRON TRANSPORT BY GUTHION, SOME RELATED INSECTICIDES, AND DEGRADATIVE PRODUCTS", Heidker, J. C., Pardini, R. S., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 3, September 1972, pp 141-146.

Heavy beef heart mitochondria (HBHM) were used to investigate the chronic effects of guthion and its metabolic desulfuration and photoinduced breakdown products on electron transport. The pesticides and electron transport carriers were added in ethanol or water. The results show that ethyl guthion, guthion, ethyl guthion oxygen analog, and guthion oxygen analog depressed the mitochondrial NADH-oxidase enzyme system at concentrations of 138.9 and 1389 nanomoles of pesticide per mg of mitochondrial protein. Benzazimide and anthranilic acid were noninhibitory. It was concluded that none of the guthion derivatives or breakdown products tested was inhibitory to the mitochondrial succinoxidase system. Since ethyl guthion and guthion were the most potent inhibitors of the NADH- oxidase system, it is suggested that the phosphorodithioate structure may be important in this inhibition.

INDEX TERMS: Bioassay, Pesticide toxicity, Enzymes, Organophosphorus pesticides, Guthion, Ethyl guthion, Dylox, Di-syston, Electron transport, Benzazimide, Anthranilic acid, Metabolites, Mitochondria.

AMIC-6096
"DIEL PERIODICITY OF CHLOROPHYLL A CONCENTRATION IN OREGON COASTAL WATERS", Glooschenko, W. A., Curl, H., Jr., Small, L. F., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1253-1259.

Samples of phytoplankton were collected from the surface water and at depths of 10, 15, 25, and 50 m in Oregon coastal waters and from two stations in the mid-Pacific for use in determining diel periodicities. Phytoplankton was filtered from sea water and stored in a desiccator in a freezer for subsequent pigment analysis or laboratory culturing. Pigment was extracted with acetone and analyzed by the method of Shickland and Parsons. The culture medium consisted of filtered sea water enriched with nutrients including thiourea. It was found that concentrations of chlorophyll a in phytoplankton exhibited a diel periodicity in Oregon coastal waters. Maximum surface concentrations often occurred around midnight and highest 25-m concentrations early in the evening (or even in late afternoon). Concentrations at intermediate depths fell in between and in a predictable progression with depth and time of day. Minimum chlorophyll a values occurred in the afternoon. No definite periodicity was established at 50 m. Laboratory studies with Skeletonema costatum demonstrated that the diel cycle of chlorophyll a per cell was related to the light intensity and duration to which cells were exposed. Highest concentrations of the pigment occurred early in the dark period and lowest concentrations in the light period when cells were grown under photoperiods of 9, 12, and 15 hr at a light intensity of approximately 1200 ft-c. Pigment bleaching probably was responsible for the low concentrations during the light period. Addition of an external carbon source during the dark period prolonged the high chlorophyll a concentrations in the dark before the decline began. Under low light (400 ft-c) chlorophyll a synthesis occurred only in the light. A correction for

AMIC-6096 (Continued) 2/2

diel pigment periodicity is recommended for models estimating photosynthesis from chlorophyll and light data and for oceanographic surveys during which sampling of chlorophyll a is carried out throughout the 24-hr day.

INDEX TERMS: Phytoplankton, Diel migration, Photosynthesis, Cultures, Photoperiodism, Chlorophyll a, Sample preparation, Skeletonema costatum.

AMIC-6097
"EFFECTS OF SOLAR RADIATION AND UPWELLING ON DAILY PRIMARY PRODUCTION OFF OREGON", Small, L. F., Curl, H., Jr., Glooschenko, W. A., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1269-1275.

Primary production was measured in units of gC per sq m per day (equals P) and gC per gram Chl a per day on a per meter squared basis (equals P sub Chl) for 4 years in Oregon coastal waters and offshore areas. P, and particularly P sub Chl, were functions of daily photosynthetically usable radiation inshore except in summer, and offshore apparently during all seasons. Values of P and P sub Chl for a given daily input of usable radiation were higher inshore than offshore, probably because of more efficient use of penetrating light by the relatively heavy coastal phytoplankton populations in nutrient-rich water. Evidence is presented that inshore phytoplankton populations in winter are acclimated to low light relative to inshore populations in spring. P and P sub Chl are related to the interaction of daily radiation and degree of upwelling in Oregon coastal waters in summer. P is a function of photic depth offshore and inshore, except in summer. Probably the presence of large quantities of non-photosynthesizing detritus, even in areas of upwelling, destroys the relation in summer. There apparently is no simple relation involving daily production and certain significant environmental factors which will allow prediction of daily production in all regions of the ocean during all seasons. (See also AMIC-6147.)

INDEX TERMS: Phytoplankton, Primary productivity, Aquatic plants, Solar radiation, Upwelling, Oregon, Environmental effects, Photosynthesis, Coasts, Measurement, Euphotic zone, Light penetration, Light intensity, Aquatic populations, Sea water, Chlorophyll a.

AMIC-6099
"ACUTE TOXICITY OF YELLOW PHOSPHORUS TO ATLANTIC COD (GADUS MORHUA) AND ATLANTIC SALMON (SALMO SALAR) SMOLTS", Fletcher, G. L., Hoyle, R. J., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1295-1301.

The acute toxicity of yellow phosphorus (P_4) to Atlantic cod (Gadus morhua) and Atlantic salmon (Salmo salar) smolts was investigated using two experimental procedures: (a) continuous exposure and (b) single brief exposure. In continuous-exposure experiments, P_4 was lethal to cod and seawater-maintained salmon at concentrations as low as 1.89 and 0.79 micrograms/liter, respectively. Salmon that were exposed to P_4 concentrations of 40 micrograms/liter or less developed a distinct external red color and showed signs of extensive hemolysis. At death, salmon that had been exposed to P_4 concentrations of 90 micrograms/liter and lower showed a progressive decline in hematocrits. In contrast, cod were never observed to show any evidence of external redness, hemolysis, or reduced hematocrits. In the brief-exposure experiments, cod and salmon were subjected (20 min to 3.5 hr) to P_4 concentrations ranging from 245 to 4030 micrograms/liter. These brief exposures resulted in mortalities to both species that were delayed for as long as 2 weeks. Salmon turned 'red' 16-24 hr following exposure, and at death showed evidence of hemolysis and reduced hematocrits. None of the cod exhibited any of these symptoms.

INDEX TERMS: Atlantic salmon, Toxicity, Smolt, Fish diseases, Marine fish, Growth stages, Juvenile growth stage, Water pollution effects, Lethal limit, Bioassay, Animal pathology, Commercial fish, Sea water, Yellow phosphorus, Atlantic cod, Grilse, Parr, Salmo salar, Gadus morhua.

AMIC-6101
"TOXICITY OF HYDROGEN SULFIDE TO GOLDFISH (CARASSISUS AURATUS) AS INFLUENCED BY TEMPERATURE, OXYGEN, AND BIOASSAY TECHNIQUES", Adelman, I. R., Smith, L. L. Jr., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1309-1317.

Bioassays were conducted to test the effect of temperature and oxygen on H2S toxicity to goldfish (Carassius auratus) and to investigate some factors that influence bioassay results. Relation of H2S toxicity to temperature is negatively logarithmic over the range of 6.5-25 C. The mean 96-hr TL50 at 6 C was 530 micrograms/liter and at 25 C was 4 micrograms/liter. At temperatures of 14, 20, and 26 C, most acute mortality from H2S ended by 11 days and the 11-day TL50's at these temperatures were significantly different. In bioassays with and without prior oxygen acclimation, decreasing oxygen concentrations increased H2S toxicity. In the former, mean TL50's were 62 and 48 micrograms/liter H2S at oxygen concentrations of 6 and 1.5 milligrams/liter, respectively, and in the latter, 71 and 53 micrograms/liter H2S at the same oxygen concentrations. Variability in bioassay results was not affected by test temperatures of 14, 20, and 26 C, and in most cases 1 week of temperature acclimation was adequate. Stocks of fish responded differently after 11 days of bioassay, although differences were not detected after 4 days of bioassay.

INDEX TERMS: Bioassay, Toxicity, Oxygen, Hydrogen sulfide, Methodology, Lethal limit, Physiochemical properties, Water properties, Water pollution effects, Water temperature, Dissolved oxygen, Water analysis, Goldfish, Carassius auratus.

AMIC-6102
"DEPTH DISTRIBUTIONS OF BENTHIC POLYCHAETES IN TWO FIORDS ON ELLESMERE ISLAND, N.W.T.", Curtis, M. A., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1319-1327.

The relation between depth and population density is described for a number of benthic polychaetes in Hare and Tanquary fiords on Ellesmere Island. Benthic fauna of the two fiords was collected in replicate grab samples taken at standardized depths from 6 to 100 m. From this collection, 68 polychaete species were identified. Two of these, Hartmania moorei Pettibone and Zeppelinia monostyla (Zeppelin), have not previously been reported in the Arctic. Population densities of common species demonstrate a marked relation to depth and the distributions of single species were similar in each fiord. Distributions at less than 10 m in Tanquary Fiord appear to be greatly modified by the presence of fiord water, a brackish surface layer formed during the summer ice melt. Among the polychaetes, depth ranges and depths of greatest abundance usually differed and so the species appeared to be scattered along the depth gradient rather than grouped in distinct assemblages.

INDEX TERMS: Ecological distribution, Benthic fauna, Fjords, Spatial distribution, Bottom sampling, Animal populations, Water quality, Environmental effects, Annelids, Elleamere Island, Polychaetes, Macroinvertebrates.

AMIC-6103
"CHANGE IN THERMAL REGIME AS A CAUSE OF REDUCTION OF BENTHIC FAUNA DOWNSTREAM OF A RESERVOIR", Lehmkuhl, D. M., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1329-1332.

A study is presented of the thermal effects on benthic fauna located downstream from a reservoir. A great reduction in the kinds and numbers of Ephemeroptera and other insects in the Saskatchewan River is attributed to changes in river temperatures caused by the reservoir. The river is warmed in winter and cooled in summer. Consequently, mayflies and other insects with strict thermal requirements cannot hatch and grow sucessfully. The effect is evident 70 miles downstream.

INDEX TERMS: Benthic fauna, Water temperature, Reservoirs, Thermal stress, Thermal pollution, Water pollution effects, Water cooling, Heated water, Crustaceans, Leeches, Thermal stratification, Mollusks, Larvae, Limiting factors, Caddisflies, Aquatic insects, Macroinvertebrates.

AMIC-6104
"EFFECTS OF EXPOSURE TO SUBLETHAL DDT ON THE LOCOMOTOR BEHAVIOR OF THE GOLDFISH (CARASSIUS AURATUS), Davy, F. B., Kleerekoper, H., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1333-1336.

A report is given of the effects of chronic exposure to sublethal doses of DDT on the locomotor behavior of the goldfish, Carassius auratus. A highly significant time-dependent correlation between consecutive turns in the locomotor pattern of normal goldfish attributed to a 'memory' process in the pertaining locomotor control mechanism in the central nervous system, is significantly reduced within 4 days by chronic exposure of the fish to 10 microgram/liter p,p'-DDT. Keeping the fish in clean water during 130-139 days did not result in the restoration of the above correlation.

INDEX TERMS: Chlorinated hydrocarbon pesticides, DDT, Movement, Fish behavior, Water pollution effects, Water analysis, Chemical analysis, Fish physiology, Goldfish, Carassius auratus.

AMIC-6105
"SOME ASPECTS OF THE BIOLOGY OF GAMMARELLUS HOMARI (CRUSTACEA, AMPHIPODA) IN THE NORTHWESTERN ATLANTIC", Steele, D. H., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1340-1343.

Gammarellus homari is a sublittoral Atlantic amphipod found from eastern Newfoundland and the northern Gulf of St. Lawrence north to Ellesmere Island. It is distinguished from G. angulosus by its larger size, smaller eyes and when alive by its red coloration. It appears to produce a single brood of young per year. Ovigerous females are found at depths of 12-15 m in the winter and the young are released in late winter or spring. It is not known where the males occur or where the adult females spend the remainder of the year.

INDEX TERMS: Systematics, Distribution patterns, Growth stages, Crustaceans, Atlantic Ocean, Invertebrates, Ecology, Amphipoda, Gammarellus homari, Macroinvertebrates.

AMIC-6106
"BLOOD CONCENTRATIONS OF TRICAINE METHANE SULPHONATE IN BROOK TROUT, SALVELINUS FONTINALLIS, DURING ANESTHETIZATION, BRANCHIAL IRRIGATION, AND RECOVERY", Houston, A. H., Woods, R. J., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1344-1346.

Blood concentrations of tricane methane sulphonate increased rapidly upon immersion of trout in 100 mg/liter solutions of the anesthetic at 3.5-5 C, and also rose significantly during irrigation for 15 min with either 50 or 100 mg/liter solutions. Clearance was rapid following transfer to running freshwater recovery tanks. Graphical estimates of 50 and 90 percent blood clearance times were 20 and 55 min, respectively.

INDEX TERMS: Brook trout, Bioassay, Fish behavior, Toxicity, Water pollution effects, Tricaine methane sulfonate, Anesthetics, Salvelinus fontinalis, Blood, Biological samples, Drugs.

AMIC-6108
"ELECTRICAL RESPONSES OF THE OLFACTORY BULB OF PACIFIC SALMON ONCORHYNCHUS NERKA AND ONCORHYNCHUS KISUTCH", Hara, T. J., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1351-1355.

Olfactory bulbar electrical responses elicited by nasal infusion of food extracts, hand rinse, and several amino acid solutions were studied in sockeye (Oncorhynchus nerka) and coho (O. kisutch) salmon from several different sources. Comparison was also made in rainbow trout (Salmo gairdneri). Significant variations in the olfactory bulbar responses were observed among different species and even among the same species from different sources. The estimated lowest threshold concentration for L-serine was between .000001 and .0000001 M in salmon. Olfactory responses of rainbow trout were always several times larger than those of salmon. Pretreatment of nasal cavity with .0001 M solutions of $HgCl_2$ or $CuSO_4$ (27 or 16 mg/liter, respectively) for 10 sec completely blocked the olfactory responses in all fish species studied. The effect was reversible; the responses returned to their original level by rinsing. Exposure of fish to 0.1 mg/liter $HgCl_2$ for up to 3 days reduced the olfactory responses to 40-10 percent of those of normal fish. $CuSO_4$ was the more toxic.

INDEX TERMS: Toxicity, Rainbow trout, Sockeye salmon, Bioassay, Copper sulfate, Copper, Mercury, Heavy metals, Water pollution effects, Fish behavior, Fish physiology, Mercury chloride, Olfactory response, Oncorhynchus nerka, Oncorhynchus kisutch, Salmo gairdneri, Coho salmon.

AMIC-6110
"CADMIUM UPTAKE BY MARINE ORGANISMS", Eisler, R., Zaroogian, G. E., Hennekey, R. J., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1367-1369.

Adults of mummichog, Fundulus heteroclitus, scallop Aquipecten irradians, oyster Crassostrea virginica, and subadult lobsters Homarus americanus were immersed for 21 days in flowing sea water containing 10 micrograms/liter of cadmium as $CdCl_2$. 2-1/2 H_2O. After exposure of the animals, 16 pooled tissue samples were prepared, 8 experimental and 8 control. Samples were (1) whole mummichog, (2) whole oyster meats, (3) scallop adductor muscle, (4) scallop remaining soft parts, (5) lobster muscle from abdomen and claws, (6) lobster gill, (7) lobster viscera and (8) lobster remainder. Samples preparation involved dry ashing and digestion in 6 N HCl. Analysis was by atomic absorption spectroscopy. Cadmium residues in whole animals and selected tissues were consistently higher in exposed organisms than controls; edible portions of treated lobster (muscle), scallop (adductor muscle), and oyster (whole animal) contained more cadmium per unit wet weight than controls by 25 percent, 19 percent, and 352 percent, respectively. Therefore, Cd concentrations in water not previously considered hazardous may, by man's ingestion of sea foods, prove to be hazardous.

INDEX TERMS: Cadmium, Food chains, Oysters, Lobsters, Absorption, Heavy metals, Public health, Path of pollutants, Biological magnification, Atomic absorption spectrophotometry, Biological samples, Sample preparation, Mummichogs, Scallops.

AMIC-6112
"ATMOSPHERIC CARBON DIOXIDE: ITS ROLE IN MAINTAINING PHYTOPLANKTON STANDING CROPS", Schindler, D. W., Brunskill, G. J., Emerson, S., Broecker, W. S., Peng, T.-H., Science, Vol. 177, September 29, 1972, pp 1192-1194.

The rate of invasion of carbon dioxide into an artificially eutrophic Canadian Shield lake with insufficient internal sources of carbon was determined by two methods: measuring the carbon: nitrogen: phosphorus ratios of seston after weekly additions of nitrogen and phosphorus, and measuring the loss of radon-222 tracer from the epilimnion. Both methods gave an invasion rate of about 0.2 gram of carbon per square meter per day. The results demonstrate that invasion of atmospheric carbon dioxide may be sufficient to permit eutrophication of any body of water receiving an adequate supply of phosphorus and nitrogen.

INDEX TERMS: Phytoplankton, Carbon dioxide, Standing crops, Eutrophication, Seston, Oligotrophy, Water pollution effects, Radioactvity techniques, Primary productivity, Limiting factors, Essential nutrients, Epilimnion, Tracers, Carbon, Nitrogen, Fertilization, Phosphorus, Chlorophyll a, Inorganic carbon, Dissolved carbon, Rn-222.

AMIC-6147
"ESTIMATES OF PRIMARY PRODUCTION OFF OREGON USING AN IMPROVED CHLOROPHYLL-LIGHT TECHNIQUE", Small, L. F., Curl, H. Jr., Glooschenko, W. A., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1261-1267.

An existing equation for the estimation of primary production from chlorophyll and light data was examined, and revisions were made to allow more precise applications of the equation to upwelling areas and other regions with relatively large fluctuations in chlorophyll concentration and production per unit of chlorophyll during the day. The revised equation was developed by estimating production in 2-hr increments through the daylight period, and integrating by parts to arrive at production in terms of gC/sq m/day. Total daily production in coastal waters was estimated within plus or minus 13 percent of mean C-14 estimates, on the average, while in offshore waters the estimates averaged within plus or minus 21 percent of mean C-14 estimates. Estimates by the revised equation averaged 52 percent better in coastal waters, and 32 percent better in offshore waters, than the basic unrevised equation. (See also AMIC-6097.)

INDEX TERMS: Estimating equations, Primary productivity, Oregon, Methodology, Solar radiation, Light penetration, Light intensity, Upwelling, Coasts, Measurement, Sea water, Photosynthesis, Chlorophyll a.

AMIC-6148
"EFFECT OF SHELTERS ON THE RESISTANCE OF DOMINANT AND SUBMISSIVE BLUEGILLS (LEPOMIS MACROCHIRUS) TO A LETHAL CONCENTRATION OF ZINC", Sparks, R. E., Waller, W. T., Cairns, J., Jr., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1356-1358.

Due to differences in fish behavior in bioassay, a study was undertaken to determine whether dominant and submissive bluegills (Lepomis macrochirus Rafinesque) would have different times to death when exposed to a lethal concentration of zinc and whether shelters would affect survival times. When pairs of bluegills were kept in bare, 10-gal compartments for 5 days, dominant-submissive relations developed, and the dominant fish survived a subsequent exposure to 32 mg/liter zinc longer than submissive fish. A flowerpot shelter in each compartment reduced the number of aggressive encounters between fish and removed the response difference. These results indicate that dominant-submissive relations may be a source of variability in the results of bioassays that use fish.

INDEX TERMS: Bioassay, Fish behavior, Sunfishes, Zinc, Lethal limit, Lepomis macrochirus, Zinc sulfate, Shelters.

AMIC-6156
"KINETIC STUDIES OF C. PYRENOIDOSA USING 94 PERCENT C-13-CO2", Fowler, E. B., Adams, W. H., Christenson, C. W., Kollman, V. H., Buchholz, J. R., Biotechnology and Bioengineering, Vol. 14, No. 5, September 1972, pp 819-829.

Chlorella pyrenoidosa has been grown in mass quantities on 94 at. percent C-13-CO2 by use of special rocking culture boxes made of lucite and an automatic pH monitoring - CO2 injection system. Three experiments were done. Experiments 1 and 2 involved growth kinetics in 5-liter growth chambers where 8 runs were performed, such that the inoculum for each run (120 hr) contained the C-13 which had been incorporated by the previous run, thereby maintaining the cells more nearly in the log growth phase. Relative mass was plotted versus time. A continuing culture in a 25-l box for 10 runs constituted the third experiment. No inhibition or adjustment periods were observed. The limiting slope of the growth curve for experiments 1 and 2 increased from 0.25 to 0.29 as the cellular content of C-13 increased from natural to 92 percent or more. The limiting slope in 3 increased from 0.13 to 0.16 as C-13 increased from 1.1 percent to 92.7 percent. Amounts of incorporated C-13/run were determined by mass spectrometry. Growth appeared stimulated by the C-13 but this was not attributed to C weight differences. Growth was affected by light intensity as affected by cellular mass, becoming a deleterious factor as density increases. Differences imparted by C-13 bond energies may affect the enzyme systems thereby affecting growth kinetics.

INDEX TERMS: Metabolism, Nutrients, Plant growth, Growth rates, Cultures, Laboratory equipment, Growth chambers, Carbon radioisotopes, Carbon dioxide, Light intensity, Photosynthesis, Light penetration, Enzymes, Aquatic algae, Primary productivity, Chlorella pyrenoidosa, Growth kinetics, C-13, Growth media.

See also: Category 1, AMIC-3876, 3896, 5946, 5951, 5955, 6025, 6037, 6055, 6111
Category 3, AMIC-5924, 6088, 6109, 6154
Category 5, AMIC-6003.

AMIC-2859
"FLOCCULANT PRODUCTION FROM KEROSENE", Biotechnology and Bioengineering, Vol. 14, No. 3, May 1972, pp 379-390.

Growth studies in shake flasks and fermenters were made to obtain maximal extracellular polymer and biomass production from kerosene-utilizing Corynebacterium hydrocarboclastus. Polymer accumulation peaked in the fermenter after 50-60 hr cultivation, amounting to about 5.5-6 g/l broth. Initial kerosene volume (2 percent v/v) yielded polymer and cell values corresponding to 37-40 percent and 67-87 percent w/w of kerosene supplied, respectively. Exponential phase polymer and cell production rates were 0.25 g/l hr and 0.27 g/l hr with maximum production of polymers at 6 g/l.

INDEX TERMS: Nutrients, Metabolism, Growth rates, Polymers, Corynebacterium hydrocarboclastus, Substrate utilization, Flocculants, Kerosene, Hydrocarbon-oxidizing bacteria, Hydrocarbons.

AMIC-5918
"MEASUREMENTS ON THE INTERFACIAL AREAS OF HYDROCARBON IN YEAST FERMENTATIONS AND RELATIONSHIPS TO SPECIFIC GROWTH RATES", Wang, D. I. C., Ochoa, A., Biotechnology and Bioengineering, Vol. 14, No. 3, May 1972, pp 345-360.

Experiments have been performed to assess the absolute values of the interfacial area of hexadecane as the carbon source for the growth of Candida intermedia. A sedimentometer, mounted directly in the fermenter, was used to measure the interfacial hydrocarbon area during active growth of this organism. The specific hydrocarbon interfacial area was found to be directly related to the impeller speed, hydrocarbon concentration and surfactant concentration in a 1-liter working volume, turbine-agitated fermenter. The specific growth rate was in turn found to be directly related to the specific hydrocarbon interfacial area. Cessation of logarithmic growth and onset of linear growth was found at all instances to be governed by the specific hydrocarbon surface area.

INDEX TERMS: Fermentation, Yeasts, Surfaces, Permeability, Oil-water interfaces, Metabolism, Nutrients, Growth rates, Cultures, Fungi, Chemical reactions, Surface area, Hexadecane, Candida intermedia, Growth media, Substrate concentration, Sedimentometer, Hydrocarbons, Interfacial area, Culture media.

AMIC-5919
"EMULSIFICATION AND DEGRADATION OF 'BUNKER C' FUEL OIL BY MICROORGANISMS", Zajic, J. E., Supplisson, B., Biotechnology and Bioengineering, Vol. 14, No. 3, May 1972, pp 331-343.

An enrichment culture procedure has been used to isolate mixed culture systems which grow upon 'Bunker C' fuel oil. When inoculated into a mineral salts aqueous medium containing Bunker C oil, the mixed cultures initiate oil emulsification. Emulsification usually is observed in 24-48 hr. The role of microbes in this emulsification is discussed. It appears that certain metabolic products produced by the microbe possess properties of surfactants. Bacteria and fungi have been isolated which possess the ability to cause emulsification. Freeze-dried biomass is also capable of emulsifying oil. Chromatographic analyses of biodegraded Bunker C fuel oil show that microorganisms selectively metabolize the n-paraffin fraction.

INDEX TERMS: Microbial degradation, Sewage bacteria, Fungi, Metabolism, Separation techniques, Microorganisms, Gas chromatography, Biomass, Freeze drying, Fuel oil, Bunker C oil, Emulsification, Enrichment, Culture media, Substrate utilization, n-Paraffins, Culturing techniques, Chemical composition, Chemical recovery.

AMIC-5920
"BACTERIA WHICH ATTACK PETROLEUM HYDROCARBONS IN A SALINE MEDIUM", Soli, G., Bens, E.M., Biotechnology and Bioengineering, Vol. 14, No. 3, May 1972, pp 319-330.

An investigation was made in order to study in detail organisms which can digest petroleum hydrocarbons in a saline environment and the conditions under which the biological process of oil degradation can be further enhanced and subsequently used on a practical basis. Bacterial strains were isolated from California coastal areas which showed the ability to oxidize normal paraffins, iso-paraffins, and aromatic hydrocarbons in a synthetic seawater medium. The ability to utilize a particular hydrocarbon was established not only on the basis of visible bacterial growth but also through a chromatographic technique which was standardized and which could define the amount of each hydrocarbon consumed by the bacteria in a mixture. Some of the strains exhibited vigorous hydrocarbon oxidation when exposed to synthetic mixtures of hydrocarbons as well as crude oil. Under conditions of aeration and agitation, mixed cultures could destroy approximately 50 percent of a South Louisiana crude oil in a period of 48 hr.

INDEX TERMS: Microbial degradation, Saline water, Pollutant identification, Cultures, Marine bacteria, Aerobic bacteria, Metabolism, Hydrocarbon-oxidizing bacteria, Corynebacterium, Arthrobacter, Achromobacter, Aromatic hydrocarbons, Culturing techniques, Culture media, Chemical recovery, Crude oil, Substrate utilization, Isoparaffins, n-Paraffins, Petroleum residues.

AMIC-5921
"DEGRADATION AND MINERALIZATION OF PETROLEUM BY TWO BACTERIA ISOLATED FROM COASTAL WATERS", Atlas, R. M., Bartha, R., Biotechnology and Bioengineering, Vol. 14, No. 3, May 1972, pp 297-308.

Within the framework of a study on the oil biodegradation potential of the sea the ability of a Flavobacterium sp. and Brevibacterium sp. to metabolize a paraffinic crude oil and a chemically defined hydrocarbon mixture was investigated. Major components of the crude oil were identified by combination gas chromatography and mass spectrometry. The rate and extent of total hydrocarbon biodegradation was measured. In addition, CO2 evolution from the crude oil was continuously monitored in a shaker-mounted gas train arrangement. Degradation started after a 2 to 4 day lag period, and reached its maximum within two weeks. At this time up to 60 percent of the crude oil and 75 percent of the model hydrocarbon mixture, each added at the level of 1 ml per 100 ml artificial sea water, were degraded. Mineralization (conversion to CO2) was slightly lower due to formation of products and bacterial cell material. n-Paraffins were preferentially degraded as compared to branched chain hydrocarbons. Biodegradation of n-paraffins in the range of C12 to C20 was simultaneous; no diauxie effects were observed.

INDEX TERMS: Oil, Microbial degradation, Sea water, Pollutant identification, Gas chromatography, Mass spectrometry, Metabolism, Marine bacteria, Aerobic bacteria, Oily water, Cultures, Mineralization, Coastal water, n-Paraffins, Crude oil, Flavobacterium, Brevibacterium, Aliphatic hydrocarbons, Substrate utilization, Chemical composition, Hydrocarbon-oxidizing bacteria.

AMIC-5924
"MEASUREMENTS OF MICROBIAL ACTIVITY AND ORGANIC MATERIAL IN THE WESTERN MEDITERRANEAN SEA", Banoub, M. W., Williams, P. J. leB., Deep-Sea Research, Vol. 19, No. 6, June 1972, pp 433-443.

Measurements of microbial activity and organic material are reported for four stations in the western Mediterranean Sea. Water samples were collected and analyzed for particulate carbon and nitrogen after combustion by infra-red analysis and colorimetry, respectively; the limit of detection of the method was 1 microgram of nitrogen per liter. The filtrates of the samples were analyzed for dissolved organic carbon, total nitrogen, and total phosphorus by utilizing modified ultraviolet irradiation procedures; the limit of detection approached 0.5 microgram-atomic nitrogen per liter. Measurement of microbial activity was manifested in the turnover of glucose and amino acids, which was determined by following the uptake and respiration of added trace amounts of both uniformly carbon-14-labelled-D-glucose and a L-amino acid mixture. In near surface water the rate of heterotrophic turnover of glucose and amino acids was found to be 30-50 percent per day; the rate of turnover decreased with depth, it was detectable at 300-500 m but not at 1800 m. The organic analyses of the water column indicated a transition zone in the region of 100 m with higher concentrations above than below; the difference was greatest in the particulate fraction. The inorganic nutrients show the reverse distribution to the organic fraction. Typical concentrations for the water in the first 100 m and the deeper water were respectively: 0.05-0.15 and 0.03-0.08 micrograms-at P/l for dissolved organic phosphorus; 3.0-8.0 and 2.0-6.0 micrograms-at N/l for dissolved organic nitrogen plus ammonia; 1.2-5.0 and 0.5-1.0 micrograms N/l for particulate nitrogen; 400-700 and 200-400 micrograms C/l for dissolved organic carbon and 18-50 and 5-10 micrograms C/l for particulate organic carbon.

AMIC-5924 (Continued) 2/2

INDEX TERMS: Microbial degradation, Measurement, Organic compounds, Chemical analysis, Nutrients, Infrared radiation, Ultraviolet radiation, Water analysis, Fate of pollutants, Mediterranean Sea, Particulate organic matter, Dissolved organic matter, Sample preparation, Organic carbon, Organic nitrogen, Substrate utilization.

AMIC-5925
"GROWTH MODELS OF CULTURES WITH TWO LIQUID PHASES. VI. PARAMETER ESTIMATION AND STATISTICAL ANALYSIS", Shah, P. S., Erickson, L. E., Fan, L. T., Biotechnology and Bioengineering, Vol. 14, No. 4, July 1972, pp 533-570.

Parameter estimation studies and statistical analyses have been conducted employing mathematical models developed previously by the investigators and experimental data collected by the last author. A batch fermentation process in which Candida lipolytica were cultured on n-hexadecane dissolved in dewaxed gas oil was employed to obtain the experimental data. The kinetic data from a number of batch experiments conducted at different initial substrate concentrations and different dispersed phase volume fractions were analyzed assuming that the basic model parameters (maximum specific growth rate, saturation constant, substrate phase equilibrium constant, adsorption constant, desorption constant) did not change from experiment to experiment. A modified Gauss-Newton method was used to minimize the conventional sum of squares criterion on computer. The individual confidence intervals were obtained for each individual parameter. The models were compared employing the F-test for equality of variances and an analysis of residuals. For the two best models, the estimated parameter values were compared with available experimental information. The results showed good agreement between the experimental data and the values predicted by the mathematical models. The results presented in this work did suggest that growth on small segregated drops may be more important than continuous phase growth on dissolved substrate.

INDEX TERMS: Mathematical models, Cultures, Computers, Computer programs, Growth rates, Statistical methods, Model studies, Fermentation, Estimating equations, Culturing techniques, Growth kinetics, Substrate utilization, Candida lipolytica.

AMIC-5927
"PRELIMINARY RESEARCH ON THE LIPOLYTIC BACTERIAL PSYCHROPHILES OF SOIL AND WATER", Breuil, C., Gounot, A. M., Canadian Journal of Microbiology, Vol. 18, No. 9, September 1972, pp 1445-1451.

Different soil extract media and other media were assayed for a comparative evaluation of both total and lipolytic populations of bacteria taken from soil and water samples during winter. By incubating at a low temperature, psychrophilic microorganisms were counted and isolated. Gram-negative bacteria, especially Pseudomonas species, were the most numerous. (In French)

INDEX TERMS: Soil bacteria, Aquatic bacteria, Pollutant identification, Pseudomonas, Assay, Glacial soils, Aquatic soils, Water temperature, Soil temperature, Psychrophilic bacteria, Lipolytic bacteria, Culture media, Thermal tolerance.

AMIC-5929
"DIFFERENTIATION BETWEEN PSEUDOMONAS TESTOSTERONI AND P. ACIDOVORANS BY GAS CHROMATOGRAPHY", Brooks, J. B., Weaver, R. E. Tatum, H. W., Billingsley, S. A., Canadian Journal of Microbiology, Vol. 18, No. 9, September 1972, pp 1477-1482.

A study was undertaken to investigate the possibility of distinguishing Pseudomonas testosteroni and P. acidovorans by gas liquid chromatography and to test the homogeneity of strains identified by other methods. All strains of both species were distinguished from each other on the basis of levulose (d-fructose) and mannitol utilization. Several growth media were tested to select a medium on which the organisms would produce the most characteristic metabolic profiles with the least background interference from volatile compounds. Twenty milliliters of spent culture medium from each of the above tests were acidified with H_2SO_4, heated for 1 hr at 80 C, cooled under tap water and extracted with ethyl ether to test for acids and hydroxy acids as butyl esters and trifluoroacetic anhydride (TFA) butyl esters by flame ionization gas chromatography. Acids from cultures were tentatively identified by comparing retention times of unknown compounds on both polar and nonpolar columns with retention times of known standards. Pseudomonas acidovorans was distinguished from P. testosteroni by gas chromatography on the basis of acids detected after 20 hr growth on heart infusion agar plates. The data obtained support the findings of other workers that P. acidovorans and P. testosteroni are two different species and indicate that gas chromatography may be used effectively to distinguish other members of the genus.

INDEX TERMS: Gas chromatography, Pollutant identification, Pseudomonas, Aerobic bacteria, Water pollution sources, Urine, Soil contamination, Soil bacteria, Pseudomonas testosteroni, Pseudomonas acidovorans, Culture media.

AMIC-5938
"ENTERIC BACTERIAL GROWTH RATES IN RIVER WATER", Hendricks, C. W., Applied Microbiology, Vol. 24, No. 2, August 1972, pp 168-174.

Enteric bacteria, including stocked strains of pathogenic species and organisms naturally present in the stream, were capable of growth in a chemostat with autoclaved river water taken 750 m below a sewage outfall. Maximal specific growth rates for all organisms occurred at 30 C, whereas culture generation times ranged between 33.3 and 116 hr. Of the six laboratory strains of enteric species used, Escherichia coli and Enterobacter aerogenes grew at generation times of 34.5 and 33.3 hr, respectively, while the remaining Proteus, Arizona, Salmonella, and Shigella spp. reproduced at a rate two to three times slower than the coliforms. Little or no growth occurred in the water at incubation temperatures of 20 and 5 C, and death was observed for Salmonella senftenberg at 20 and 5 C and for E. aerogenes and Proteus rettgeri at 5 C. When enteric bacteria naturally present in the river water were employed in similar experiments, coliform bacteria demonstrated a generation time of approximately 116 hr, whereas fecal coliforms failed to grow. Growth of the bacteria from the river demonstrated a periodicity of approximately 100 hr, which suggests that much of the growth of these organisms in the chemostat may be on the glass surfaces. This phenomenon, however, was not observed with any of the stocked enteric species. Neither the stock cultures nor the aquatic strains were capable of growth in autoclaved river water taken above the sewage outfall at the three temperatures tested. (Reprinted from Applied Microbiology, Vol. 24, No. 2, August 1972, pp 168-174. Copyright 1972, by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Enteric bacteria, Freshwater, Growth rates, Rivers, Sewage effluents, Pathogenic bacteria, Coliforms, Aerobic bacteria, Cultures, Water temperature.

AMIC-5942
"ERYTHRITOL AS A SELECTIVE SUBSTRATE FOR THE GROWTH OF SERRATIA MARCESCENS", Slotnick, I. J., Dougherty, M., Applied Microbiology, Vol. 24, No. 2, August 1972, pp 292-293.

Serratia marcescens grew on a basal medium containing 0.5 percent erythritol as sole source of carbon for growth and energy. Only an occasional strain of Enterobacter aerogenes among several members of the family Enterobacteriaceae were able to utilize erythritol. (Reprinted from Applied Microbiology, Vol 24, No. 2, August 1972, pp 292-293. Copyright 1972 by the American Society for Microbiology. Reprinted by permission of the copyright owner.)

INDEX TERMS: Growth rates, Enteric bacteria, Pathogenic bacteria, E. coli, Salmonella, Shigella, Pseudomonas, Coliforms, Aerobic bacteria, Aquatic bacteria, Organic compounds, Serratia marcescens, Selective media, Erythritol, Substrate utilization, Culture media, Enterobacter, Klebsiella, Erwinia, Proteus vulgaris, Proteus morgani, Proteus rettgeri, Proteus mirabilis, Salmonella typhimurium, Shigella sonnei, Citrobacter freundii, Edwardsiella tarda, Pseudomonas aeruginosa, Substrates.

AMIC-5970
"AN AUTOMATIC, MULTICHAMBER SOIL-WASHING APPARATUS FOR REMOVING FUNGAL SPORES FROM SOIL", Bissett, J., Widden, P., Canadian Journal of Microbiology, Vol. 18, No. 9, September 1972, pp 1399-1404.

An automatic soil-washing apparatus for washing fungus spores out of a large number of soil samples simultaneously consists essentially of ten tubes vertically mounted in a base which allows water and air to circulate through each tube. The tubes are fitted with sieve assemblies to retain the soil samples and tight fitting caps which allow passage of air. The air agitates the soil as the water washes out the spores. The apparatus is also fitted with a siphon which automatically drains the washing columns when the water reaches a certain level. Tests of the apparatus indicated that superficial spores were removed from most of the soil particles. This allowed organisms growing in soil as vegetative mycelia to be isolated more readily without the serious competition commonly encountered from organisms sporulating heavily in the soil. Virtually no cross-contamination of soil samples occurred in the multichambered apparatus.

INDEX TERMS: Laboratory equipment, Mechanical equipment, Soil analysis, Design, Soils, Soil fungi, Soil contamination, Sample preparation, Spores, Penicillium janthinellum, Removal.

AMIC-5971
"AN INEXPENSIVE VERSATILE INCUBATOR FOR SOIL BIOLOGICAL RESEARCH", Dyck, F. B., Campbell, C. A., Weinberger, J. F., Biederbeck, V. O., Canadian Journal of Microbiology, Vol. 18, No. 9, September 1972, pp 1513-1517.

A household freezer was converted to an inexpensive incubator by incorporating a heating system and a controller unit. The temperature was automatically varied sinusoidally over a 24-hr cycle or maintained at a constant level. Cost, excluding labor, was 400 dollars. The specifications are maximum and minimum temperatures, 38 and minus 21 C; maximum and minimum ranges of the sinusoidal temperature, 22 and 4 C; accuracy, plus or minus 0.5 C.

INDEX TERMS: Incubation, Automatic control, Microorganisms, Laboratory equipment, Cultures, Mechanical equipment, Instrumentation, Temperature, Design, Construction materials, Growth chambers, Incubators.

AMIC-5972
"STOMACHING: A NEW CONCEPT IN BACTERIOLOGICAL SAMPLE PREPARATION", Sharpe, A. N., Jackson, A. K., Applied Microbiology, Vol. 24, No. 2, August 1972, pp 175-178.

An entirely new mixing device, particularly suitable for preparing bacterial suspensions from foods, fabrics, swabs, and other fairly soft materials, has been developed. With this technique the sample and diluent are put into an inexpensive, sterile plastic bag which is vigorously pounded on its outer surfaces by paddles when placed inside the machine. The resulting compression and shearing forces effectively remove even deep-seated bacteria. After samples are taken for analysis the bag and its remaining contents are thrown away. Labor involved in cleaning and sterilizing reusable homogenizer cups or probes is eliminated, and the device is immediately ready for reuse. Running costs are thus drastically reduced, compared with conventional homogenizers. Additional advantages of this device, which is simple and inexpensive to manufacture, are low noise level, negligible temperature rise, and the small storage space required for bags. Coliform counts in samples of beef cuts, chicken, comminuted meats, processed beef, pastry, vegetables, and fish prepared by this method compared favorably with those in samples prepared by conventional techniques.

INDEX TERMS: Coliforms, Foods, Fish, Isolation, Enteric bacteria, Separation techniques, Sample preparation, Biological samples, Homogenization, Stomaching.

AMIC-6047
"THE NECESSITY OF CONTROLLING BACTERIAL POPULATIONS IN POTABLE WATERS: COMMUNITY WATER SUPPLY", Geldreich, E. E., Nash, H. D., Reasoner, D. J., Taylor, R. H., Journal American Water Works Association, Vol. 64, No. 9, September 1972, pp 596-602.

Bacteria carried past the disinfection barriers in preparation of potable water can be monitored by continuous turbidometric measurement and standard plate-count techniques. Once in the distribution system, suppression must be accomplished; the critical level of such suppression occurs when the general bacterial population exceeds 1,000/ml. This population can be controlled to below a 500/ml level by maintenance of a residual chloride level of approximately 0.1-0.3 mg/l.

INDEX TERMS: Water pollution control, Bacteria, Potable water, Chlorination, Turbidity, Monitoring, Water quality control, Public health, Taste, Water purification, Odor, Pollutant identification, Enteric bacteria, Pathogenic bacteria, E. coli, Coliforms, Pseudomonas, Clostridium, Salmonella, Shigella, Mycobacterium, Achromobacter, Proteins, Arthrobacter, Gallionella, Leptothrix, Spirillum, Serratia, Corynebacterium, Bacillus, Flavobacterium, Plate counts.

AMIC-6088
"EFFECT OF HEPTACHLOR AND RELATED COMPOUNDS ON GROWTH OF STAPHYLOCOCCUS AUREUS", Langlois, B. E., Sides, K. G., Bulletin of Environmental Contamination and Toxicology, Vol. 8, No. 3, September 1972, pp 158-164.

Cultures of Staphylococcus aureus in trypticase soy broth were exposed to purified chlordane, 99.8 percent gamma chlordane, 99.5 percent nonachlor, and 72, 73, 74, 99, and 99.8 percent heptachlor to determine the cause of greater growth inhibition with 72 percent heptachlor than with 99.8 percent heptachlor. Subsequent tests were also conducted to determine the effect of initial population, effect of skimmilk broth, and effect of static vs. shaking incubation. All pesticides caused an initial decrease in population and increases in the length of the lag period and the generation time. The initial study suggests that the effect on viability as well as length of lag phase depend on the amount of chlordane and gamma chlordane rather than heptachlor in the pesticides. Both are constituents of technical (72-74 percent) heptachlor. However, generation time in TSB appears to depend on the amount of heptachlor and possibly chlordane present. In the related tests it was found that S. aureus was not affected by heptachlor or chlordane when grown in skimmilk. In addition, larger initial populations resulted in increased viability in TSB with chlordane and heptachlor. When the initial population was less than 100,000/ml, growth was greater in the pesticide samples under static than under shaking incubation. The reverse was found when the initial population was over 1,000,000/ml.

INDEX TERMS: Cultures, Incubation, Pesticide toxicity, Bioassay, Growth rates, Heptachlor, Chlorinated hydrocarbon pesticides, Population, Inhibitors, Staphylococcus aureus, Culture media, Chlordane, Nonachlor, Gamma chlordane, Survival.

AMIC-6090
"WINTER SURVIVAL OF FECAL INDICATOR BACTERIA IN A SUBARCTIC ALASKAN RIVER", Gordon, R.C., Alaska Water Laboratory, College, Alaska, Report No. EPA-R2-72-013, August 1972, 41 pp.

Survival of fecal indicator bacteria in a subarctic Alaskan river was studied during the winter of 1969-70 when there was total ice cover and the water temperature was 0 C. Most of the domestic pollution entered the river from one source. Since no additional pollution entered downstream from this source, an uninterrupted study covering seven days of flow time (210 river miles) was possible. Nine sample stations were established to obtain total coliform, fecal coliform, enterococcus and water chemistry data. Samples were collected four to eight times from each station during the two week period of data collection, and a discharge measurement was made at each station during the same period. Bacteria survival was examined with and without consideration for the effect of dilution. After seven days flow time, total coliforms were reduced to 3.2-6.5 percent of the initial count, fecal coliforms to 2.1-4.2 percent, and the enterococci to 18.1-37.3 percent depending on dilution consideration.

INDEX TERMS: Path of pollutants, Sewage effluents, Bioindicators, Coliforms, Pathogenic bacteria, Water temperature, Dissolved oxygen, Alkalinity, Hydrogen ion concentration, Conductivity, Statiastical methods, Nitrates, Phosphorus, Water pollution effects, Enteric bacteria, Domestic wastes, Biochemical oxygen demand, Alaska, Water pollution sources, Survival, Chena River, Yukon River, Enterococci, Fecal coliforms.

AMIC-6109
"EFFECT OF TWO IODOPHORS ON BACTERIAL AND FUNGAL FISH PATHOGENS", Ross, A. J., Smith, C. A., Journal of the Fisheries Research Board of Canada, Vol. 29, No. 9, September 1972, pp 1359-1361.

In in vitro tests on nine species of bacteria (Aeromonas salmonicida, A. liquefaciens, Vibro anquillarum, Cytophaga psychrophila, Chondrococcus columnaris, redmouth bacterium, fluorescent and nonfluorescent pseudomonads, and Corynebacterium sp) and two species fungi (Phomaherbarum and Saprolegnia parasitica), the majority of strains tested did not survive a 5-min exposure to either Betadine or Wescodyne at a concentration of 25 ppm active ingredient.

INDEX TERMS: Bioassay, Pathogenic bacteria, Fungi, Toxicity, Lethal limit, Betadine, Wescodyne, Iodine compounds, Redmouth bacterium, Aeromonas salmonicida, Aeromonas liquefaciens, Vibrio anquillarium, Cytophaga psychrophila, Chondrococcus columnaris, Corynebacterium, Phoma herbarum, Saprolegnia parasitica.

AMIC-6149
"A TAXONOMIC STUDY OF SOME CORYNEFORM BACTERIA", Bousfield, I. J., Journal of General Microbiology, Vol. 71, No. 3, August 1972, pp 441-455.

Some 110 features (biochemical tests, microscopic and cultural characteristics, and DNA base composition) have been used as a basis for the numerical, computer-assisted analysis of 158 coryneform bacteria in order to determine their suitability of fit in their present taxonomic divisions. The general conclusions of the work include the following: (1) The genus Corynebacterium and the taxonomy of Brevibacterium are not satisfactory. (2) Several organisms previously classified as flavobacteria seem better placed in the coryneform group. (3) Certain non-cellulolytic strains could more properly be placed in the genus Cellulomonas, e.g., Nocardia cellulans. (4) The boundary between Nocardia and (Artrobacter) is ill-defined and several organisms of the Mycobacterium rhodochrous type seem transitional. (5) The taxonomy of the genus Microbacterium is shown as unsatisfactory but a solution has not been provided.

INDEX TERMS: Systematics, Sewage bacteria, Computers, Mathematical studies, Soil contamination, Numerical analysis, Speciation, Marine bacteria, Cultures, Activated sludge, Vegetation, Coryneform bacteria, Nucleic acids, DNA, Guanine, Cytosine, Biochemical tests, Numerical taxonomy, Organic bases.

AMIC-6150
"FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA IN LAND-DRAINAGE WATER", Evans, M. R., Owens, J. D., Journal of General Microbiology, Vol. 71, No. 3, August 1972, pp 477-485.

The rate of discharge and the concentration of faecal bacteria in the water from a subsurface field drain were monitored by standard techniques initially for one winter without application of animal excrement to the pasture, and, subsequently, for two winters when pig excrement was sprayed over the pasture. The concentration of Escherichia coli and enterococci in the water were found to be affected by three main factors: the flow rate of the drain discharge; the number of bacteria in or on the soil and vegetation; and the application to the land of large volumes of semiliquid animal excrement over short periods of time. In the absence of excrement application, the concentration of faecal bacteria in the water was related to the flow rate and to time by an equation of the form: log bacterial concentration equals a plus b log flow rate minus c days, where a, b and c are constants. The concentrations of bacteria in the water declined with time, the 90 percent reduction times being 57 days for E. coli and 96 days for enterococci. The spraying of pig excrement over the pasture resulted in a 30- to 900-fold increase in the concentrations of faecal bacteria in the drain discharge within 2 h of the start of the spraying. The concentrations of faecal bacteria returned to their normal levels over a period of 2 to 3 days.

INDEX TERMS: Drainage water, Farm wastes, Environmental effects, Subsurface drainage, Enteric bacteria, Subsurface waters, Hogs, Flow rates, Equations, Water pollution sources, Percolation, Soil water movement, Seepage, Pollutant identification, Biochemical oxygen demand, E. coli, Filtration, Membranes, Discharge (water), Enterococci, Biochemical tests, Fecal coliforms.

AMIC-6151
"THE NUTRITION OF BACILLUS MEGATERIUM AND BACILLUS CEREUS, White, P. J., Journal of General Microbiology, Vol. 71, No. 3, August 1972, pp 505-514.

A study of the nutritional requirements of Bacillus megaterium and Bacillus cereus involved an assessment of growth by photoelectric colorimetry, nutritional requirements by standard techniques, and total and viable counts by phase-contrast microscopy. Out of nine strains of Bacillus megaterium from culture collections, only five grew in a minimal medium that contained glucose and ammonium sulphate as principal nutrients. One strain required biotin, while three other strains required two or more amino acids for growth. A freshly isolated strain of B. megaterium required three amino acids for growth. Three strains of Bacillus cereus from a culture collection each required two or more amino acids for growth. From two of these strains, substrains independent of amino acids were developed by serial transfers. Ability to grow in a minimal medium is therefore not so valuable as a distinction between B. megaterium and B. cereus as previously had been supposed.

INDEX TERMS: Amino acids, Nutrients, Cultures, Nutrient requirements, Amino acids, Vitamins, Water pollution sources, Aquatic bacteria, Soil bacteria, Growth rates, Viability, Bacillus megaterium, Bacillus cereus, Glucose, Ammonium sulfate, Biotin, Photoelectric colorimetry, Phase contrast microscopy, Substrate utilization.

AMIC-6152
"ASSIMILATION AND TOXICITY OF EXOGENOUS AMINO ACIDS IN THE METHANE-OXIDIZING BACTERIUM METHYLOCOCCUS CAPSULATUS", Vol. 71, No. 3, August 1972, pp 541-554.

Tracer studies are described which deal with the pathways for amino acid synthesis used by Methylococcus capsulatus, and with kinetics and relief of growth inhibition by amino acids. Bacterial growth was followed by optical density measurements using a colorimetric technique. Carbon-14-labelled amino acids are incorporated by exponentially growing cultures, and these amino acids are separated from culture samples by ascending paper chromatography. The radioactive areas (amino acids) on chromatograms were located by autoradiography, purines and pyrimidines detected by u.v. light, nucleic acid bases separated by a filtration technique, and radioactivity of cells on membrane filters were determined by liquid scintillation spectrometry. Of 21 amino acids tested, only L- and D-threonine, L-phenylalanine, L-histidine, L-tyrosine and L-homoserine inhibited exponential growth of Methylococcus capsulatus at 1.0 mM. Inhibition by L-threonine was relieved by L-methionine, L-homoserine, L-alanine and L-valine, but not by L-lysine, 2,6-diaminopimelic acid or L-arginine. C-14-labelled methane, L-aspartate, L-threonine, L-homoserine, L-glutamic acid, L-phenylalanine and L-tryptophan were all assimilated. The results suggested that the branched pathways for threonine, isoleucine, methionine and lysine synthesis from aspartate is functional. An explanation of threonine-inhibition in terms of an interference with end-product regulation of this pathway is proposed.

INDEX TERMS: Toxicity, Amino acids, Methane bacteria, Path of pollutants, Absorption, Pollutant identification, Growth rates, Cultures, Radiochemical analysis, Metabolism, Inhibition, Radioactivity techniques, Methylococcus capsulatus, Organic bases, Biosynthesis, Assimilation, Culturing techniques, Biological magnification.

AMIC-6153
"BACTERIOLOGICAL QUALITY AND OCCURRENCE OF VIBROS IN DUNGENESS CRABMEAT IN OREGON PROCESSING PLANTS AND MARKETS", Allen, E. C., Woodburn, M., Journal of Milk and Food Technology, Vol. 35, No. 9, September 1972, pp 540-543.

Dungeness crabmeat samples from Oregon processors and retail markets were analyzed for Vibrio parahaemolyticus, numbers of fecal streptococci, and aerobic total plate count. Samples were collected from three processors during one commercial season. Five of 31 samples of crabmeat from Oregon retail markets and 4 of 75 crabmeat samples from Oregon processors were positive for halophilic vibrios. Positive samples from processors were raw crabmeat and picked crabmeat. The numbers of fecal streptococci in crabmeat from both processors and retail markets were generally within the guideline of less than 1000 organisms per gram of crabmeat. The median aerobic total plate count of 1.2 million organisms per gram for the crabmeat samples from retail markets was above the limit of 100,000 organisms per gram established by New York City and used elsewhere. The median plate count of to-be-packed crabmeat from processors remained within this limit.

INDEX TERMS: Commercial shellfish, Crabs, Marine animals, Pollutant identification, Foods, Food processing industry, Oregon, Animal parasites, Animal pathology, Enteric bacteria, Cultures, Streptococcus, Marine bacteria, Vibrio parahaemolyticus, Cancer magister, Macroinvertebrates, Halophilic bacteria, Fecal streptocci.

AMIC-6154
"INACTIVATION OF SALMONELLA TYPHIMURIUM BY SORBIC ACID", Park, H. S., Marth, E. H., Journal of Milk and Food Technology, Vol. 35, No. 9, September 1972, pp 532-539.

Nutrient broth, skimmilk, and evaporated milk at pH 5.0, 5.5, or without pH adjustment and with and without 2,000 and 3,000 ppm sorbic acid were evaluated at 7, 13, and 37 C for their effects on Salmonella typhimurium. The combination of 3,000 ppm sorbic acid and acetic acid at pH 5.0 most effectively inactivated S. typhimurium in all media and at all temperatures. Complete inactivation by this treatment required from 12 hr or less in nutrient broth at 37 C to 55 days in evaporated milk at 7 C. In some instances, treatment with 3,000 ppm sorbic acid combined with lactic acid at pH 5.0 was equally effective. Reduction of sorbic acid concentration to 2,000 ppm or raising the pH of the substrate to 5.5 increased the time needed for inactivation of S. typhimurium. Inactivation of S. typhimurium was most rapid in nutrient broth at 37 C and required progressively more time either as the temperature was reduced or as more complex foods were substituted for the broth. Growth of S. typhimurium occurred at 37 and 13 C in plain nutrient broth, in nutrient broth at pH 5.0 or 5.5, and in nutrient broth with 2,000 or 3,000 ppm sorbic acid (pH not adjusted). Growth in skimmilk occurred under similar conditions except when the pH was reduced to 5.0 with acetic acid. In evaporated milk, growth at both temperatures was possible only in untreated samples and in those acidified to pH 5.5. In some instances, a lag period of 25-29 days occurred at 13 C before growth was evident.

INDEX TERMS: Hydrogen ion concentration, Cultures, Temperature, Growth rates, Aqueous solutions, Enteric bacteria, Aerobic bacteria, Inhibition, Salmonella typhimurium, Sorbic acid, Inactivation, Culture media.

AMIC-6155
"RAPID DIAGNOSIS FOR STREPTOCOCCUS AGALACTIAE AND STREPTOCOCCUS UBERIS", Smith, A. R., Johnston, S. M., Journal of Milk and Food Technology, Vol. 35, No. 6, June 1972, pp 383-384.

In comparison with other media the TKT-ferric citrate medium lends itself well for use in a rapid screening method for Streptococcus agalactiae and Streptococcus uberis isolation and identification from milk samples in that: (a) nonprofessional technicians can rapidly identify positive colonies as S. agalactiae or S. uberis on initial isolation; (b) additional confirmatory tests (CAMP, etc.) are usually unnecessary, thereby reducing labor and media costs; and (c) the medium is selective for streptococci and inhibitory to contaminants thereby increasing the number of isolations.

INDEX TERMS: Aerobic bacteria, Cultures, Milk, Sampling, Pollutant identification, Aqueous solutions, Pathogenic bacteria, Isolation, Streptococcus agalactiae, Streptococcus uberis, TKT-ferric citrate medium, Colonies, Blood agar, Hemolysis, Culture media, Selective media.

AMIC-6157
"MODEL FOR THE GROWTH OF AEROBIC MICROORGANISMS UNDER OXYGEN LIMITING CONDITIONS", Ryder, D. N., Sinclair, C. G., Biotechnology and Bioengineering, Vol. 14, No. 5, September 1972, pp 787-798.

A simple dynamic model is proposed which will allow fermenters to be run at throughputs which fully utilize the mass transfer capabilities of the fermeters while not decreasing the yield from the substrate. The model is compared with one previously proposed, which was originally formulated for double substrate limitation when both substrates were supplied in the feed. Computer solutions of the model are given which show the effects of the parameters used. Experimental results from growing Candida utilis on a high concentration of glucose were found to be similar to those predicted by the model.

INDEX TERMS: Growth rates, Model studies, Limiting factors, Oxygen sag, Aerobic conditions, Aerobic bacteria, Fungi, Anaerobic conditions, Deficient elements, Mathematical studies, Computers, Data processing, Substrate concentration, Aerobic microorganisms, Substrate utilization, Candida utilis, Data interpretation, Glucose.

AMIC-6158
"THE EFFECT OF CARBON DIOXIDE AND PARTICLE SURFACE AREA ON THE MICROBIOLOGICAL LEACHING OF A ZINC SULFIDE CONCENTRATE", Torma, A. E., Walden, C. C., Duncan, D. W., Branion, R. M. R., Biotechnology and Bioengineering, Vol. 14, No. 5, September 1972, pp 777-786.

The effects of carbon dioxide-enriched air on the rate of zinc extraction during the microbiological leaching of a high-grade zinc concentrate by Thiobacillus ferrooxidans have been studied. Under normal air-aeration conditions, the leach rate is limited initially by the availability of solid substrate surface area per unit volume of leach liquor, then by availability of carbon dioxide. If carbon dioxide-enriched air is supplied, along with excess substrate, the zinc extraction rate increases as the carbon dioxide content increases until some other, as yet unknown, factor becomes limiting.

INDEX TERMS: Carbon dioxide, Particle size, Leaching, Environmental effects, Free surfaces, Particle shape, Limiting factors, Thiobacillus ferrooxidans, Sulfur bacteria, Oxidation, Zinc sulfide, Substrate utilization, Substrates, Biological activity.

AMIC-6159
"THE 'ROTARY COLUMN' METHOD FOR GROWTH OF LARGE-SCALE QUANTITIES OF CELL MONOLAYERS", Santero, G. G., Biotechnology and Bioengineering, Vol. 14, No. 5, September 1972, pp 753-775.

A method and an apparatus that reduce the heavy expenses involved in traditional methods for the large-scale monolayer production of primary and secondary, strain and line cells and of the biologicals derived therefrom are described. The method is based on the principle of gathering in a single unit a sheaf of columns by means of general manifolds fitted with cocks. The growth of cells on the glass walls is irrespective of the number, length, and diameter of the columns used. The apparatus, placed in a thermo-adjustable room and connected to adequate devices which allow it to rotate on its longitudinal axis and to be in a vertical position, need not be dismounted nor transported since it can be connected by a number of tubes to the necessary services. Sterilization is carried out by flowing steam and fluids are poured in or drained off by vacuum or pressure. A microscope fitted to the bearing structure allows the operator to observe the cell monolayers and the cytopathic effect of viruses on the whole length of the outer columns. During the various working stages pH is under continuous control and automatically adjusted. The whole working cycle is extensively described (cleaning, sterilization, seeding, incubation, trypsinization of the monolayer, culture and harvesting of the virus) and results compared with those obtained by traditional methods.

INDEX TERMS: Viruses, Methodology, Cytological studies, Equipment, Temperature, Hydrogen ion concentration, Cultures, Steam, Incubation, Microscopy, Cell monolayers, Rotary column method, Culturing techniques, Growth studies, Sterilization, Trypsinization, Aujeszky disease virus, A2 Hong Kong influenza virus.

AMIC-6160
"AN EVALUATION OF PROCEDURES FOR ENUMERATING BACTERIA IN ACTIVATED SLUDGE", Pike, E. B., Carrington, E. G., Ashburner, P. A., Journal of Applied Bacteriology, Vol. 35, No. 2, June 1972, pp 309-321.

A procedure for counting viable heterotrophic bacteria in activated sludge was evolved from a study of the effects of modifications to procedures at the different stages of enumeration. Samples were obtained from sewage works and from various experimental plants at the Water Pollution Research Laboratory including (1) an outdoor plant which treats batches of settled sewage, and (2) small experimental units treating settled sewage alone or with up to 5 mg/l amounts of toxic metal ions (Cu, Cr, Zn, Ni) added singly or in combination, or with added detergents, or treating petrochemical wastes. Samples from laboratory plants were analyzed very shortly after collection. Optimal counts were obtained with Casitone-glycerol-yeast extract agar (CGY) with incubation for 6 days at 22 degrees. Homogenization of mixed liquor was conveniently performed, with minimal lethal effect on the bacteria, by treating samples, diluted 1/10 in sodium tripolyphosphate solution (5 mg/l), in a boiling tube immersed in the Kerry ultrasonic cleaning bath for 1 min. Counts were significantly affected by the pH value of diluent and CGY, but not by the homogenization method or by treating homogenized samples with enzymes or N-acetyl cysteine, or by adding colloidal peptizing agents to the diluent. Replicate colony counts showed variances greater than the mean, although precision increased with increasing number of colonies/dish; there was a direct relationship between colony counts and volume plated for up to about 1000 colonies/dish. Counts on spread plates tended to be higher and more precise than on dilution frequency plates, although the 2 methods showed satisfactory correlation. Counts were not significantly affected by the method of sampling and preparing the

AMIC-6160 (Continued) 2/2

initial dilution, and it was considered prudent to examine samples immediately after collection.

INDEX TERMS: Methodology, Activated sludge, Evaluation, Variability, Sewage bacteria, Sewage sludge, Hydrogen ion concentration, Enzymes, Separation techniques, Sampling, Sewage lagoons, Enumeration, Heterotrophic bacteria, Counting, Homoganization, Spread-plate techniques, Culture media.

AMIC-6161
"ELECTRONMICROSCOPIC OBSERVATIONS ON THE DEGRADATION OF CELLULOSE FIBRES BY CELLVIBRIO FULVUS AND SPOROCYTOPHAGA MYXOCOCCOIDES", Berg, B., Hofsten, B. V., Pettersson, G., Journal of Applied Bacteriology, Vol. 35, No. 2, June 1972, pp 215-219.

Cellvibrio fulvus and Sporocytophaga myxococcoides were grown on different types of cellulose fibres and the degradation was followed by means of light and electron microscopy. Some of the specimens were freeze-dried, contrasted with gold and examined by scanning electron microscopy. Other specimens were examined with transmission electron microscopy after being (1) prefixed in buffered 2.5 percent gluteraldehyde, (2) brought to pH to 6.8, (3) further fixed in 2 percent osmium tetraoxide solution suspended in 2 percent agar, dehydrated, embedded in Epon, and (4) sectioned on an ultratome with glass or diamond knives. The very compact fibres prepared from cottom were degraded slowly by C. fulvus. The bacteria penetrated into the lumen of the fibres, accumulated there in large numbers, and degraded the fibres from within. Sporocytophaga myxococcoides attacked fibres both from the outside and from within by making close contact with the cellulose. Lignin free pulp fibres, which have a very open structure, were rapidly degraded by both kinds of bacteria. Cellvibrio fulvus also degraded these fibres from within. It is concluded that structure of the fibre greatly influences the rate at which different kinds of cellulolytic bacteria decompose cellulose.

INDEX TERMS: Cellulose, Fibers (plant), Microbial degradation, Electron microscopy, Cotton, Pollutant identification, Sporocytophaga myxococcoides, Transmission electron microscopy, Cellvibrio fulvus, Flexibacterium, Scanning electron microscopy, Agars, Fate of pollutants, Light microscopy.

AMIC-6162
"GROWTH AND CELLULASE FORMATION BY CELLVIBRIO FULVUS", Berg, B., Hofsten, B. v., Pettersson, G., Journal of Applied Bacteriology, Vol. 35, No. 2, June 1972, pp 201-214.

Growth and cellulase formation by Cellvibrio fulvus were studied by investigating how culture conditions influence the formation of carboxymethylcellulose (CMC) hydrolyzing enzymes and some properties of the enzyme components occurring in culture filtrates of stationary phase cultures. Culture samples were allowed to incubate and the protein content was determined by standard techniques, hydrolysis of CMC by a colorimetric method, a vicel degradation activity by a standard procedure, and protein concentrations in cellulolytic enzymes by ion exchange chromatography. This aerobic cellulolytic bacterium grew on several sugars and polysaccharides, but not on highly substituted cellulose derivatives, organic acids and alcohols. Whereas no growth was obtained on long cotton fibres, it occurred on such fibres cut into small pieces, and on filter paper and chromatography powders derived from cotton. Lignin free wood pulp was rapidly degraded. The organisms grew best a pH 7-8 and utilized nitrate, ammonium and some amino acids as nitrogen sources. The bacteria have cell-bound cellulase but the enzyme was also found in the culture medium. Glucose repressed cellulase formation and the enzyme activity of cultures grown on cellulose was much higher than on sugars. Reducing sugar was not detected in cellulose cultures. The pH optimum for hydrolysis of CMC was 7 and the enzyme was inhibited by mercuric acetate but not by p-chloromercuribenzoate or EDTA. Fractionation of cellulase preparations from cultures grown on partially hydrolyzed filter paper gave many components of different molecular weights. The activities of these components against carboxymethylcellulose and microcrystalline cellulose differed.

INDEX TERMS: Growth, Microbial degradation, ellulose, Cotton, Lignins, Cellvibrio fulvus, Cellulase, Cellulolytic bacteria, Ion exchange chromatography.

AMIC-6163
"EFFECT OF GLUTARALDEHYDE ON THE OUTER LAYER OF ESCHERICHIA COLI", Munton, T. J., Russell, A. D., Journal of Applied Bacteriology, Vol. 35, No. 2, June 1972, pp 193-199.

The effects of glutaraldehyde on the outer layers and especially the protein components of Escherichia coli were studied by the following methods: (1) determining amount of sodium lauryl sulphate (SLS) in the cell walls by spectrophotometry, (2) determining electrophoretic mobilities of suspended spores or vegetative cells with a microelectrophoresis apparatus, and (3) extracting purified protein and polysaccharide components from E. coli using homogenized phenol and water at 68 C. At pH 3 and 8 sodium lauryl sulphate lysed cell walls of Escherichia coli. Pretreatment with glutarldehyde at pH 3 and at pH 8 prevented this lysis. SLS induced maximum lysis of E. coli cells at 40 degrees; pretreatment of cells with glutaraldehyde also prevented this lysis. Electrophoretic studies indicated that glutaraldehyde accumulated on the surface of E. coli cells more rapidly in acid than in alkaline conditions, and that it blocked amino groups on the surface layer of Bacillus subtilis spores. The relationship of these findings to the bactericidal efficiency of glutaraldehyde in acid and alkaline solution is discussed.

INDEX TERMS: E. coli, Proteins, Aqueous solutions, Cytological studies, Separation techniques, Electrophoresis, Adsorption, Protective coatings, Inhibitors, Surfactants, Cultures, Glutaraldehyde, Polysaccharides, Sodium lauryl sulfate, Bacillus subtilis.

See also: Category 1, AMIC-5933.

AMIC-6049
"RATIO MATCHING - A STATISTICAL AID FOR DISCOVERING GENERIC RELATIONSHIPS AMONG SAMPLES", Anders, O. U., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 1930-1933.

A statistical technique of matching the ratios of elemental concentrations of a sample with the equivalent ratios of other samples can provide correlations which indicate potential generic relationships among samples. The technique is applied by calculating 'concentration ratios' which are obtained by dividing the concentration of each element by that of each element. These data are used to construct a 'concentration ratio matrix'. The ratios for two samples can be compared by forming a 'ratio matrix of the two samples'. This triangular matrix is obtained by dividing each of the elements of the 'concentration ratio matrix' for one sample by those of another. This ratio can be reduced to an element of a 'correlation matrix', whose elements are defined as the proportion of elements in the ratio matrix which meet a 'matching criterion'. The statistical significance of a correlation between two samples is then evaluated by carrying out correlation between random samples of the same type. The technique was evaluated by applying it to data obtained from neutron activation analysis of As, Sb, Cu, Zn, Au, Cd, Hg and Cr in 91 sediment samples from Michigan and California waterways. One potential application of the method is fingerprinting of wastes from certain industries.

INDEX TERMS: Sediments, Heavy metals, Industrial wastes, Correlation analysis, Copper, Zinc, Gold, Cadmium, Mercury, Chromium, Data interpretation, Fingerprinting, Arsenic, Antimony, Ratio matching.

AMIC-6060
"PRODUCTION AND ANALYSIS OF SPECIAL HIGH-PURITY ACIDS PURIFIED BY SUB-BOILING DISTILLATION", Kuehner, E. C., Alvarez, R., Paulsen, P. J., Murphy, T. J., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2050-2056.

Sub-boiling distillation from pure quartz or Teflon (Du Pont) stills has been investigated for the production of high-purity inorganic acids and water. Nitric, hydrochloric, hydrofluoric, perchloric, and sulfuric acids produced by this method contained significantly lower cationic impurities than high-purity acids from commercial sources. A complete system, including the Class 100 environment, production, and storage of these high-purity reagents is described. A method based on spark source mass spectrographic isotope dilution analysis has been developed for the simultaneous determination of 17 elements in these materials. Results of the analyses of both the acids purified by sub-boiling distillation and the ACS reagent grade acids used as starting materials are reported. The sum of the common impurity elements determined in the purified acids ranged from 2.3 ppb in nitric acid to 27 ppb in sulfuric acid. No element in any of the purified acids exceeded 10 ppb and most were well below the 1-ppb level. (Reprinted from Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2050-2056. Copyright 1972 by the American Chemical Society. Reprinted by permission of the copyright owner.)

INDEX TERMS: Acids, Distillation, Trace elements, Heavy metals, Storage, Lead, Zinc, Strontium, Copper, Nickel, Iron, Chromium, Calcium, Potassium, Magnesium, Sodium, Ultrapure water, Spark source mass spectrometry, Impurities, Tellurium, Barium, Thallium, Tin, Silver.

AMIC-6063
"GELATIN AS A MATRIX FOR A MERCURY REFERENCE MATERIAL", Anderson, D. H., Murphy, J. J., White, W. W., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2099-2100.

Gelatin produced by hydrolysis of collagen from animal bones and hides has been found to be useful as a mercury reference material in the determination of mercury in plant and animal tissues. Gelatin is particularly useful for this application since it contains trace quantities of elements likely to be encountered in the biological samples being analyzed. Reference material is prepared by drying to determine the moisture content of the gelatin, reconstituting by adding water and mercury standard solution, drying, and pulverizing. Reference samples were analyzed by seven laboratories in a preliminary study and later by 18 laboratories using atomic absorption and neutron activation techniques. The results were in good agreement with the expected values, indicating that the reference material was homogeneous. It was found that 1 ppb of mercury in gelatin could be determined by neutron activation analysis without preconcentration. By combusting the sample and collecting the mercury on a thin film of gold, it was possible to detect 1 ng of mercury by atomic absorption. An alternative preparation for AA involved digesting the gelatin in hot nitric acid. Investigation of the stability of the samples showed that they remained relatively unchanged after one year when stored in air tight bottles in a desiccator. Gelatin also appears promising as a carrier for other elements.

INDEX TERMS: Mercury, Stability, Neutron activation analysis, Reference samples, Collaborative studies, Atomic absorption spectrophotometry, Biological samples, Sample preparation, Sample preservation, Detection limits.

AMIC-6129
"COLLABORATIVE STUDY OF AN AUTOMATED METHOD FOR PHOSPHORUS IN FERTILIZERS", Johnson, F. J., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 979-983.

A collaborative study was made of an automated method for total and direct available phosphorus (P_2O_5) in comparison with the official gravimetric quimociac method. Eight laboratories participated in the analysis of the 13 sample solutions, and the results were evaluated by the technique of closely matched pairs. The t-test showed no difference in the means of the results of the 2 methods. The estimates of the random, systematic, and total errors of the automated method all differed significantly from those of the official method when evaluated by the F-test.

INDEX TERMS: Quality control, Analytical techniques, Statistical methods, Automation, Collaborative studies, Method validation, Errors, F-test, T-test.

AMIC-6130
"COLLABORATIVE STUDY OF THE OFFICIAL AOAC FLAME PHOTOMETRIC METHOD FOR THE DETERMINATION OF SODIUM IN FERTILIZERS", Corominas, L. F., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 986-988.

Two official final action methods for flame photometric analysis of sodium in fertilizers were used by 9 collaborators to analyze prepared samples. A total of 600 results were then evaluated using Youden's method. The evaluation showed one method to be more precise than the other based upon the standard deviation of systematic errors. It was also found that results were comparable when different types of flame photometers were used.

INDEX TERMS: Quality control, Analytical techniques, Statistical methods, Instrumentation, Collaborative studies, Precision, Errors.

AMIC-6132
"COLLABORATIVE STUDY OF ANALYTICAL METHODS FOR FLUORIDE IN VEGETATION: EFFECTS OF INDIVIDUAL TECHNIQUES ON RESULTS", Jacobson, J. S., McCune, D. C., Journal of the Association of Official Analytical Chemists, Vol. 55, No. 5, September 1972, pp 991-1003.

A collaborative test of analytical methods and techniques for fluoride in samples of vegetation was carried out by 64 participants and effects on the magnitude and variability of analytical results were assessed. When data were grouped according to the techniques employed by the collaborators, statistical analyses indicated that many variations in techniques were affecting the analytical results. Both the data and the information supplied by participants support the following conclusions: (1) An explicit set of instructions, specifically designed for samples of vegetation, should be published to reduce the number of variations in analytical procedures used by different laboratories. (2) The semiautomated method, specifically developed for vegetation samples, is a preferred technique because it is simpler and faster than older methods and gives results comparable to those obtained by the Willard-Winter method. (3) The AOAC official final action method for fluoride may be used for the analysis of vegetation if modifications are made. Results of this collaborative study also suggest that additional studies should be performed to discover why alkaline fixative agents used for ashing affect angt;;al results and whether simpler and more precise analyses will be obtained by replacing titrimetric or spectrophotometric techniques with the use of the selective ion electrode.

AMIC-6132 (Continued) 2/2

INDEX TERMS: Fluorides, Quality control, Statistical methods, Plant tissues, Chemical analysis, Spectrophotometry, Volumetric analysis, Alfalfa, Grasses, Leaves, Collaborative studies, Sample preparation, Ion selective electrodes, Pine needles.

AMIC-6169
"CHARTS FOR CONFIDENCE LIMITS AND FOR FAILURE RATES", Nelson, W., Journal of Quality Technology, Vol. 4, No. 4, October 1972, pp 190-195.

Simple charts for determining upper confidence limits for a product failure rate are given and their use is illustrated. They are also used to determine statistical demonstration tests. These charts are applicable when the number of failures has a Poisson or binomial distribution or when the distribution of time to failure for a product is exponential. (Reprinted from Journal of Quality Technology, Vol. 4, No. 4, October 1972, pp 190-195. Copyright 1972 by the American Society for Quality Control. Reprinted by permission of the copyright owner.)

INDEX TERMS: Quality control, Statistical methods, Confidence limits, Data interpretation, Failure rates.

AMIC-6170
"ON APPROXIMATIONS TO THE t-DISTRIBUTION", Dudewicz, E. J., Dalal, S. R., Journal of Quality Technology, Vol. 4, No. 4, October 1972, pp 196-198.

The distribution function of the Student's t-distribution is often needed in applied statistics, e.g., in computing the significance probability (p-value) of the usual test when comparing two means, and in computing tables needed for statistical procedures which do not assume known variances. It has been customary to either use a table-lookup or to calculate values via an infinite series or via an approximation which performs poorly for a small number of degrees of freedom. The authors note an algorithm for evaluation of this distribution function which can be implemented in a fast, accurate and short computer program. (Reprinted from Journal of Quality Technology, Vol. 4, No. 4, October 1972, pp 196-198.)

INDEX TERMS: Computer programs, Quality control, Statistical methods, Probability, Student's t-distribution, Significance.

AMIC-6171
"A COMPUTER PROGRAM FOR THE SOLUTION OF DOUBLE SAMPLING PLANS", Chow, B., Dickinson, P. C., Hughes, H., Journal of Quality Technology, Vol. 4, No. 4, October 1972, pp 205-209.

A computer program is described which provides solutions to double sampling plans when given an acceptable quality level and a lot tolerance percent defective. Output from the program includes: (1) sample sizes, (2) acceptance and rejection numbers, and (3) average outgoing quality limit. The user may also request values for: (1) proportion defective, (2) probability of acceptance, (3) average total inspection, (4) average outgoing quality, and (5) average sample numbers. The data may be obtained for four sampling plans which minimize either the consumer's or the producer's risk.

INDEX TERMS: Computer programs, Quality control, Sampling, Statistical methods, Double sample procedures, Acceptance testing.

AMIC-5908
"MOVING MAGNET METERS FOR CONTROL INSTRUMENTATION", MacKenzie, E. K., Measurement and Data, Vol. 6, No. 4, July/August 1972, pp 74-75.

A new, weatherproof process meter, with a moving magnetic mechanism has been introduced as having or exceeding the capabilities of the Bourdon tube gage in accuracy, readability, and ruggedness. The meter also meets the requirements of electrical codes, and affords the case of calibration and field adjustment while being competitive in cost and installation.

INDEX TERMS: Automatic control, Instrumentation, Automation, Flow measurement, Electrical equipment, Moving magnet meter, Process meters, Precision.

AMIC-5910
"ION SELECTIVE ELECTRODES. PART I. A STUDY OF THE FACTORS INVOLVED IN THE CONSTRUCTION OF A HETEROGENEOUS ION SELECTIVE ELECTRODE", Davies, A. B., Atomic Weapons Research Establishment, Aldermaston, England, Report No. AWRE-0-46-71, October 1971, 16 pp.

A method is described for the preparation of heterogeneous chloride ion selective electrodes, and the effects of specific parameters on EMF are evaluated. A variety of silver chloride electrodes were prepared to determine which parameters govern the response of these electrodes. The parameters considered were the particle size of silver chloride, loading (defined as the percentage of active material present in the matrix dry volume), the preparation of material, and the effect of nitric acid washing of the resulting membranes. Measurements were made of the EMF's of cells incorporating the electrodes, the response to a decade change in chloride concentration, and the resistances of the electrodes. The 60 - 600 microns silver chloride particle sizes were produced by grinding under dichloroethane, oven drying, and finally dry sieving. Each of the sieved fractions was mixed with the appropriate amount of a finely powdered thermoplastic powder to give loadings of 20, 40, 60, and 80 percent by volume of silver chloride. In this way the construction of the electrodes including molding of the membranes was accomplished. A 10-minute, 0.1 molar nitric acid wash was made after initial measurements, and the measurements were then repeated. The measurements include: EMF, response to decade change in chloride concentration ('A' values), effect of nitric acid washing, and electrode impedances. The 'A' values were found to be unaffected by any of the parameters evaluated, and the electrode impedances were deemed satisfactorily low at the higher loading levels.

AMIC-5910 (Continued) 2/2

INDEX TERMS: Construction, Ions, Membranes, Temperature, Equations, Electrical impedance, Hydrogen ion concentration, Particle size, Resistance, Drying, Sieves, Measurement, Pollutant identification, Anodes, Cathodes, Selectivity, Design, Maintenance, Ion selective electrodes, Silver chloride, EMF, Loading (chemical).

AMIC-5950
"THE ELECTROCHEMICAL CHARACTERISTICS OF NATURAL REDOX CELLS", Whitfield, M., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 383-393.

A description is given of experiments designed to determine equilibrium exchange current densities in a variety of natural redox cells. Such experiments also permit quantitative assessment of the possibility of using such cells as energy producers. The cells studied represent the systems, air-saturated water-anoxic water and air-saturated water-reduced sediments. The cells of the former system were designed to contain fairly high concentrations of degraded organic material, and those of the latter for field situations (reduced mud and mud at roots of Zostera bed). The inert electrodes used were platinum mesh or sheet and gold sheet. The equilibrium exchange current densities (i) were calculated and compared with the current drains imposed by modern electrometers. The results indicate that instrumental loading should be negligible, but the small values of i observed may result in the slow attainment of a steady-state potential. This effect may not be so serious in reduced sediments where the Eh is closely correlated with sulfide activity. In other cases some of the irregularities in electrode behavior may be removed by discharging the cell in situ and measuring its recharge characteristics.

INDEX TERMS: Electrochemistry, Oxidation-reduction potential, Reduction (chemical), Electrical properties, Freshwater, Sea water, Organic matter, Mud, Sediments, Oxidation, Chemical reactions, Measurement, Silts, Aquatic soils, Oxygen sag, Aerobic conditions, Anaerobic conditions, Redox cell, Reproducibility, Inert electrodes, Substrates.

AMIC-5966
"MODIFICATIONS OF SHIELDED NET RADIOMETERS TO MEASURE SOLAR RADIATION PROFILES IN WATER", Idso, S. B., Limnology and Oceanography, Vol. 17, No. 2, May 1972, pp 462-466.

Five specific and successful modifications of polyethylene-shielded net radiometers to measure solar radiation underwater were developed and tested for use in determining both downwelling and upwelling radiation. A field trial of the instruments indicated that they yielded a logarithmic extinction relation in very turbid water with the upwelling radiation being equal to about 2.2 percent of the downwelling radiation at any level. Since the modifications are simple to make, their use should greatly enhance the possibilities of studying underwater light to a good degree of precision with fair economy. The spectral characteristics of the net radiometers may also favor their use over some more conventional light meters in many biological and physical applications.

INDEX TERMS: Solar radiation, Light intensity, Underwater, Light penetration, Upwelling, On-site data collections, Aquatic environment, Calibrations, Measurement, Turbidity, Equipment, Instrumentation, Shielded net radiometers, Sensitivity.

AMIC-5961
"PORTABLE SPECTRORADIOMETER FOR UNDERWATER ENVIRONMENTS", Burr, A. H., Duncan, M. J., Limnology and Oceanography, Vol. 17, No. 3, May 1972, pp 466-475.

A battery-powered spectroradiometer is described which can be operated either manually or automatically in remote field applications. The submersible 6-kg probe is connected by cable to the control box on the surface with power supplied by 2 small 12-V storage batteries and a 6-V dry cell. The PIN photodiode measures, successively, the radiation transmitted by 16 interference filters and a 1 percent neutral density filter mounted in a rotating wheel. The probe can be easily maneuvered into restricted environments. The incident spectrum is determined by measuring successively through 16 interference filters transmitting in narrow wavebands from 401-698 nm. Minimum detectable spectral irradiance is 0.002-0.015 microW/sq cm/nm and is lowest at longer wavelengths. The instrument can measure with an accuracy of plus or minus 5 percent or less to depths where spectral irradiance is 0.03-1.2 percent of surface. Construction and operation details are included.

INDEX TERMS: Underwater, On-site data collections, Light intensity, Light penetration, Aquatic environment, Design, Construction, Automation, Radiation, Equipment, Instrumentation, Euphotic zone, Reliability, Spectroradiometer, Precision, Detection limits, Sensitivity, Performance evaluation.

AMIC-6003
"REMOTE MEASUREMENT OF POLLUTION", National Aeronautics and Space Administration, Langley Research Center, Report No. NASA SP-285, 1971, 253 pp. NTIS Report No. N72-18324.

This report, which was prepared by a Working Group on Remote Measurement of Pollution, resulted from a review of information about pollutants, e.g. their physics, chemistry, biological effects, and distribution, and contains a consensus of remote sensing possibilities for identifying and monitoring pollutants. The review covered gaseous air pollution, water pollution, particulate air pollution, and instrumentation. Methods available for remote monitoring of water pollution fall into three broad categories: in-situ sensors coupled to telemetry; direct detection by sensors aboard a satellite, and inferential methods based on observation of material not in itself classed as a pollutant. These techniques are discussed along with the potential of using these techniques for detecting oil, suspended sediment, chemical and toxic wastes, solid wastes, thermal effluents, radioactive wastes, nutrient wastes, and living organisms. The instrumentation presently available is also discussed. Recommendations are made regarding future directions of remote sensing.

INDEX TERMS: Remote sensing, Water pollution, Thermal pollution, Industrial wastes, Oil, Instrumentation, Domestic wastes, Radioactive wastes, Suspended solids, Bioluminescence, Aerial photography, Bacteria, Red tide, Phytoplankton, Acid mine water, Water temperature, Fraunhofer line discriminator, Multichannel scanning radiometers, Pulsed laser systems, Scanning spectrometers, Chlorophyll correlation radiometer, Polarimeters, Scintillation counters.

AMIC-6017
"THERMAL STUDY OF THE MISSOURI RIVER IN NORTH DAKOTA USING INFRARED IMAGERY", Crosby, O. A., U. S. Department of the Interior, Geological Survey, Water Resources Division, Bismarck, North Dakota, Report No. NASA-CR-125639, 1971, 51 pp. NTIS Report No. N72-18346.

Studies of infrared imagery obtained from aircraft at 305- to 1,524-meter altitudes indicate the feasibility of monitoring thermal changes attributable to the operation of thermal-electric plants and storage reservoirs, as well as natural phenomena such as tributary inflow and ground-water seeps, in large rivers. No identifiable sources of ground-water inflow below the surface of the Missouri River (North Dakota) could be found in the imagery. The thermal patterns from the generating plants and the major tributary inflow are readily apparent in imagery obtained from an altitude of 305 meters. Though the patterns are generally discernible in the imagery from 1,067-meter and 1,524-meter altitudes, there is not sufficient ground resolution to make any but the most general qualitative analyses. The quality of the imagery varied with land-water temperature relations as well as with instrument properties. Portions of the tape-recorded imagery were processed in a color-coded quantization to enhance the displays and to attach quantitative significance to the data. Apparent radiant temperature computations from the 305-meter imagery were generally within 1 C of ground-truth data. The study indicates a marked decrease in water temperature in the Missouri River prior to early fall and a moderate increase in temperature in late fall because of the Lake Sakakawea impoundment. At the present time, thermal additions generated by the powerplants have little affect on the temperature regimen of the Missouri River at high rates of river discharge.

AMIC-6017 (Continued) 2/2

INDEX TERMS: Thermal pollution, Remote sensing, Water temperature, Missouri River, Thermal powerplants, Electronic equipment, Ground truth.

AMIC-6053 (Continued) 2/2

INDEX TERMS: Adsorption, Mercury, Electrodes, Optical properties, Ions, Lead, Cadmium, Zinc, Pollutants, Pollutant identification, Electrochemistry, Analytical chemistry, Deposition (metals), Stripping (metals), Spectroelectrochemical characteristics, Platinum, Spectroelectrochemistry, Molar absorptivity, Thallium.

AMIC-6053
"SPECTROELECTROCHEMICAL STUDIES OF METAL DEPOSITION AND STRIPPING AND OF SPECIFIC ADSORPTION ON MERCURY-PLATINUM OPTICALLY TRANSPARENT ELECTRODES", Heineman, W. R., Kuwana, T., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 1972-1978.

Optical and electrochemical characteristics of the mercury-platinum optically transparent electrode (Hg-Pt OTE), as applied to the deposition of a metal into the thin mercury film, are evaluated. Substantial mercury character can be achieved with film thicknesses of as little as 10 mC mercury/sq cm (ca. 150 A), as evidenced by the stripping behavior for lead. The use of the Hg-Pt OTE for the evaluation of molar absorptivities of metals dissolved in mercury and the detection of ionic surface excess at the electrode-solution interface is described. Light passing through the Hg-Pt OTE during the diffusion controlled reduction of metal ions is attenuated by the accumulation of electrodeposited metal in the thin mercury film. The rate of this attenuation is related to the molar absorptivity of the metal in mercury. Molar absorptivities for Pb, Cd, Tl, and Zn which were determined in this manner are compared with reported values for the bulk metal. The existence of a surface excess of a metal ion can be detected by a perturbation on the transmission absorbance-time curve. This is quantitatively demonstrated for lead tetrabromide. A step change in the applied potential was also found to produce an optical perturbation which is attributed to the attendant change in the surface concentration of non-electroactive ionic species such as nitrate and bromide. Signal averaging was necessary to resolve the small optical responses involved. Use of the Hg-Pt OTE for stripping analysis is considered.

AMIC-6066
"CHEMICAL ENRICHMENT AND EXCLUSION WITH ION EXCHANGE MEMBRANES", Blaedel, W. J., Kissel, T. R., Analytical Chemistry, Vol. 44, No. 12, October 1972, pp 2109-2111.

Chemical gating, exclusion, and enrichment of ionic species by ion exchange membranes are illustrated by noting the response of a membrane-wrapped, ion-selective electrode when it is dipped into various solutions. A sulfonated fluorocarbon cation exchanger and an inert polyvinyl alcohol (PVA) membrane having no exchange sites were wrapped around four types of electrodes: flat glass, combination glass, monovalent cation, and saturated calomel reference electrodes. After a PVA spacer film was added to the electrode to act as a combination spacer and reservoir for inside solution, a calibrated and rinsed wrapped electrode pair was immersed in 100 ml of a solution containing an ion to which the electrode was directly (heavy water or ammonium ions) or indirectly (hydroxide ions) sensitive in order to illustrate enrichment or the speed of ion penetration. Electrode response was recorded as a function of time after immersion, and was taken as an indication of how fast the concentration of the sensed ion built up in the inside solution. Some systems were chosen to illustrate the slowness of co-ion penetration, while others were chosen to illustrate the rapid penetration of counter ions or their enrichment in the inside solution. In general, all of the experiments demonstrate that ion exchange membranes show high permeability to counter ions and virtually no permeability to co-ions in dilute solutions. Permselectivity of the ion-exchange membranes resulted in short-time enrichment effects of counter ions ranging from 5 to 100 for the systems studied, which may be of analytic analytical use in sampling and in increasing the sensitivity of ion-selective electrodes.

AMIC-6066 (Continued) 2/2

INDEX TERMS: Ion exchange, Permselective membranes, Hydrogen ion concentration, Temperature, Thin films, Aqueous solutions, Anodes, Cathodes, Reservoirs, Heavy water, Pollutant identification, Glass electrodes, Monovalent cation electrodes, Saturated calomel reference electrodes, Co-ions, Sensitivity.

AMIC-6114
"UTILITIES COOPERATE FOR AUTOMATIC METER READING", Walden, R. M., Jr., Water and Sewage Works, Vol. 119, August 31, 1972, pp 20-26.

Westinghouse is developing an automatic meter reading system which is the prototype of an integrated, modular system employing integrated circuit designs and data processing via a mini-computer. The system, now being tested in Raleigh, N. C., is modular by design with various components being fitted together for a tailored system with a minimum of 'non-standard' apparatus. An integrated circuit encoder, which replaces the electro-mechanical encoder, solves a previous reliability problem with a non-volatile memory which enables the encoder to 'remember' the meter reading if power to the circuit fails. The encoder has readout and control circuits and parity coding so that transmission errors may be determined by the mini-computer decoder. The edge card connected, 3-encoder circuit board is designed for residential applications to read water, gas, and electric meters over the same system.

INDEX TERMS: Minicomputers, Data collections, Automatic control, Instrumentation, Automation, Electronic equipment, Research and development, Design, Prototypes, Data storage and retrieval, Electric switches, Switchgear, Data processing, Telemetry, Analytical techniques.

AMIC-6116
"ELECTRODES FOR MAGNETIC FLOWMETERS", Grey, S., Water and Sewage Work, Vol. 119, August 1972, pp 93-98.

The two types of electrodes produced for electro-magnetic flowmeters are 'standard', the model most commonly used, and 'bullet nose', which are designed with self-cleaning capabilities. Selection of material for construction of the electrodes is based primarily on their resistance to corrosion and abrasion, depending upon the application. A standard type should be set flush with the liner of a flow tube, and a bullet nose type should project approximately one-fourth inch into the liner's inside diameter. These two types of electrodes are removable and easily inspected, cleaned, and replaced. The following methods of cleaning electrodes are offered by different manufactures: internal scraper, heating, ultrasonics, and hot water flushing methods. Precautions should be taken to keep a magnetic flow system from malfunctioning due to action of the raw sludge flow. The principles and purpose of the electrodes are discussed.

INDEX TERMS: Electrodes, Flow measurement, Electrical equipment, Velocity, Sludge, Cleaning, Pollutant identification, Construction, Maintenance, Flow, Flowmeters, Magnetic flowmeters.