

H. Martin (United Kingdom Atomic Energy Authority) in a study of persons under irradiation therapy, found no correlation between dose and β -aminoisotretic excretion.

Most of the papers on radiation physics were presented by participants from Oak Ridge National Laboratory. R. H. Ritchie and M. Harkrider have computed cross sections and have made a numerical solution of the cascade spectra from low energy secondary electrons, and Emerson *et al.* have investigated the collective effects in the absorption of radiation in several metals. In addition to the broad continuum exhibited by most metals, silver emitted a sharp peak at 3300 Å (3.7 eV). Both the broad continuum and the observed peak are explained by Ritchie's theory of transition radiation and optical bremsstrahlung, in which transition radiation is regarded as coherent radiation by accelerated electrons belonging to an irradiated dielectric medium.

Several solid state dosimeters, useful in the milliroentgen region where the health physicists' interest is usually centered, were reported on in the dosimetry session. Metaphosphate glass devices activated by silver were the subject of papers by I. Miyanaga *et al.* (Japan Atomic Energy Research Institute), by D. K. Durkee *et al.* (Edgerton, Germeshausen, and Grier, Inc.), and by S. V. Kaye (Oak Ridge). Energy dependence has been reduced by shielding, accuracy improved to ± 5 percent, and a lower limit of 30 mr suggested. A thermoluminescent dosimeter employing calcium fluoride has been developed by E. F. Blase *et al.* (EG&G) and one employing lithium fluoride by R. C. McCall *et al.* (Controls for Radiation, Inc.). Since these devices employ low atomic number materials, they are inherently more energy-independent than glass. A range of 5 mrad to 10^4 rad was reported for lithium fluoride.

Improvements in the sensitivity and the interpretation of film suggest that the film badge will remain a widely used personnel dosimeter for some years to come. An interpretation of $4 \text{ mr} \pm 1 \text{ mr}$ (radium gamma) is possible using a multiple light-pass reading technique developed by A. Brodsky (University of Pittsburgh). Further increases in sensitivity are feasible if the variations in emulsion thickness and composition could be reduced to 0.5 percent.

Since the medical uses of radiation

constitute the largest man-made general population exposure, health physicists have been active in determining the dose from x-ray procedures and in devising techniques to provide minimum dosage to the patient. Gastrointestinal doses from x-ray fluoroscopy have been measured by R. A. Finston *et al.* (Sloan-Kettering), and bone marrow and gonadal doses from diagnostic x-ray procedures by E. R. Epp *et al.* (Sloan-Kettering). The former reported an average dose of 3.7 r (range 2.1 to 6.7 r) to the stomachs of six patients who were examined by a radiologist.

In the absence of a detailed knowledge of the complex radiation associated with the μ -meson flux from the Brookhaven 33-GeV accelerator, F. P. Cowan *et al.* suggested that estimates of the approximate quality factor (formerly relative biological effectiveness) are necessary for personnel dosimetry. Analysis of the linear energy transfer associated with the radiation indicates that the overall quality factor is comparatively low.

Most of the papers in the fallout session dealt with I^{131} . It appears that their content will be repeated at the forthcoming Hanford Symposium on the biology of radioiodine.

One of the most interesting papers from the more specialized sessions was a preliminary report by F. X. Roser *et al.* (Catholic University, Rio de Janeiro) in collaboration with M. Eisenbud *et al.* (New York University Medical Center). Two areas in Brazil, one of monazite sands containing elements of the thorium chain and another of alkali intrusives containing uranium and thorium are under epidemiological study. Normal levels from 0.2 to more than 1 mr/hr are encountered and the diets of these regions contain 10 to 20 times the normal levels of Ra^{228} and Ra^{226} .

Whole body counters and electronic computers are among the working tools of today's health physicist. The mean Cs^{137} body burdens of adult Japanese, measured in a whole body counter by S. Suguri *et al.* (Japan) during the summer of 1962, was 4.2 nanocuries; while that of Alaskan Eskimos from a village inside the Arctic Circle, measured by H. E. Palmer *et al.* (Hanford) was 429 nanocuries. The latter is presumably the result of a caribou and reindeer meat diet. A complete system for electronically processing and analyzing metabolic data, using an I.B.M. 7090, was outlined by C. R.

Richmond (Los Alamos). J. R. Watts (Savannah River) described the use of an I.B.M. 1620 for routine functions, such as sample activity calculated from raw counter data, bioassay excretion curves, and Fermi-Kurie analyses of beta spectrum.

A maximum permissible concentration for the ingestion of Rn^{222} and a revised value for Sr^{90} were presented by S. R. Bernard (Oak Ridge) and W. S. Snyder *et al.* (Oak Ridge). Based on data from the literature, Bernard estimated a maximum permissible concentration of Rn^{222} of 5×10^{-4} microcuries per cubic centimeter for a permissible 0.3 rem per week to the fat or yellow marrow. A concentration for Sr^{90} of 4×10^{-6} microcuries per milliliter (for 160-hour week), based on experimental data, was suggested by Snyder. This is four times the present value established by the National Committee on Radiation Protection and Measurements which is based on a comparison with Ra^{226} .

About 600 of a total membership of about 2000 were present, and the total registration was just over 1000 persons. The incoming president for 1963-64 is W. T. Ham (Medical College of Virginia) and the president-elect is H. L. Andrews (National Institutes of Health). J. Auxier (Oak Ridge) received the Elda E. Anderson Memorial Award for his outstanding contributions to health physics as director of the Ichiban Project. The next annual meeting will be held at Cincinnati, Ohio, during the week of 15 June 1964.

ANDREW P. HULL

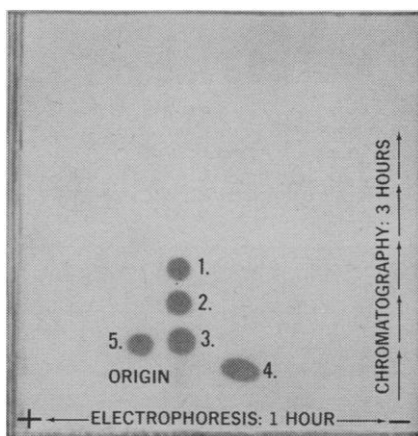
Health Physics Division,
Brookhaven National Laboratory,
Upton, New York

Biogeochemistry

The theme, geochemical processes in the ocean that are caused by marine organisms, was developed during a 2-day symposium held in conjunction with the meeting of the Scientific Committee on Oceanic Research (SCOR) at Halifax, Nova Scotia (4-9 April). Approximately 30 scientists participated in this round-table discussion.

Biogeochemistry is concerned with the interaction and distribution of molecules, elements, and their isotopes in nature as determined by biological activity; chemical equilibria; physical processes; and implications for the

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earth and its history. While such a definition includes almost all scientific endeavors, only four essential aspects related to the marine environment were considered at the symposium: (i) the concentration of elements in the shell and soft parts of marine organisms; (ii) the production of compounds by organisms during their activities; (iii) the fractionation and separation processes which occur in the marine environment; and (iv) marine biogeochemical cycles.

Little is known about the spectrum of trace elements in carbonate shells; most of the information concerns strontium and magnesium. It is known that the uptake of these two elements is affected by the biochemistry and growth stage of the organism and the crystal phase of the shell, as well as by the temperature, chlorinity, and possibly the total chemistry of sea water. In addition, the substrate upon which the organisms grow plays a vital role in the entire system.

Since trace elements are an integral part of the mineral in which they occur, one must know all the mineral species which are precipitated by marine organisms. Little information is now available on this point. This is true even for the "extensively" studied organisms which secrete carbonates. Relatively recent investigations on the organic matrices of mineralized carbonate shells indicate that their physical structure and amino acid residues can be utilized to define the biochemistry of species, as they are affected by ecologic factors. Moreover, preliminary studies indicate that protein chemistry may be a controlling factor in the formation of particular mineral phases, that is, calcite or aragonite. In this type of investigation knowledge of the trace-element chemistry of the soft parts and body fluids is essential because some are involved in the physiology of the organisms as well as affecting the chemical processes in the ocean. Information obtained from such studies may aid in tracing the biochemical evolution of marine organisms and may be used for monitoring the temperature, chlorinity, and total chemistry of the ancient oceans, and for distinguishing between original and altered composition of fossil skeletons.

Two basic questions arise in the study concerned with the organic content of both sea water and sediments. What is present? What function does it have? Reference to the literature will disclose an extensive bibliography of

description: determinations of the organic carbon and nitrogen content of sea water and sediments; correlations between organic matter and sediment particle size, or with plankton bloom; variations of organic matter, at different depths, in both sediment and water in some environments. These studies, even with their shortcomings, have provided the groundwork for the future. With the advent of more sophisticated techniques such as mass spectroscopy and chromatography, the scientist has been able to ascertain the presence of carbohydrates, proteins, fatty acids, hydrocarbons, and other compounds in sea water and sediments. However, present analytical knowledge is inadequate for determining some of the individual compounds and a serious attempt is being made to obtain the necessary information.

Organic matter in sea water is present in dissolved form, in particulate form, and in the living organisms. In the sediments it is present as discrete particles, living organisms, dissolved in the interstitial water and also associated with the inorganic minerals present in a manner not yet thoroughly understood. It ranges in type from that which is extremely unstable and that which is readily utilized by marine organisms all the way to highly stable products which have been termed kerogen or described as "lignin-like."

Dissolved organic matter in water has usually been estimated at 1 to 2 milligrams per liter with values of greater than 5 milligrams per liter in some bodies of water. In sediments the average amount of total organic matter is estimated at 1.5 percent or less. These represent relatively low concentrations but at least part of the organic matter is metabolically active, thus being a very significant component.

While organic matter acts as an energy source for marine organisms, especially microorganisms, in both water and sediments, the details of this system are not yet known. The rates of turnover of biologically utilizable organic compounds are of primary concern for the elucidation of energy cycles in the environment. An intimate relationship exists between the organic matter, the minerals present, and the bacteria. This affects not only the living population of any portion of the sea floor, but also the alteration of the sediment itself. Thus, sediments begin their alteration or diagenesis simultaneously with deposition. In addition, it has been demonstrated that the forma-

tion of calcite or aragonite is affected not only by the physiology of an organism and the physical factors of the environment around it, but also by the presence of certain organic compounds. Certain metals may also be accumulated in sediments and shells by the presence of specific organic compounds and by living organisms, or they may be precipitated by micro-organisms.

Studies concerning the abundance and fractionation of isotopes in the sea and its contents are of great and growing importance; most investigations have been concerned with hydrogen, carbon, and oxygen. Both hydrogen and oxygen isotopes may be useful tracers of water masses, but from the standpoint of oceanic biogeochemistry a thorough study of the isotopic effect of these three elements (H^1 and H^2 , O^{16} and O^{18} , C^{12} and C^{13}) will aid in studying biochemical processes in the marine environment.

For instance, the isotope effect of carbon is extremely useful in photosynthesis investigations because the extent of fractionation indicates activity. It is also possible to use this effect as a tool in studying carbonate precipitation, the decomposition of marine organic material, and the fossilization of carbon.

From the ratios of oxygen isotopes in marine organisms, such as foraminifera and belemnites, ancient ocean temperatures have been estimated. This has been most effectively used for determining oceanic paleotemperatures during the last ice age and during earlier periods.

Oxygen isotopes may also indicate the origin of certain marine calcium carbonate deposits by revealing if they precipitated directly from sea water, if they have passed through the biological cycle, or if they have been reworked from earlier deposits. In addition, fractionation studies between mineral phases can help in understanding the origin of authigenic feldspars. In addition to carbon, hydrogen, and oxygen, another isotope, silicon, is important because it may indicate the source used by organisms in the formation of their skeletons.

Many elements have a wide variation of concentration with depth of water in the sea. For instance the concentration of barium, mercury, the rare earths, radium, uranium, and others is 2 to 4 times greater at depths below 1 to 2 kilometers than at the surface. A common reason for con-

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Carbon-14 Fat Oxidation Test, A New Method of Measuring Fat Utilization in the Human	SUSANNE VON SCHUCHING & ARTHUR F. ABT V. A. Center, Martinsburg, W. Va.
Diffusion of Labeled Molecules in Heart Muscle	ERNEST PAGE Harvard Univ. Medical School
The Use of Labeled Non-Metabolized Amino Acids in Biochemical Research	THOMAS R. RIGGS & HALVOR CHRISTENSEN University of Michigan
Use of Carbon-14 Labeled DMO to determine pH.	THOMAS C. BUTLER Univ. of North Carolina Medical School
Iodine-125 as a Clinical and Biological Tracer	PAUL V. HARPER Argonne Cancer Research Hospital
Biosynthesis of Carbon-14 Labeled Bilirubin	RUDI SCHMID University of Chicago
Isotope Fractionation Effects in the Chromatography of Doubly-Labeled Compounds	PETER KLEIN Argonne National Laboratories
Radioassay of Thin Layer Chromatograms	FRED SNYDER Oak Ridge Inst. of Nuclear Studies
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centration at depth appears to be an extraction of the elements in question from solution in the surface layers of the ocean by living organisms, which upon death sink into the deeper layers or to the bottom. During this process decomposition takes place and the elements are entirely or partially released into solution.

Copper, nickel, and zinc appear to have uniform concentrations from the surface of the water to the bottom. However, these and other trace elements are sensitive to the presence of organic matter, thus, the published values may not be real. For instance, a column extraction of zinc does not equally absorb three or four of the various species present. Also, certain organic complexes of zinc are known to exist in the sea and these are not generally measured by the methods used.

Although in recent years there has been remarkable advancement in oceanic biogeochemistry, answers to many presently known problems are still lacking and continually elude the scientist. Continued development and refinement of analytical methods are needed, and caution should be exercised when applying a method to one substrata which was devised for another. It is also essential that more data be obtained by existing methods. This naturally requires that samples and data be made available to laboratory specialists by seagoing oceanographers.

Additional information is required on the trace element composition and mineralogy of shells and soft parts of organisms. Rather than obtaining isolated data on a few shells per species, it is essential to collect enough statistically valid information to permit a knowledge of concentration ranges and of their relations to biologic and ecologic controls. It is also necessary to know more about the organic composition of sea water and sediments, not only the dissolved organic fraction in water but also the particulate fraction. Attention must be directed not only to the rarer components and those easy to analyze but also to the mass of the organic material; these are both the original and decomposition products resulting from the environmental history. It is also important that molecular determinations be quantitatively related to the total organic carbon present.

A greater potential lies ahead with further studies on variations in isotope abundances and fractionation proc-

esses. These must be investigated in natural waters, in the shells and soft parts of organisms, in inorganically deposited minerals, and in the atmosphere. Data on the presence and availability of nutrients and biologically essential elements in time and space are required as well as on the mineralization and concentration by microorganisms during diagenesis. After all, biological processes are the key to biogeochemistry and the mechanisms concerned.

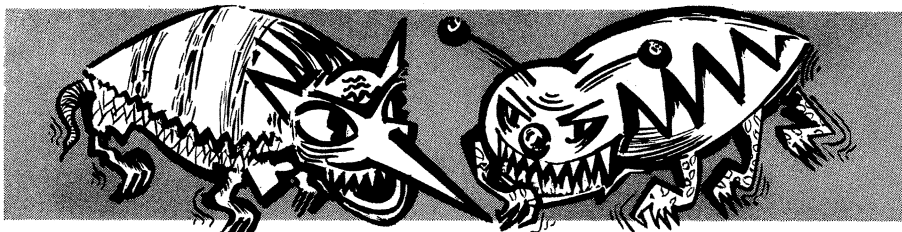
When considering the development of both laboratory and field experiments it becomes apparent that the growing of organisms under controlled conditions and under close observation must be expanded. Investigations should be designed not only for correlation but also to determine the various mechanisms of inclusion. Likewise, experimental techniques can aid in separating the innumerable and seemingly unfathomable interrelationships which the natural environment portrays when the incorporation of organic material in sedimentary deposits is studied. Simple experiments, increasing in sophistication with time, may well point toward basic processes.

The setting up of bacteriological experiments in order to determine how the environment affects the bacteria and vice versa are of prime importance. Laboratory work may indicate how bacteria function in decomposing marine organic matter and ultimately produce the large mass of highly stable organic compound present in sediments. Likewise, experiments should be devised where recycling processes and rates of cycling can be obtained. Problems concerning the isotope effect, such as degradation of organic compounds, carbonate precipitation, and photosynthesis and its associated problems in the sea, may be answered by experimental means.

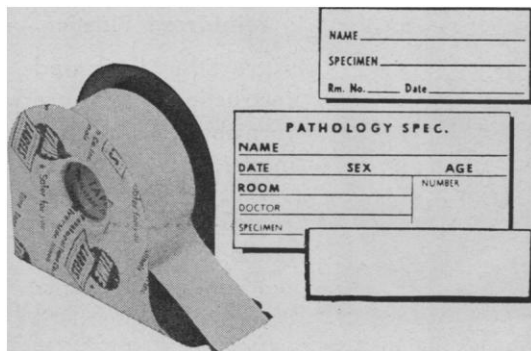
Finally, we should combine the analytical data from natural samples with the understanding obtained from experimental endeavors, expend much effort in thought, and arrive at logical, reasonable conclusions.

The programmed participants in this symposium were: F. F. Koczy, H. A. Lowenstam, L. J. Greenfield, G. O. S. Arrhenius, C. H. Oppenheimer, J. R. Vallentyne, R. G. Bader, S. Epstein, I. A. Breger, P. E. Cloud, J. D. Strickland, E. D. Goldberg, and M. C. Sargent. In addition, many specialists from various disciplines were invited and they also participated. This sym-

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National Science Foundation,
Washington, D.C.

FRIEDRICH F. KOCZY

Institute of Marine Science,
University of Miami, Miami, Florida

Forthcoming Events

October

8-10. **Science and Engineering**, 10th annual symp., U.S. Air Force Academy, Colo. (Maj. J. Shafer, RROND, U.S. Office of Aerospace Research, Washington, D.C.)

8-11. **Electromagnetic Relays**, intern. conf., Sendai, Japan. (C. F. Cameron, School of Electrical Engineering, Oklahoma State Univ., Stillwater)

8-11. **American Roentgen Ray Soc.**, Montreal, P.Q., Canada. (American College of Radiology, 20 N. Wacker Dr., Chicago 6, Ill.)

9. **American Acad. of Arts and Sciences**, Brookline, Mass. (R. W. Burhoe, American Acad. of Arts and Sciences, 280 Newton St., Brookline Station, Boston, Mass.)

9-11. **Aerospace Electronics**, exposition and conf., Los Angeles, Calif. (E. Niles, Aerospace Electrical Soc., 3540 Wilshire Blvd., Los Angeles 5)

9-13. **Cytophotometry and Interference Microscopy**, symp., Giessen, Germany. (W. Sandritter, Pathologisches Institut, Justus Liebig Universität, Giessen)

10-11. **Bioassay and Analytical Chemistry**, 9th conf., San Diego, Calif. (G. Bucolo, General Atomic Div., General Dynamics Corp., Box 608, San Diego)

10-11. **Engineering** conf., Long Beach, Calif. (Natl. Soc. of Professional Engineers, 2029 K St. NW, Washington, D.C.)

10-11. **Kidney**, 15th annual conf., New York, N.Y. (Natl. Kidney Disease Foundation, 342 Madison Ave., New York 17)

10-11. **Lipid Transport**, intern. symp., Nashville, Tenn. (H. C. Meng, Vanderbilt Univ. School of Medicine, Nashville)

10-13. **American Soc. of Clinical Hypnosis**, 6th, San Francisco, Calif. (W. T. Heron, American Soc. of Clinical Hypnosis, 800 Washington Ave., SE, Minneapolis 14, Minn.)

13. **American College of Dentists**, Atlantic City, N.J. (O. W. Brandhorst, 4236 Lindell Blvd., St. Louis, Mo.)

13-17. **Neurosurgery**, 10th Latin American conf., Buenos Aires, Argentina. (R. Morea, Callao 1685, Buenos Aires)

13-18. **Society of Motion Picture and Television Engineers**, 94th technical conf., Boston, Mass. (H. J. Hall, Itek Corp., Lexington, Mass.)

13-18. **Plastic Surgery**, 3rd intern. congr., Washington, D.C. (Capt. Joseph Connelly, Bethesda Naval Hospital, Bethesda 14, Md.)

14-16. **Geological Sciences**, intern. un-