tional triple bonds (dehydroannulenes) with a study of the aromatic properties as defined by Hückel's rule [$(4n + 2)$ π-electrons]. If aromatic, an annulene or a dehydroannulene should sustain an induced ring current of π-electrons, a property measurable by NMR. In agreement with theory, those substances expected to be aromatic (for example, monodehydro-[14]-annulene, [18]-annulene, tridehydro-[18]-annulene) showed NMR spectra, thus indicating the existence of a ring current. Those expected to be non-aromatic (for example, [14]-annulene, [24]-annulene, tetradehydro-[24]-annulene) indicated no ring current. It is interesting that the aromatic annulenes and dehydroannulenes did not show benzene-like chemical behavior or stability.

In the area of inorganic chemistry, major attention was focused on high temperature chemistry of inorganic salt systems and on inorganic polymers. Progress in the first area was summarized by H. Bloom (University of Tasmania, Australia). Interest in such systems has received much impetus recently from the use of molten salts in the extraction of minerals, and their potential use in the development of atomic energy, rocket propulsion, and fuel cells. Apart from the industrial value of molten salt systems, they are of great theoretical interest since they are the only class liquids in which the structural units are ions.

In the analytical chemistry sessions major emphasis was placed on neutron activation analysis, a technique particularly adapted to determination of trace impurities. Analysis of the germanium, arsenic, antimony, copper, chromium, molybdenum, silver, indium, zinc, and palladium content of 67 iron meteorites was reported by A. A. Smalos and D. Mapper (Atomic Energy Research Establishment, Harwell, England). Statistical analyses indicated significant correlations for a number of the elements. Important similarities have also emerged, particularly among the hexahydrite group.

Actions taken by the Council of IUPAC at the conference included the adoption of revised statutes for the Union. It is hoped this action will permit broader participation by the member nations. Viet Nam and South Korea were admitted to the Union. Lord Todd (Great Britain) was elected president for 1963–1965, succeeding W. Albert Noyes (United States); W. Klemm (Germany) was elected to the new office of president-elect; and John C. Bailar, Jr. (United States) succeeded Sir Charles Dodds as honorary treasurer. The complete plenary lectures will be published by Butterworth, probably in November.

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Health Physics

Health physics, as a specialized profession concerned with the prevention and control of hazards from ionizing radiation and radioactive materials, is now in its third decade. The wide range of its concerns was apparent at the 1963 annual meeting of the Health Physics Society held on 10–13 June at New York City. Included were sessions on studies of the Hiroshima and Nagasaki survivors, radiation biology, radiation physics, dosimetry, and fallout. Also included, but perhaps mostly of specialized interest to the profession were sessions on air monitoring, bioassay, instrumentation, nuclear safety, personnel monitoring, waste disposal, and standards.

Shields Warren, who introduced the first session of invited papers on dosimetry and medical effects of the nuclear bombings of Hiroshima and Nagasaki, observed that the studies are a reversal of the health physicists' usual role in that they are a study of a planned maximum exposure. Stuart Finch (Yale), a former member of the Atomic Bomb Casualty Commission, summarized its medical findings to date. These include an increase of one case per million persons per rad in the leukemia rate which seems linear with dose down to the general Japanese population background rate; an increase in lenticular opacities, an alteration of 1 percent in the sex-ratio of the F_1 generation, and some evidence of micro-encephaly in the offspring of mothers who were in the first trimester at the time of exposure. Little evidence of accelerated aging, loss of visual acuity, and increase in non-neoplastic disease, or malformed offspring had been found. Emphasis is currently shifting to a study of the borderline evidence for an increased cancer incidence and for some retardation in the natural ossification processes in the F_1 generation.

Most of the dosimetry of the Hiroshima and Nagasaki exposures has been by retrospective estimation. J. Auxier (Oak Ridge National Laboratory) reviewed the current efforts of Project Ichiban to improve the precision of these dose estimates. Data from 1962 Nevada experiments (employing the bare Health Physics Research Reactor) should reduce the present uncertainty from $\pm$ 50 to $\pm$ 27 percent. C. S. White (Lovelace Foundation) presented information on blast and thermal radiation effects. An overpressure in the range of 50 to 55 pounds per square inch is an LD_{50} for man (that is, it kills 50 percent of those exposed). The pathological effects of overpressure are observed at the junction of tissues of different densities. White's data indicated that reflection may increase the overpressure in a foxhole or fallout shelter kind of enclosure and that the range of these "conventional" effects increases with yield faster than the nuclear dose.

In the radiation biology session, A. H. Sparrow (Brookhaven National Laboratory) presented data on the continued exposure of plants which showed a close correlation between nuclear volume and radiosensitivity. Many of the gymnosperms have an LD_{50} below 1000 rads. In 20 generations of mice, the males of which had been given one 200-r exposure 24 hours after birth, J. P. Spalding *et al.* (Los Alamos Scientific Laboratory) observed a decline in litter size but an increase in period of productivity and number of conceptions in the F_{16} generation. The mean survival time of the irradiated F_{22} generation was reduced under continued gamma exposure from 38.4 to 30.4 days. Most of this decrement could be eliminated by cross breeding with the control line.

The hypothesis of a simple equivalence between radiation damage and that due to aging was not supported in studies made by W. T. Ham *et al.* (Medical College of Virginia) on the eyes of rabbits exposed to x-rays. A 25 to 50 percent protective effect was demonstrated by mice which had been administered 10 μmoles of 2-aminoethylisothiouronium bromide-hydrobromide and 1 μmole of 5-hydroxytryptamine creatinine sulfate 5 to 10 minutes prior to 1200-r x-irradiation (J. L. Leitch, U.C.L.A.). β-aminoisohotyric acid, an end product of the normal break-down of the DNA in the cell nucleus, has been suggested as a sort of "built-in" dosimeter. H. Smith and J.

H. Martin (United Kingdom Atomic Energy Authority) in a study of persons under irradiation therapy, found no correlation between dose and β-aminoisohotyric 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 dietectric 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 mr ± 1 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 epidemological 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.

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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