McIlwain and Ray also reported that the Pioneer data show the presence of a relatively penetrating component in the outer zone as well, with a range corresponding to electrons of 650,000 volts or more. The nature of the outer penetrating component is not known at the present time.

Solar Origin of Outer Zone

The probable origin of the layers was the subject of the liveliest debate at the conference. The origin of the belts may be either the beta decay of cosmic ray neutrons into electrons and protons or injection into the upper atmosphere by streams of particles coming from the sun. At the conference, Gold described a theory of solar origin in which gusts of plasma emitted from the sun established magnetic channels for the transit of energy-charged particles to the neighborhood of the earth. Parker has proposed, as an alternative theory of solar origin, that protons from the sun form a "solar wind," which may blow across the earth and inject particles in the Van Allen layer without prior establishment of a solar-terrestrial magnetic channel. Whatever the precise mechanism for transfer of particles to the layers, the solar origin of the outer zone appeared to be definitely established by preliminary Pioneer IV results presented at the conference. McIlwain and Ray reported that the radiation intensity in the outer zone was several times greater during the Pioneer IV flight than that observed in Pioneer III. They noted further that the Pioneer IV flight had followed directly on 5 days of continuous and unusually intense solar activity.

A judgment on the relative merits of the Gold and Parker theories will have to wait on further space-vehicle experiments, and in particular on the simultaneous measurement of magnetic field strengths and particle intensities during a period of varying solar activity.

Difficulties Remain

The origin of the inner zone is less clear, but the currently available evidence favors the beta-decay theory originally advanced by Singer, Christofilos, and Vernov (Moscow). Argus results reported at the conference by Christofilos indicate a remarkable stability of the inner-zone population, with no evidence of diffusion or mixing between the two zones. This result would appear to eliminate external streams as the origin of the inner zone.

Some difficulties remain in the beta-decay hypothesis. Estimates by Singer indicate that the decay of fast neutrons will yield perhaps 100 times more energetic protons than are actually observed. On the other hand, calculations by Kellogg on the yield of soft electrons from the beta decay of thermal neutrons indicate an intensity 100 times less than the observed intensity of the soft radiation. It is possible that these discrepancies may be accounted for by uncertainties in the values announced for atmospheric density, and by the approximations made in the course of a complex calculation.

The presence of a gap between the two zones poses a more serious problem. On the hypothesis of beta decay for the inner zone and a solar origin for the outer zone, we would expect the inner zone to rise smoothly into the outer, and it is difficult to explain the finding of a minimum in radiation intensity between the two. In this connection an interesting suggestion was made at the conference by Dessler (Lockheed, Palo Alto), who pointed out that there is an irregularity in the magnetic field of the earth over South Africa, an irregularity which may be described as a hole in the magnetic field. He pointed out, further, that the lines of force passing through this irregularity are located at the position of the gap between the zones. When particles are trapped on these lines of force in the magnetic field they descend to lower altitudes than would be the case in a perfectly dipole field. At the lower altitudes they pass through a denser atmosphere and are rapidly removed from the radiation layer.

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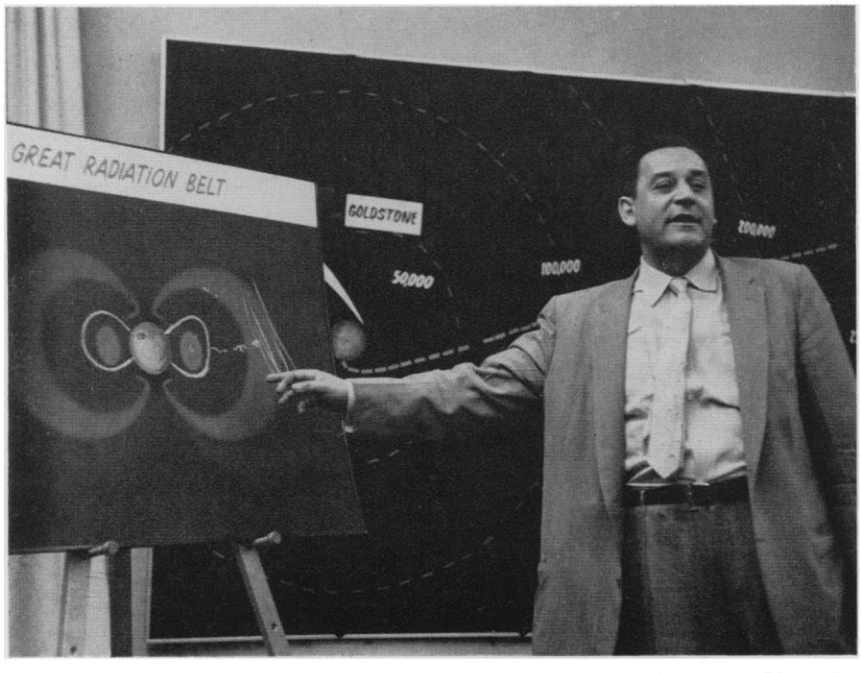

N. Christofilos describes the Argus results illustrating the stability of the inner Van Allen layer.

Nuclear Liability Problem Studied

The problem of nuclear liability is a growing one that is causing increasing concern. There is a risk that a catastrophic accident might occur in the operation of atomic power facilities and other nuclear installations. This could impose an overwhelming loss, both upon the public exposed to injury and also upon the enterprises operating or supplying the facilities. One of the groups that is studying this problem intensively is the International Atomic Energy Agency's Panel of Experts on Civil Liability and State Responsibility for Nuclear Hazards. This panel will hold a second series of meetings at IAEA headquarters in Vienna, beginning 11 May, as an outgrowth of a first series recently concluded.

IAEA Preliminary Findings

In the course of its first deliberations, the panel was provided with information on the safety evaluation of nuclear installations, the possibility of catastrophic accidents, the medical nature of injuries resulting from such accidents, the possible risks involved in the transportation and storage of nuclear fuels and radioactive materials, and emergency measures to be taken immediately after a nuclear incident. The panel agreed that, as a matter of first priority, it had to deal with the problem of civil liability for property damage and personal injuries from nuclear incidents. The experts also agreed that primary liability for such damage should not require proof of fault to be brought by the victim; that such

liability should be limited in time and in amount; that the state in which a nuclear installation causing damage was located should alone be competent to establish detailed rules concerning liability, apportion liability between private parties and the state, and designate a court to process claims by victims. The secretariat was asked to prepare a draft convention embodying these views, to be discussed at the May meetings.

The first series of meetings showed that the specialists were of the unanimous opinion that they should formulate minimum principles acceptable to all nations and that these principles should interfere as little as possible with existing liability concepts and legislative efforts undertaken on a national or regional basis.

The chairman of the panel is Paul Ruegger (Switzerland), who is a member of the Permanent Court of Arbitration and of the board of the Academy of International Law, both in the Hague, and an associate member of the Institute of International Law in Geneva. The United States representative on the panel, which has ten members from as many countries, is Edward Diamond, who has just resigned as associate general counsel of the Atomic Energy Commission.

Yugoslav Atomic Accident Studied

A new IAEA project is closely related to the work of the panel. Two specialists from the International Agency are visiting the Yugoslav Atomic Energy Center, the Boris Kidric Institute at Vinca, near Belgrade, to study the pattern of circumstances that led to an accident there last October. At that time, a group of young Yugoslav scientists were exposed to high doses of radiation during an experiment with the critical assembly (zero power reactor) at Vinca. All but one of the scientists, who were treated at the Curie hospital in Paris, have recovered and are back in their own country.

In view of the importance of obtaining all possible information that would be helpful in elaborating general safety criteria for atomic work, IAEA Director-General Sterling Cole asked for permission to send IAEA investigators for studies and discussions on the spot.

The staff members who are visiting Vinca are Dean Brown and David Newby, both from the agency's Reactor Division. Brown is an American theoretical physicist who has specialized in reactor physics. His activities in the United States, at the Savannah River Laboratory, were connected with reactor kinetics problems, and in the last 2 years he has worked on safeguard studies. Recently he has taken part in the evaluation of the power reactor at Halden, Norway. Newby has worked at the United Kingdom's Atomic Energy Research Establishment at Harwell, in reactor engineering, and has had experience in the field of safety of reactors and critical assemblies.

Atomic Forum–Harvard Law Study

Possible approaches to the international nuclear liability problem are the subject of a report published last month by the Atomic Industrial Forum, the national association of the United States atomic industry. Entitled *International Problems of Financial Protection against Nuclear Risk,* the report is based on a study conducted under the auspices of the Forum and the Harvard Law School by a Harvard research team headed by Robert B. Eichholz, former counsel for this country's foreign-aid program.

The new study points out that the risk of loss through nuclear accident should be allocated so as to give "reasonable protection to the exposed public, while not obliging atomic enterprises to risk an intolerable burden of liability." "Ideally," the report says, "a solution is called for which would embrace *all* nations participating in the development of nuclear power, and which would deal with all phases of the third party liability problem."

The report notes, however, that pending adoption of a global convention, a western European convention now in preparation under the auspices of the Organization for European Economic Cooperation could "serve on an interim basis as a partial groundwork for further international arrangements and national legislation." The report strongly recommends government indemnification for damages exceeding the limit for which operators and suppliers would be held liable under the draft O.E.E.C. convention and urges that this be provided for in advance rather than after the event. The Harvard study team suggests, further, that an opportunity exists to work out a satisfactory solution to the third-party liability problem under the joint nuclear power program of the United States and the six countries of the Euratom community, all of whom are members of the O.E.E.C.

The Havard study is the second major independent research effort on the liability problem that the Atomic Industrial Forum has underwritten. The first, a study conducted for the Forum by the Legislative Drafting Research Fund of Columbia University, was devoted to the domestic aspects of the problem.

Special grants from more than 30 member organizations of the Forum, and contributions from the American Insurance Association and the American Mutual Insurance Alliance, made the Harvard study possible. The report may be obtained, at $6 per copy, from the Atomic Industrial Forum, 3 E. 45 St., New York 22, N.Y.

Radiation Control Assessed for Public Health Service

A report on the control of radiation hazards that was prepared by the National Advisory Committee on Radiation for the Surgeon General of the U.S. Public Health Service was released on 26 March. Excerpts from the report follow.

During the past several years, a number of scientific bodies, including the National Academy of Sciences of the United States and the United Nations Scientific Committee on the Effects of Atomic Radiation, have reported extensively on the influence of ionizing radiation on biological systems. From these reports it is evident that serious health problems may be created by undue radiation exposure and that every practical means should be adopted to limit such exposure both to the individual and to the population.

The principal sources of ionizing radiation which have been created or developed by man include x-ray machines, nuclear reactors and their radioisotopic by-products, high-energy particle accelerators, a number of concentrated forms of naturally occurring radioactive materials, and the fall-out constituents of nuclear weapons. Among these sources, only nuclear reactors, their fuels, their radioisotopic by-products, and their radioactive wastes have been placed under substantial regulation from the standpoint of their influence on health and safety. This is notwithstanding the fact that extensive studies have revealed that most of the ionizing radiation received by the population today, other than received from natural sources, has been from the x-ray machines employed by the health professions. Concerted effort is now being applied by these professions to reduce, as far as is possible, the exposure of individuals undergoing x-ray diagnosis and treatment. Even so, the absence of a comprehensive program through which the health hazards of all sources of ionizing radiation may be brought under supervision appears to this committee to be an important weakness in this nation's efforts to control radiation safely.

In addition to the rapid, anticipated growth of the use of devices and products which produce ionizing radiation, there is another factor which urgently points to the nation's need for a comprehensive program governing the public health aspects of this radiation. This is the increasing respect given by scientists to radiation exposure as demonstrated by the steady downward revision, made