the vicinity of the dawn and dusk terminators. Reconnection of field lines on the day side increases the tail flux; reconnection on the night side decreases the tail flux.

In Dessler's model, deposition by radiation at the poles (polar cap events) would start at low latitudes and move toward the pole; in Dungey's model the whole polar cap would experience absorption at the same time. Van Allen and H. Stolov said that all events studied by them began at the pole and should satisfy Dungey's model. Van Allen also pointed out that Mariner IV was within about 4 Earth radii of the Earth-Sun-line extension, for 2 weeks at 3300 Earth radii, without observing particle or magnetic-field change associated with the tail. Dessler felt that this did not prove that the tail was closed, but Van Allen concluded that if you do not measure it it is not there.

The experimentalists were amused by the intuitive theoretical discussions and tried to determine which measurements may prove useful. It seems important to measure the proton and electron energies at many locations across the bow shock, transition region, and magnetopause. Two satellites are necessary to resolve spatial and temporal variations; the distance between them should be less than 1000 km. The boundary of the bow shock should be carefully measured with a magnetometer and plasma probe.

The use of sources of artificial radiation for studying fundamental processes in the Van Allen belt was discussed by N. Christofilos. Sufficient quantities of radiation must be injected into a narrow L shell in order to follow temporal and spatial changes. Electrons and protons are not attractive because of the high ambient levels and because they are naturally injected in an unknown fashion. Christofilos advocated using positrons and alpha particles; he preferred the latter. C. Roberts pointed out that, if whistlers are important for diffusion, positrons will not provide the correct data. R. Hynds and others objected to injection of alpha particles before the natural flux and energies are measured; such measurements may require several years.

Since previous high-altitude, nuclear detonations have provided very essential experimental data on the radiation belt, some researchers advocate an International Test Series of small nuclear detonations at different altitudes. Except in the outer part of the outer belt, effective lifetime information has come only from nuclear tests.

Results from the Star Fish test of 9 July 1962 were presented by J. Van Allen. He found that 3 percent of the Star Fish electrons were trapped at 10 hours, the electrons were a fission spectrum, and essentially none were injected beyond 0.5 Earth radii (L of 1.5). Van Allen contrasted his analysis with the Hess-Nakada model, which showed 25 percent trapped, some even beyond two Earth radii. Hess had based most of his data on W. Brown's Telstar-I data. Hess and Brown have revised their estimates. Brown's first estimate was that over 25 percent of the electrons were trapped, but more detailed analysis reduced the percentage to 10. If a soft spectrum (as measured by Harry West) is assumed, the inventory is about 6 percent. Hess and Brown concede that the soft electrons above L of 1.5 may be due to some acceleration of natural electrons, such as by an MHD shock; however, since the slot between the inner and outer belts was obscured for 2 weeks, some kind of catastrophic effect was produced by Star Fish. J. Zinn and S. Colgate discussed Star Fish expansion phenomena. Although there are major uncertainties, Colgate found that shock heating could account for the enhancement in soft electrons found above L of 1.5.

Additional observational data were presented for Star Fish and the three Soviet high-altitude nuclear tests by C. McIlwain, H. West, W. Brown, H. Elliot, and Van Allen, with tentative remarks on diffusion, pitch-angle realignment, lifetimes, and other factors.

The basic processes produced in solar cells and transistors by trapped electrons and protons are poorly understood, but W. Brown and J. Martin have taken sufficient experimental data to develop empirical procedures that provide for the design of reliable systems with predictable results. According to W. Keller and D. Adams, the shielding provided by space vehicles and the dose within can be adequately determined. There is no hazard in orbits of up to 500- to 800-km altitude, but the center of the inner belt is very hazardous for manned satellites. Human response to radiation must be refined before the radiation hazard for man in space can be fully assessed.

The study institute was sponsored by NATO, ONR, and ARO. The proceedings will be published by D. Reidel Publishing Company, Dordrecht, Holland. The participants generally agreed on a 2-week meeting in 1967. Special emphasis will be on the outer magnetosphere; injection, acceleration, diffusion, and precipitation of particles; and lifetimes and experimental observations of particles.

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Photon and Electron Impact

Phenomena related to photon and electron impact were the main topics of a symposium at the 13th annual conference on mass spectrometry and allied topics, held 16–21 May 1965 in St. Louis, Missouri.

In the opening lecture on photoionization processes, particularly in diatomic molecules, J. A. R. Samson (Geophysical Corporation of America) outlined the ways in which vacuum ultraviolet radiation can be absorbed by gaseous molecules; he pointed out the interest in knowing individual cross sections for each of the processes. He discussed the techniques for investigating these processes at photon energies greater than the first ionization threshold, and illustrated them with a description of the measurements of a new ionization threshold for molecular oxygen at 11.85 ev. R. I. Schoen (Boeing Scientific Research Laboratories) continued with a description of processes resulting from absorption of photons in polyatomic molecules. He described the production of molecular ions in ground electronic or vibrational states or in an excited electronic vibrational state, or dissociative ionization. As each process is reflected in a loss of energy available to the emitted electron, they may be identified by the use of electron-retarding potential studies. The apparently increasing importance of the role of autoionization was discussed. The relation of the retarding-potential studies to studies of fluorescence stimulated by vacuum ultraviolet radiation was also mentioned.

The photoionization of some atoms and diatomic molecules was reviewed by F. J. Comes (Institute of Physical Chemistry, University of Bonn). Comes reported on absolute cross sections for rare gases measured from onset of

ionization to 282 Å by means of a line source of photons. Mass spectrometric techniques permitted measurement of the cross section of doubly charged xenon and the dissociative ionization of nitrogen and hydrogen molecules. However, the electron-retarding technique was also used to measure the excitation probability for the $^2P_{\frac{1}{2}}$ state of the heavier rare-gas ions.

A new apparatus with greatly improved mass resolution for the study of the photodetachment of electrons from negative ions was described by Bruce Steiner (National Bureau of Standards, Washington, D.C.). An f/1.5 monochromator permits light resolution between 2 Å and 200 Å, and is limited only by the attainment of usable, photodetached electron signals. Various negative ions have been extracted from a hot-cathode arc discharge. In particular, Steiner described the photodetachment of negative ions formed in a SF_6-NH_3 discharge as a function of wavelength. He discussed the absolute cross sections, the threshold energies, and the nature of the transitions involved.

In the opening lecture on electron impact processes, C. E. Kuyatt (National Bureau of Standards, Washington, D.C.) first showed the audience an artist's conception of an electron, the appearance of which left no doubt as to the authenticity and to the reasons for occasional difficulties in their management. Kuyatt then described the basic features of two electron monochromators now in use at NBS. He presented details of the properties of available electron beams, such as current, angular divergence, energy, and energy spread. Studies of the interaction of nearly monoenergetic electron beams with atoms and molecules have led to the observation of striking features including sharp resonances in the total electron-scattering cross section attributed to the temporary formation of highly excited negative ions.

P. Marmet (Laval University, Quebec) reported on a clarification of some electron monochromator problems. He made a distinction between the essential and auxiliary parts of the cylindrical electron monochromator, and emphasized the importance of considering the scattering effect in high electron densities. The proper design of the ionization chamber was discussed and recent results of studies with the Marmet-Kerwin monochromator were presented. Using an electrostatic electron analyzer patterned after this monochromator, M. A. Fineman (General Atomic Division of General Dynamics, San Diego) obtained electron-impact measurements of hydrogen molecules and atoms. He compared the former with reported photoionization measurements and ascribed differences between the two to processes allowed for electron impact but not permitted for photon impact. Some features of the ionization efficiency curve for hydrogen seem to be related to vibrational and rotational structure of the ion. However, most of the structure is obscured by competing processes such as autoionization. The consensus of the speakers was that ionization processes for the simplest of molecules appear to be anything but simple.

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Canadian Plant Physiology

The Canadian Society of Plant Physiologists (La Société Canadienne de Physiologie Végétale) held its annual meeting at the University of New Brunswick, Fredericton, 2–5 June 1965. The program opened with a symposium on problems in marine algal physiology. J. S. Craigie (National Research Council, Halifax) discussed the problems of isolating and identifying excretory products of marine algae from sea water. Compounds excreted by several brown and red algae were identified as condensed polyphenolic substances with properties capable of promoting growth. A derivative of brominated benzyl alcohol, excreted by *Polysiphonia lanosa*, was isolated and crystallized. A pure crystalline extracellular chitan excreted by the diatom *Thalassiosira fluviatilis* was isolated and characterized, and was claimed to be the first recorded evidence for the occurrence of poly-*N*-acetyl glucosamine in the algae. L. Provasoli (Haskins Laboratories, New York) discussed the nutritional requirements of marine algae grown aseptically. Unlike unicellular algae, seaweeds grown autotrophically require a range of vitamins in specific concentrations and ratios for normal morphological development. The growth of *Ulva* and *Monostroma* in aseptic culture was maintained only in the presence of plant hormones and phenolic compounds and by the addition of supernatants containing active substances from a variety of red and brown seaweeds and from several unicellular algae grown aseptically on artificial media. These unidentified, active substances can be extracted with ethanol and are heat resistant. Their ubiquitous production in the sea underlies the significance of external metabolites in the water environment. R. T. Wilce (Amherst, Massachusetts) reported on the survival of algae in the Arctic Sea. Reproductive activity at the end of the winter period and an abundant spring and summer growth were found to depths of 30 meters. The greatest concentration of algal biomass occurred at 15 to 20 meters, where extremely low light intensities were recorded. Survival under these conditions requires either the possession of a highly efficient photosynthetic apparatus or the facility to exist heterotrophically. Evidence for the heterotrophic growth of pigmented algae in deep lakes and unlit caves suggested that these arctic populations also thrived by the heterotrophic utilization of organics from the sea.

Continuing their work on plant photorespiration, G. Krotkov *et al.* (Queens, Kingston) showed a distinction in spruce tissue between photo- and dark respiration, with the latter inhibited by light. W. Turner and R. G. S. Bidwell (Toronto) presented evidence for the enhancement of CO_2 assimilation by leaf blades after the application of 3-indoleacetic acid (IAA). E. R. Waygood *et al.* (Manitoba), working with detached wheat leaves, showed that photophosphorylation could be both restored and enhanced by treatment with benzimidazole, and that the synthetic pathway of nicotinamide adenine dinucleotide (NAD) and NAD phosphate from C^{14}-carbonylnicotinic acid was essentially the same as that reported for animal tissues and microorganisms. The permanent bleaching of *Euglena gracilis* by derivatives of nitrofuran was discussed by D. R. McCalla (McMaster, Hamilton). Other mutagens and radiomimetic agents were used as bleaching agents but only *N*-methyl-*N*-nitroso guanidine proved nonlethal. It was suggested that these bleaching agents damage chloroplast DNA. Continued interest in the biosynthesis of aromatic compounds and phenolase enzyme systems were reported by A. C. Neish *et al.* (Atlantic Regional Laboratory, National Research Council, Halifax). In particular, the biosynthesis of the derivatives of cinnamic acid