Meetings

Solar and Stellar Magnetism

Various aspects of the astronomical universe were discussed at a symposium of the International Astronomical Union, held in Rottach-Egern (near Munich), Germany (3–10 September). More than 100 scientists from 20 countries participated.

The astronomical universe is composed mainly of plasma, that is, fully or partially ionized gas moving under the constraints of gravity, magnetic fields, and hydrodynamic forces. On a cosmic scale, problems such as containment, boundaries, and high vacuum, which plague the laboratory physicist, do not disappear but take on different dimensions. Astronomers have been aware of such problems through the appearance of magnetic fields in the sun (both in sunspots and in the elusive general field), in stars (many of which have general fields above 10,000 gauss), in interstellar space, and in cosmic radio sources. Many of the pioneers in magnetohydrodynamics, such as Alfvén, Biermann, Lüst, Schlüter, Cowling, and Severny, noted how some of the first applications of magnetohydrodynamics have been in astronomy. The laboratory physicists working on the magnetic stability and containment problems connected with thermonuclear fusion may be assured that nature, at least on the astronomical scale, can and often does produce very high energy particles in moving, magnetized plasmas.

The meeting was approximately evenly divided between discussions of observational data and theoretical interpretation. Topics included the description of stellar magnetic fields, the large solar field (which may or may not be changing polarity at present), the localized solar fields responsible for the hot spots in the chromosphere, the sunspot fields and their changes as related to solar flares. The theorists covered instability in plasma physics (Schlüter), the effect of fields on the internal and sunspot convection, the cooling of sunspots, solar flares (Sweet), and the alternative interpretations of the variation of stellar magnetic fields (Cowling).

Recent observational results include studies of the small-scale magnetic fields in solar plages, the reticulated structure of the solar chromosphere, and the velocity fields observed by Leighton. Above the granulation level of the solar photosphere, the gas motion and field pattern transfers into a larger-scale pattern in the chromosphere at a level in which at least some energy dissipation and heating occur. An extraordinarily complete mapping of magnetic fields near sunspots has been carried out by Severny who used both longitudinal and transverse Zeeman effects. The field lines so deduced can in general be modeled by simple subsurface fields. After a solar flare, Severny finds a rearrangement and simplification of the field lines, as if energy has been transferred from the field to matter in motion and possibly to high-energy particles. The solar flare observations by Zirin and motion picture films by Moreton showed the complex pattern of these extraordinary, energetic events which have such profound effects in interplanetary space and on geophysical phenomena. In stellar magnetic phenomena, perhaps the greatest emphasis was placed on the changes in the apparent surface composition of the stars that have large magnetic fields (Sargent, Greenstein, Burbidge). The abundances of many elements are affected, for example, O, Si, P, Mn, Eu, and the rare earths, and in one star He^3. It is probable that the reshuffling of the elemental abundances is caused by nuclear reactions induced by high-energy particles. The question of how deep this contamination goes is an interesting one, and the consensus of belief is that it is a shallow phenomenon.

One disconcerting result of the theoretical discussion is that it is not yet possible to ascertain the magnitude and pattern of the magnetic field inside a star from observations of its surface field. Unless a priori assumptions such as equipartition are made, it is possible for a stellar field to be squeezed largely into layers near the surface, or alternatively even to be largely trapped beneath the surface with few lines of force emerging. Another difficult theoretical question concerns models for sunspot fields beneath the surface and for the complex surface fields in which solar flares occur. The fundamental physics of the instability of plasma flow was touched on from many astronomical aspects. The hope is that the origin of stellar magnetic fields and of the interstellar fields may soon be understood. One important impression resulting from the symposium was how widespread and important these fields are in the energy balance of the universe.

The local arrangements were handled by scientists from the various branches of the Max Planck Institute in Munich. One day of the meeting was spent at the new centers of plasma physics, magnetohydrodynamics, and space science at the Institute. The proceedings will be published in full detail as a book.

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Electron Microscopy

An almost equal balance between biological and nonbiological topics existed at the 21st annual meeting of the Electron Microscope Society of America, held in Denver, Colorado, 28–31 August. About 700 researchers from a wide variety of fields attended.

Since the design of commercially available electron microscopes has now advanced to the stage where the amount of information obtained from a specimen is frequently dependent on a detailed knowledge of the operation of the instrument and the quantitative determination of the performance by the research worker, a symposium on optimum use of modern electron microscopes was held. This symposium, arranged by W. C. Bigelow, featured lectures by well-known experts in the

field who emphasized the various aspects of electron microscopy that must be mastered by a researcher.

Two simultaneous sessions were devoted to techniques of interest to biologists and nonbiologists. New methods of specimen preparation and new devices which allow greater control over the specimen during examination were discussed.

Widespread interest was exhibited in the quantitative results obtained by application of electron microscopy and selected area electron diffraction to crystalline specimens. A symposium on the structure of thin films, organized by K. R. Lawless, dealt with topics such as nucleation, growth, and structure of pyrolytic, evaporated, and electrodeposited films. Particular emphasis was placed on the determination and origin of lattice defects in epitaxial films. Additional discussions covered the structure and growth of a variety of evaporated, electrodeposited, and oxide films. It was noted that a pressing need exists for more quantitative structural investigations carried out under carefully defined conditions with minimization of experimental variables.

Other nonbiological topics included lattice defects in crystals; microstructure and phase transformations; structures resulting from the agglomeration of quenched-in lattice vacancies in metals and alloys and the correlation of the resultant structures with other physical properties; and the dislocation arrangements in metals which result from cyclic stressing. Results indicated that electron miscroscope studies, particularly on single crystals, should provide the basis of a theory of cyclic work-hardening. Also discussed were the tempering of martensite, as studied by transmission electron microscopy; the relationship of observed changes in structure to changes in physical properties; phase transformations in refractory metals and magnesium-cadmium alloys; and the changes in dislocation arrangements associated with the recovery process in alloys with low-stacking fault energy.

Transmission electron microscopy has provided much valuable information concerning radiation damage. Effects of neutron irradiation on carbon containing molybdenum and the damage produced by ion bombardment in bcc metals was described. Interesting observations were reported on the damage produced in thin foils due to

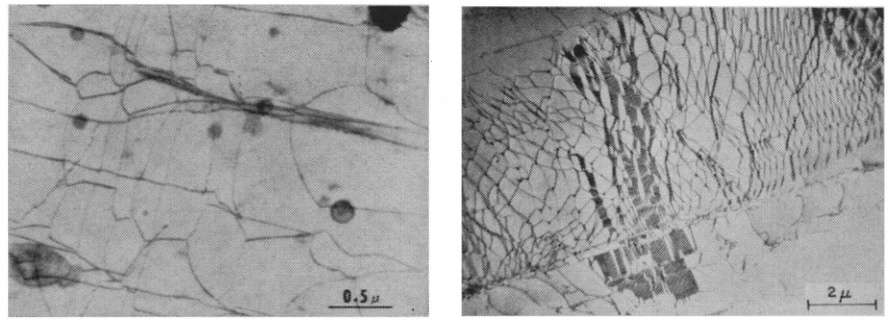

Fig. 1 (left). Dislocation network in silicon formed as a result of phosphorus diffusion during "gettering" treatment. These dislocations are not the lowest energy pure edge network. (From "Substructures in epitaxial silicon," G. Thomas. Work was carried out in cooperation with J. Washburn and H. J. Queisser.) Fig. 2 (right). A single crystal of Cu-7.3 percent Al, elongated 10 percent in easy glide and recovered by heating at 450°C for 100 minutes. Section almost parallel to the primary glide plane. The networks become regular and dipoles more closely aligned to the 112 direction after recovery. (From "Some observations on the recovery of low stacking fault energy alloys," P. R. Swann.)

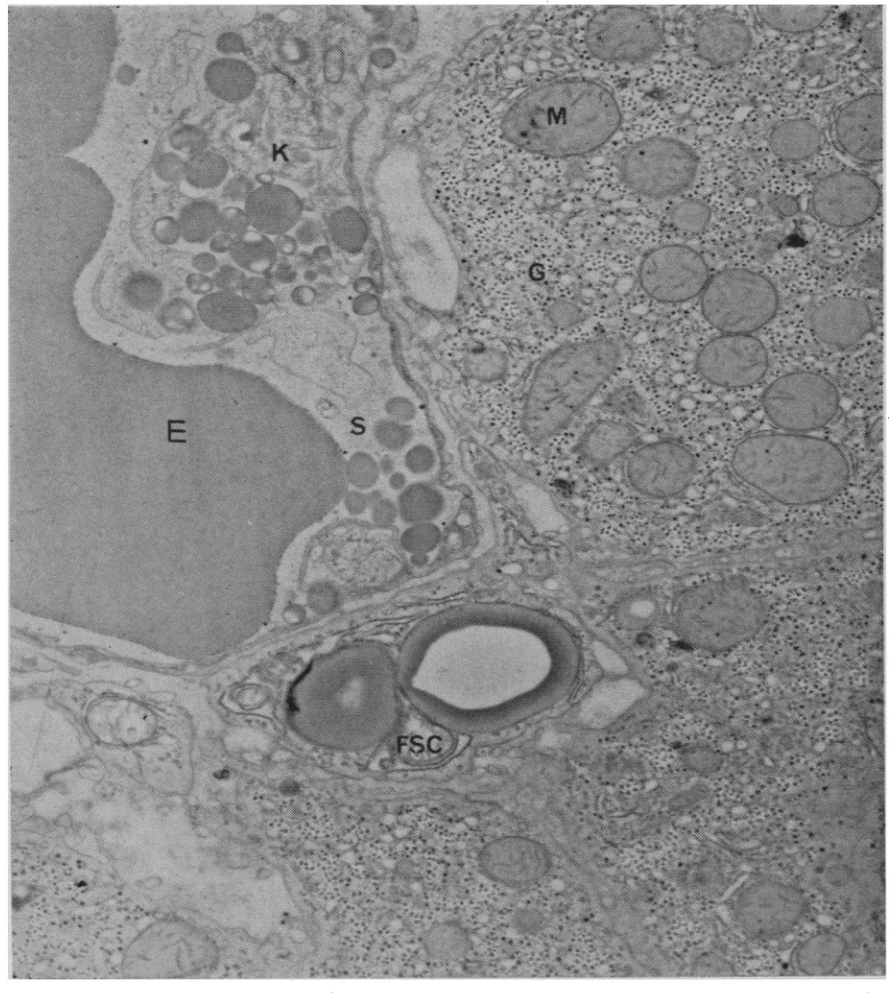

Fig. 3. Electron micrograph of a thin section of human liver. A large part of the sinusoidal space in the micrograph contains a portion of an erythrocyte (*E*). Fat globules in a Kupffer cell (*K*) and in the sinusoid (*S*) at left represents an administered reticuloendothelial test emulsion. Parenchymal cells at right possess spherical mitochondria (*M*) and many dark particles of glycogen (*G*). A portion of a fat-storage cell of Ito (*FSC*) is seen below. Glutaraldehyde-OsO_4 fixation. Araldite embedment. Lead citrate stain (about × 12,000). (From a paper presented by A. J. Ladman, N. K. Salky, and N. R. DiLuzio.)

ion bombardment at low temperatures in the electron microscope itself and the structural changes in NaCl wafers held at low temperatures during observation with an electron microscope. Other applications of electron microscopy have been in the fields of analysis, lubrication, structure of glass, and polymer research.

Rapid advances in the electron microscopy of biological specimens in the last few years has been closely related to developments in embedding techniques; the current status was reviewed in a symposium on embedding of cells and tissues with J. Luft as chairman. The requirements and properties of embedding materials for electron microscopy were discussed and evaluated in terms of the most commonly used materials, that is, methacryates, vestopal, and the epoxy resins. The use of water-soluble embedding media for cytochemical localization was also covered. While the epoxy resins are now probably the most widely used, it was concluded that no one material can render consistently good general embedding. It was suggested that a major factor may be the lack of standardization of the various production lots of the component materials. The biologist must continually adapt the embedding procedures and materials to obtain optimum results.

A very wide variety of biological subjects covered general animal and plant cell morphology, viruses, neoplasms, and protein fibers. Reports covered the structure of viruses and the changes they bring about in various cell types. The methods of negative staining and enzyme digestion were widely employed in elucidating viral structure. Various aspects of normal morphology, experimental pathology, and human biopsy were covered during several talks on electron microscopy of liver.

The wide variety of topics presented in the biological sessions gave the participants a good spectrum of the progress of electron microscopy outside their own specialty.

Abstracts of the papers have been published in the August 1963 issue of the *Journal of Applied Physics.*

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British Association for the Advancement of Science

The 125th annual meeting of the British Association for the Advancement of Science was held in Aberdeen, England, 28 August–4 September 1963. As usual, the sessions were directed chiefly to the informed public, and consisted primarily of a series of reports by outstanding British scientists on current developments in scientific affairs which might have popular interest. In the traditional manner there were many splendid receptions by the University, with conferring of honorary degrees, and with special dinners, lunches and receptions by civic groups.

At the opening session, Sir Eric Ashby delivered the presidential address; his subject was "Investment in man." Honorary degrees were conferred upon Sir George Allen, secretary of the British Association; Sir Charles Morris, vice-chancellor of the University of Leeds; and J. M. Robertson, Gardiner professor of chemistry at the University of Glasgow.

Featured were the presidential addresses in the various sections. For the section on physics and mathematics, J. S. Forrest considered the problems of "High voltage insulation." J. M. Robertson discussed "A physical approach to chemical structure" for the section on chemistry. F. F. Darling, for the section on zoology, outlined "The unity of ecology," and for the section on medicine, J. McMichael reported on "The contribution of clinical medicine to physiology." For the section on geography, H. C. Darby discussed British National Parks, and for the section on agriculture, Martin Jones analyzed food supplies for man and beast. The section on psychology heard a discussion from O. L. Zangwill on "Cerebral localization of psychological function."

A significant part of the Aberdeen meeting, which extended through 4 half-day sessions and was appealing both to the public and to specialists, was a symposium on land use in the Scottish uplands. In these sessions, the British Association emphasized two of its important functions: (i) it allowed for public presentation of contributions of scientists to the solution of an urgent practical problem in the management of natural resources; and (ii) it demonstrated the value of a broadly based scientific approach to a major topical question by bringing together geographers, botanists, zoologists, agriculturists, economists, and other repre-