NEWS and VIEWS

Microscopy Symposium

On June 10, 11, and 12, Armour Research Foundation of Illinois Institute of Technology and the physics department of the Institute sponsored the first joint symposium on electron and light microscopy. International in scope, the Chicago meeting was attended by more than three hundred microscopists, who heard papers on such subjects as metallography, pigments, electron diffraction, fibers, goniometry, fats, particle size determination, bacteriophage action, ultraviolet and infrared microscopy, and metal films evaporated in high vacuum. A portion of the formal program was devoted to phase microscopy, a recent modification which employs the light microscope in such a way as to enhance image contrast, thus enabling the microscopist to observe sections that cannot be examined adequately by conventional methods. The informal panel presentations discussed instrumentation for electron microscopy, preparation of metal surfaces for microscopic examination, and problems in high speed microtomy. In addition, the Symposium featured an instrument display and photographic exhibit. Tentative plans have been made to perpetuate the Symposium. C.F.T.

Applied Mathematics

Electromagnetic theory was under discussion at the Second Symposium on Applied Mathematics of the American Mathematical Society held at MIT on July 29–31. Papers were presented on the status of the new covariant formulation of quantum electrodynamics, reformulations of electromagnetic field theory along classical lines, the solutions of several types of boundary value problems related to the Maxwell field theory, methods of solving boundary value problems, orbit theory and its applications, the response of linear electrical networks, nonlinear electrical networks, the abstract formulation of problems in the communication of information, and on random noise.

The meeting gave a good illustration of the various aspects of the interplay between pure mathematics and applied mathematics, and there were illustrations of the way in which a body of abstract mathematical theorems finds application to seemingly different problems. Thus Heins described the use of the theory of Wiener-Hopf integral equations for the solution boundary value problems in electromagnetic theory and Lee used the same theory in connection with his treatment of the statistical theory of message transmission. Wallman showed how the central linear theorem of probability may be used to predict the response behavior of a number of networks, each of which is assumed to have a monotonic time-function response to a step-function. Taub applied known results on one-parameter Lorentz groups to the integration of the equations of motion of charged particles in constant fields.

Another aspect of this interplay, namely the stimulation of purely mathematical investigations, was also demonstrated. Infeld discussed the method developed by Dirac, Schroedinger, himself, and his students for solving second order differential equations by a factorization into a system of first order equations. This discussion outlined the method of finding one solution and generating others from it. The method originated with some quantum mechanical problems but leads to a mathematical classification of eigen-value problems. Duffin in his discussion of nonlinear electrical networks illustrated how the theory of nonlinear systems, which is in its infancy, could be guided by answering questions arising from circuits used in practice. Pekeris discussed the mathematical relationship between two methods of solving a given boundary value problem, the ray method and the normal mode method.

Applied mathematicians readily agree, and pure mathematicians usually agree grudgingly, that there are aspects of applied mathematics that have little to do with mathematics. The formulation of various concepts into a theory and the introduction of simplifying assumptions which are reasonable on the basis of nonmathematical grounds are two illustrations of these aspects. Feshbach's report on the new formulation of quantum electrodynamics illustrated both of these. The papers of Synge and Watson which dealt with new formulations of classical field theory, of Kac on distribution problems in random noise, and of Wiener on entropy information were excellent illustrations of mathematical formulation.

The use of various approximation techniques was well illustrated in the papers by Feenberg, Rice, Romberg, Stevenson, and Truell.

The proceedings of this symposium will be published by the American Mathematical Society. A.H.T.

Aligned Nuclei

The Oak Ridge National Laboratory Conference on Low Temperatures and Nuclear Physics, August 7 and 8, was held to foster an exchange of ideas between scientists in these two fields. Since the alignment of nuclear spins interested both groups, particular emphasis was given to this subject. The low temperature physicist is interested in it because through the use of aligned nuclei it may sometime be possible to obtain temperatures as low as one millionth of a degree absolute. The nuclear physicist is interested because the study of neutron scattering and capture by aligned nuclei will give information about the spin of the nuclear compound state, and about nuclear forces.

The theoretical and experimental aspects of the problem of first producing aligned nuclear spins and second using the aligned nuclei in nuclear physics investigations were discussed by M. E. Rose, H. B. G. Casimir, J. G. Daunt, E. M. Purcell, and F. London. Nuclear spins, it was suggested, might be aligned in some such way as this. If a nucleus has a spin, it will also have a magnetic moment. If this nuclear magnet is subjected to an intense magnetic field it will tend to be oriented with the field, but this tendency will be opposed by thermal motion. Only when the magnetic field energy of the

nucleus is comparable to its thermal energy will nuclei line up in any numbers. Because the nuclear magnetic moment is very small, the temperature must be exceedingly low to minimize the thermal motion, and the magnetic field must be very large to get the maximum orienting force. For example, the easiest nucleus to align would be the proton, and even this would require a field of thirty five thousand oersteds at a temperature of one hundredth of a degree absolute to give about ten percent alignment. A higher magnetic field, of, say, one hundred thousand oersteds would of course be more desirable for its greater orienting effect but fields of this magnitude are difficult to obtain.

Cooling the nuclear spin system of a sample of material to a temperature of about one hundredth of a degree absolute, also difficult, is partly a question of transferring heat from the nuclei to the surrounding lattice and partly that of transferring it through the lattice to the source of cold. Briefly, if the lattice has paramagnetic impurities, or is itself paramagnetic, the energy transfer from the nuclei to the lattice may be possible within a reasonable time, even at one hundredth of a degree absolute, but this has not been demonstrated experimentally. As to heat transfer through the bulk of the material, it seems that only good metallic electrical conductors like copper—but not superconductors—will have usefully large heat transfer coefficients at one hundredth of a degree absolute.

In conclusion, it seems that the alignment of nuclear spins is theoretically possible but that there are many hard technical problems to be solved before the goal can be reached. Once this goal has been attained, many new research possibilities in the low temperature and nuclear fields will be opened. For example, scattering and absorption measurements with polarized neutrons would provide information concerning spin dependence of the forces and would, in principle, determine the shape of the nuclear well for both spin orientations. M. E. R. and L. D. R.

Operations Research

A General Research Office has been established at The Johns Hopkins University, under contract with the Army, to apply techniques of scientific analysis to military problems in weapons development, strategy, tactics, and logistics. Under the General Staff supervision of Major General A. C. McAuliffe, who heads research and development for the Army, the new organization is directed by Ellis A. Johnson, physicist on leave from the Carnegie Institution of Washington. Its program specifies the broadest use yet announced of operations research, such as analysis of optimum weapons, equipment, and systems for anti-aircraft defense, studies of relative value of short range guided missiles, free rockets, and artillery, and studies of comparative over-all costs of various methods of waging ground warfare. The program includes evaluation and planning of specific weapons as well as complete weapon systems and analysis of psychological problems in personnel relations and problems involving coordination with the Navy and Air Force. The Office will be part of The Johns Hopkins University's Institute for Cooperative Research. Staff members are not under civil service but are appointed by the president of the University and can participate in other activities of the University.

NBS News

Electron microscope experiments conducted by L. L. Marton of the National Bureau of Standards have developed an electron optical analogy to the Schlieren effect for the quantitative study of electrostatic or magnetic fields. By forming a dark field image of magnetic or electric fields occurring between the electron source and a magnetic lens, a visual representation of fringe fields from the small domains of spontaneous magnetization in ferromagnetic materials is obtained. The characteristics of such field intensity patterns may then be used to compute the field distribution in the region under study. Extension of the principle provides a means of broadening present knowledge concerning space-charge fields, fields produced by contact potentials, wave guide problems, and the microstructure of metals.

Thus the new Schlieren method can be used to explore complex electric and magnetic fields of extremely small dimensions. Heretofore, field intensity at a point could be computed only in the special cases when the field was geometrically symmetrical. Using Schlieren images, the actual intensity in the neighborhood of a sample of any shape can be computed.

The technique was developed at the Bureau to measure the magnetization of wire used in sound recorders or electronic computers. But many other uses have suggested themselves. The Bureau plans a study of the behavior of fringe field patterns as a function of temperature up to the Curie point and a repetition of the measurements on a single crystal material having very large domains. There are also plans for extending the method to ferroelectric materials, to check the domain theory.

Dr. Marton addressed the French Physical Society on the new Schlieren effect when he was in Europe this summer, surveying current work in electron optics and helping to organize such research in Belgium, where he did fundamental work on the subject before 1938.

The National Bureau of Standards has developed methods for grinding and polishing thallium halide crystal prisms useful in long wavelength infrared spectrometry. Prisms of other materials, such as potassium bromide, have been available for measurements to twenty-four microns; the new thallium bromide-iodide prism allows observations up to forty microns.

AEC News

A program for the production and domestic distribution of several important chemicals tagged with radioactive elements, for research, medical, and industrial use, was announced by the United States Atomic Energy Commission. For the past two years investigators have been able to get radioisotopes from the Oak Ridge National Laboratory but they have had to synthesize or manufacture special compounds in their own laboratories.