

direct observation of frequencies in the 10,000 megacycle range.

Precision milli-decibel wave guide attenuation measurement techniques for four-terminal, low-loss microwave structures was presented by J. H. Vogelmann (Watson Laboratories). Techniques and equipment were described which minimize the errors due to nonlinearity of detectors, power reflections from the test sample, noise in the detector amplifiers, residual frequency modulation of signal source (long line effects), and attenuation in the measuring line. Termination impedances and corrections on rated values of dissipative type attenuators terminated in any complex impedance were discussed in a paper by Charles M. Allred (NBS).

The final session was opened with a paper by J. A. Saxton (Radio Division of the National Physical Laboratory, Teddington, England) who discussed a field strength meter designed primarily to study radio wave propagation at 600 mc. The meter has a fairly wide band intermediate frequency amplifier to ensure that a received signal remains in tune during long periods of recording. As a calibrated instrument, however, it may be used for accurate comparison of radio field strengths, or powers, over a frequency range 500-700 mc/sec. W. J. Albersheim (Bell Labs) discussed the measuring technique for broad band long distance radio relays. By rapid scanning, transmission characteristics can be traced on paper strips or cathode ray screens, and alternating switches will permit the superposition of reference traces. Methods of measuring transmission and impedance of traveling wave tubes operating in the 4,000 megacycle common carrier band in which the frequency is swept over a 500 megacycle band were described by F. E. Radcliffe (Bell Labs).

A survey of microwave measurement techniques in the 28,000-300,000 megacycle region was made by Leonard Swern (Sperry Gyroscope Co.). Emphasis was on techniques fundamentally similar to those effective at lower frequencies. However, new approaches to the microwave measurements problem were discussed; among them, optical and semi-optical approaches, and the applicability of molecular resonance absorption. Recent extensions of crystal-controlled frequencies into the microwave region by harmonic generation, and the extension of the frequency range of crystal units in filter networks have called for more accurate measurements of the electrical elements of the equivalent network of the crystal unit. Work of this nature being conducted at The Bell Telephone Laboratories was reported by L. F. Koerner.

The shape of a flat conducting surface has considerable effect on the microwave reflections from it when the source-to-reflector distance is of the order of magnitude of the dimensions of the reflector. S. J. Raff (Naval Ordnance Laboratory) designed an optimum shape for simulating the reflection back to the source of an infinite plane reflector. It was designed for a surface inscribed in a circle of 23 wavelengths diameter, 25 wavelengths from a dipole antenna, and showed a maximum error of 3%; the reflection measured from this surface was within 4% of the infinite plane reflection over the range of 15 to 35 wavelengths from the antenna.

The Conference was concluded with a group of demonstration lectures. A Stark-modulation type microwave spectrograph displaying ammonia absorption lines on a projection oscilloscope was exhibited by L. J. Rueger, R. G. Nuckolls, and H. Lyons of the NBS. Nuclear quadrupole hyperfine structure lines, Stark effect, pressure broadening of the lines, and possible power saturation were shown. Of

particular note were the possible applications of this technique to chemical analysis, chemical reaction rates, isotope analysis, and nuclear physics. An instrument which measures and records minute differences in frequency between a test cavity and a reference cavity and used for recording the atmospheric index of refraction at microwave frequencies was exhibited by George Birnbaum, S. J. Kryder, and R. R. Larson of the NBS. The output meter of the instrument was projected on a screen, and variations in meter reading were noted as someone breathed into the test cavity or a moist blotter was held near it. The 2600 to 4000 megacycles VSWR measuring set developed by S. F. Kiesel and J. W. Kearney and discussed during the second session was also displayed. A quantitative picture of the VSWR looking into a wave guide was visually demonstrated on an oscilloscope.

W. E. Kock (Bell Labs) presented the principal demonstration lecture of the evening. A mechanical scanning method for photographically displaying the space patterns of microwaves and centimeter wave length sound waves was first described and then refraction, diffraction, and focusing of these waves by iterative metallic structures were demonstrated. Photographs of a large variety of field patterns and the simultaneous focusing of sound waves and microwaves by the same lens were also shown.

ELECTRON EMISSION SYMPOSIUM

APS DIVISION OF ELECTRON PHYSICS

A conference on the physics of the emission of electrons from solid surfaces was held at City College, New York City, January 30-31, 1951. This meeting was organized and sponsored by the Division of Electron Physics of the American Physical Society and by the Panel on Electron Tubes of the Research and Development Board. Twenty-eight papers were heard and discussed by an audience of about 250.

About half of the proceedings were concerned with thermionic emission of electrons. The physics of the Philips' "L cathode" and of the new boride cathodes was discussed. New data were presented on precious metal and rare-earth-oxide emitters. Alkaline-earth-oxide cathode work presented included a tentative energy level diagram for BaO, some new electrical conductivity studies, a review of cathode interface effects, a study of life as a function of reducing agents present in the base nickel, and a study of the diffusion of Ba in BaO. New work was presented on the adsorption of strontium on tungsten and on the electron emission from alkaline earth metals and from zirconium. Results of a study of the diffusion of magnesium through nickel were applied to electron emission problems. A theory of the bombardment-enhanced thermionic current from an oxide cathode was presented. The cause of the "high-speed, ten-volt effect" in vacuum tubes with oxide cathodes was identified with space-charge and secondary emission effects.

Field emission studies were presented of sodium chloride and of tungsten single crystal surfaces, including an investigation of the migration of tungsten on the latter. Another talk related high voltage breakdown to field emission in certain cases.

Secondary electron emission at high current densities for reasonably long periods of time was described. An extension of Wooldridge's theory of secondary emission was presented. A paper was given on the emission of electrons by positive ion bombardment of a solid surface.

Radiation-enhanced photoelectric emission from oxide cathodes and photoconductivity in composite photoemitters were described. A study of photoemission from F-centers on

rubidium bromide revealed some optical interference effects.

There were two papers on techniques in electron emission studies. One of these described new gauges, valves, and other techniques useful in the production of vacua of the order of 10^{-10} mm of mercury. The other presented new work on electron counting (using a secondary emission multiplier and pulse amplifier) applied to electron emission studies.

The titles of invited papers and the abstracts of contributed papers will appear in the *Physical Review*.

The conference gave specialists in this field of physics an opportunity to hear about recent work and discuss common problems. There were no simultaneous sessions competing for attention, so everyone could hear whatever papers he wished to hear. Since this meeting was held just before the New York APS meeting, some of the pressure for time on the program of that meeting was relieved by presentation of papers at this conference instead.

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MEETINGS TO BE HELD

APPLIED MATHEMATICS SYMPOSIUM

The Fourth Symposium on Applied Mathematics of the American Mathematical Society, with Fluid Dynamics as its theme, will be held at the University of Maryland, College Park, Maryland, and the United States Naval Ordnance Laboratory, White Oak, Maryland, cosponsoring institutions, on Friday and Saturday, June 22nd and 23rd. Sessions on turbulence, foundations, compressible and incompressible flow are planned. Participation in the program is by invitation of the Committee on Arrangements, and inquiries should be addressed to the Committee's chairman, M. H. Martin, at the University of Maryland, College Park, Maryland.

GORDON RESEARCH CONFERENCES

The 1951 Gordon Research Conferences, sponsored by the American Association for the Advancement of Science, will be held from June 18 to August 31. Sessions on the physics and the chemistry of metals will take place from July 9 to 13, and there will be an instrumentation conference from July 30 to August 3. The conferences will be held at the New Hampton School, in New Hampton, N. H. The first meeting will be concerned mainly with surfaces of metals. The second meeting will include subjects dealing with recent advances in infrared instrumentation, microspectrophotometry, refractometry, magnetic measurements, spectroscopy, and other specialized instruments. Communications should be directed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I.

AIEE MEETS IN TORONTO

Electrical engineers and scientists from Canada and the United States will have an opportunity to inspect industrial installations in Toronto during the Summer General Meeting of the American Institute of Electrical Engineers at the Royal York Hotel, June 25-29. Some 1800 scientists are expected to attend the five-day session, one of four held annually by the Institute. Technical sessions will cover a wide variety of subjects, including transmission and distribution, relays, electronic power converters, power generation, instruments and measurements, feed back control systems,

nucleonics, wire communication systems, computing devices, protective devices, industrial power systems, electronics, mining and metal industry, metallic rectifiers, and system engineering. In addition, technical trips to various plants and several social events are planned.

CANADIAN MATHEMATICAL CONGRESS

The third summer seminar of the Canadian Mathematical Congress will be held from August 17th to September 7th at Dalhousie University, Halifax, Nova Scotia, and will feature research and instructional lectures and sub-seminars on statistics, probability, and cognate fields of mathematics. While the subjects have been chosen because of the relation between the modern theories of statistics and probability and the theory of functions of real variables, lectures of a general nature, designed to appeal to specialist and non-specialist alike, will be given in parametric surfaces, measure theory, matrices and quadratic forms, and pure mathematics. Lodging and board will be arranged through the facilities of Dalhousie University, with additional accommodation planned for families. Inclusive fee for membership is \$10. Further information may be obtained by writing to Canadian Mathematical Congress, Engineering Building, McGill University, Montreal, Canada.

NUCLEAR PHYSICS AND FUNDAMENTAL PARTICLES

The University of Chicago's Institute of Nuclear Studies has announced that it will sponsor a five-day international conference on nuclear physics and fundamental particles next September. Invitations have been sent out to more than one hundred leading physicists, including twenty-five foreign scientists. Visiting scientists will be housed in Burton-Judson Court of the University. The meetings will include ten major papers dealing with nuclear physics and the physics of fundamental nuclear particles, with emphasis on researches conducted with high energy particle accelerators. Funds for the conference are being supplied by the Office of Naval Research and the Atomic Energy Commission.

ABRASION AND WEAR SYMPOSIUM AT DELFT

An international symposium on friction and lubrication problems and on the abrasion and wear of metals, plastics, rubber, and other material is to be held next November at Delft, Holland to celebrate the opening of the new building of Rubber-Stichting, a research and development institute concerned with natural rubber. R. Houwink heads the organizing committee, and it has been announced that papers will be presented by scientists from a number of countries. Further information may be obtained from the secretary, H. C. J. de Decker, P. O. Box 66, Delft, Holland.

BRITISH ASSOCIATION MEETS IN SCOTLAND

The 113th meeting of the British Association, a scientific organization established in 1834, will be held this year in Edinburgh from August 8 to 15. Sessions will touch on past and future physics, chemistry, geology, engineering, physiology, philosophy of science, psychology, and the social and international relations of science. A provisional program is now available, it has been announced, and a full program will be published early in July giving detailed arrangements for the meeting. Further information can be obtained from the secretary of the British Association, Burlington House, Piccadilly, London W. 1.