



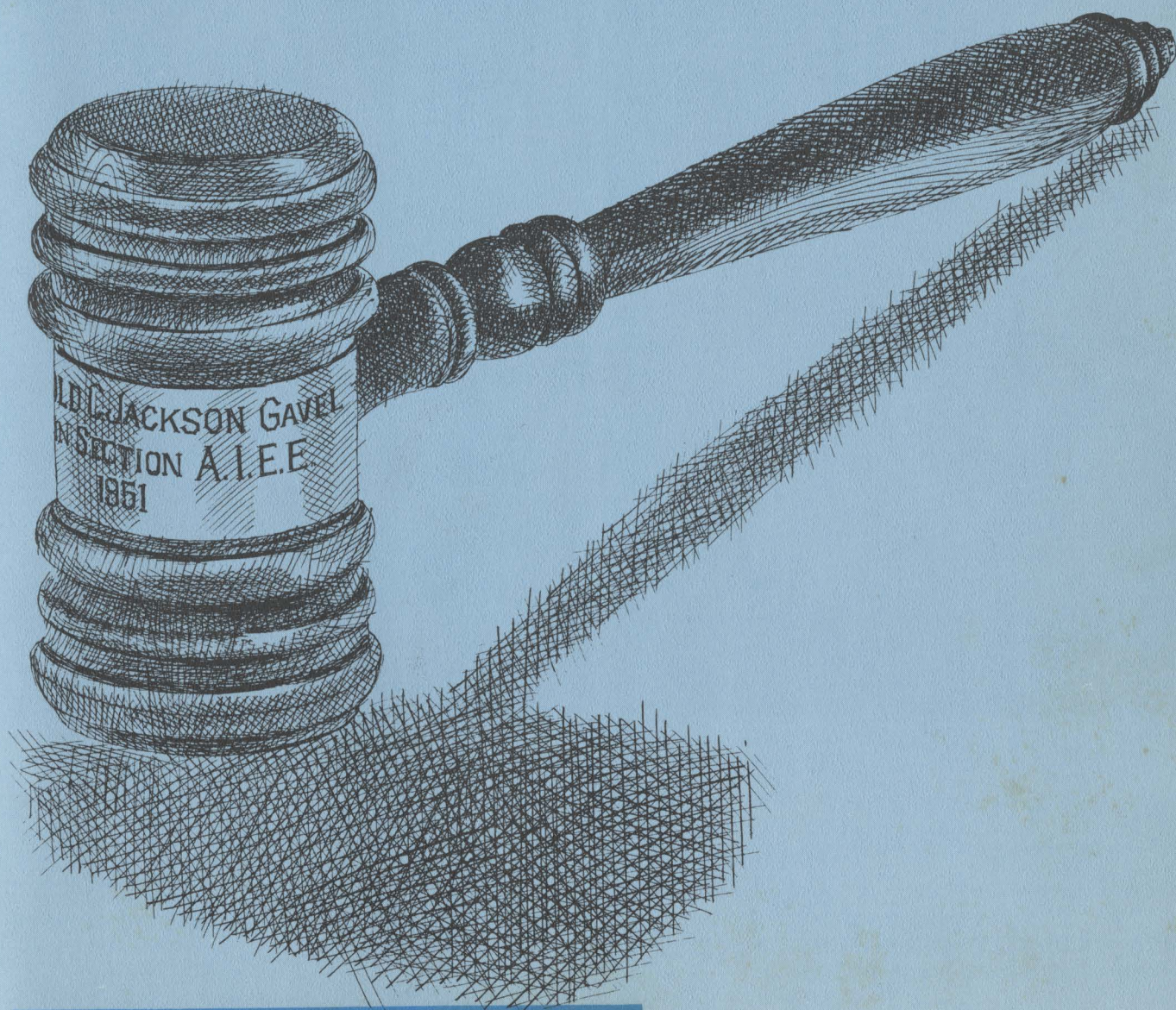
The Reflector

SEPTEMBER 1963
VOLUME 12, No. 1

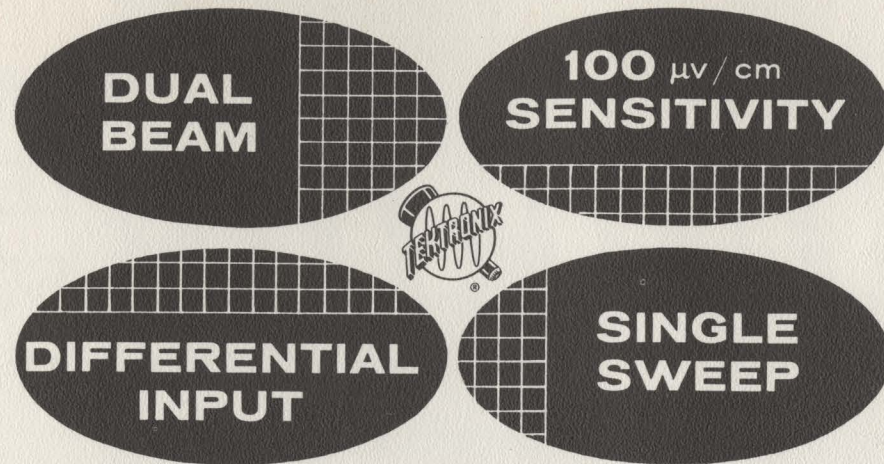
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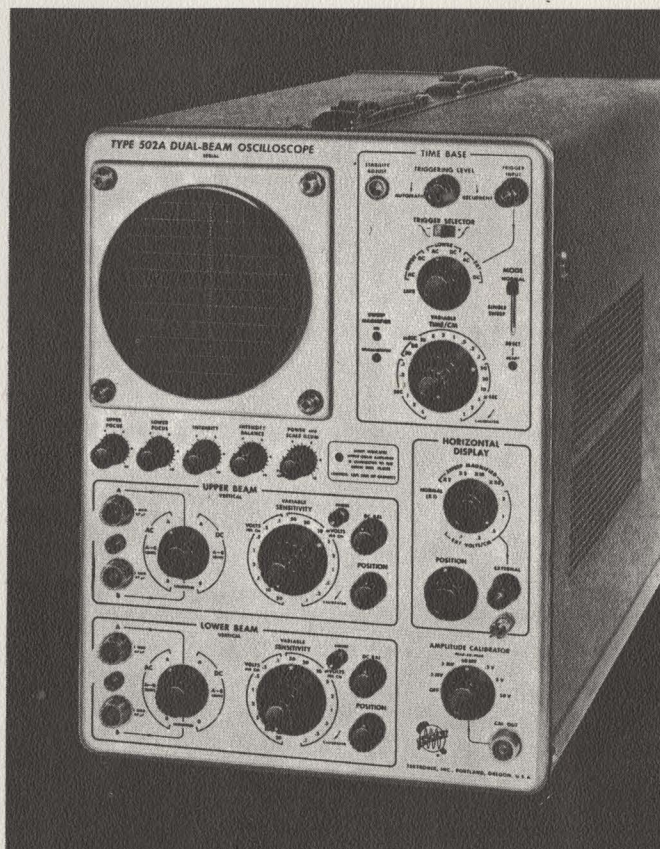


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R. H. G.	17
Sylvania	11
Techni-Rite	20
Tektronix	2, 14
W. & L. E. Gurley	7
Yewell Associates	23
Harrison Laboratories	9

The Reflector

SEPTEMBER 1963

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COVER STORY

The Jackson Gavel
See pages 8 & 10

THE NASA ELECTRONICS CENTER



RONALD E. SCOTT
Chairman — Boston Section

THE most important electronics event of our 1963-64 season will be the disposition of the NASA electronics center. It seems clear that there will be such a center. Let us hope that it comes to Boston.

NASA needs an electronics center. An interdisciplinary problem such as space research requires groups of scientists from many disciplines to be housed within a single building where they can interact and set up an intellectual environment to stimulate new concepts. In addition the same manpower capability can provide superior systems management for the diverse sub-contractors in the general area of space electronics.

NASA management of this facility is preferable to company management because no one company can provide the necessary capability without dominating the whole field. NASA management is preferable to university man-

agement because the systems-management function is not suitable for an academic environment.

Boston is the ideal location for such a facility. It has an intellectual climate which attracts scientists in such diverse fields as physics, electronics, biology, medicine, and food technology, all of which are important to NASA. It has a large pool of graduate students available for training in these areas. And above all, it has a large number of small but creative companies whose capabilities are being overlooked by NASA at the present time.

The new laboratory could break up many of the mission-oriented problems of NASA into smaller parcels which could be handled by these companies. An increased use of small company capability, much of which is centered in New England, would be good for the area and good for the nation.

Table of Contents

Executive Committee	3
PTG Chapter Officers	4 & 21
The NASA Electronics Center	5
PTG Chapter Meetings	6, 7, 10, 12, 13, 17, 18, 19 & 20
Cover Story	8 & 10
New IEEE Publications Policy	8
Dean Willenbrock Nominated	14
Merrimack Valley	14
New PTG Chapter Formation	16

TUTORIAL SESSIONS ON ENERGY CONVERSION

COINCIDENT with the general advancement of our civilization, certain basic and powerful concepts evolve. One such significant concept is "energy sources as the basis of productivity." With the recognition of energy sources, so to speak, as the basis of prosperity, comes naturally a concern with conversion of energy from one useful form to another. It becomes increasingly evident that the two major classes of energy conversion are the conversion of fossil fuels to locomotive power and the conversion to the electrical power from a variety of sources. Generally then, we restrict the definition of energy conversion to the generation of useful electrical power from other energy sources.

The tutorial session on energy conversion will be concerned with a review of the present status of the conversion to electrical power by five important means.

- (1) fossil fuel—steam turbine
- (2) nuclear fuel—steam turbine
- (3) photovoltaic
- (4) thermoelectric
- (5) fuel cell

It is unfortunately impossible to cover the many remaining means in one evening, such as techniques in plasmadynamics, batteries, chemical conversion, or exotic techniques such as biological energy conversion, etc.

Due to an expression of interest by the group membership, and as an experiment, this meeting will be tutorial in nature, with three invited speakers and will be quite long (estimate 2½ hours).

PANEL DISCUSSION—After the speakers' presentation, a panel discussion and question period will be presented, which panel discussion might be subtitled twenty nasty questions concerning energy conversion. The membership are invited and encouraged to bring their own questions.

Fossil and Nuclear Fuel Energy Conversion

The design principles and operation of central station power generation equipment will be briefly reviewed. The subject will include also a review of the status of total power cost to the user, comprising generation, transmission, and distribution, as well as the significance of these three items and the trends that are expected to occur during the next decade. Power pooling affects the size and efficiency of generating units and the system interconnections (transmission). The centralized dispatching of energy on these pools also has a significant effect on base generation and the types of units to be used.

The current status of nuclear fuel and fossil-fueled plants will be presented. The future economic and technical trends in these plants and how they can be effectively integrated into the utility system will be presented, with the projected growth of energy requirements and the role of both fossil and nuclear fuels to meet these requirements.

Mr. Harold E. Vann is Vice-President and Manager of the Nuclear Department at Jackson and Moreland, consulting engineers of Boston and New York. Prior to 1960, Mr. Vann was Chief of the Planning Section, Division of Reactor Development for the Atomic Energy Commission, and as such was responsible for the preparation of several of the ten-year reactor development programs. Mr. Vann has also spent nearly ten years with General Electric in a variety of capacities including test, design, layout of steam turbines and generator. He has published numerous papers on fossil and nuclear fuel power generation.



HAROLD E. VANN
Jackson & Moreland

Fuel Cell Energy Conversion

A brief description of the underlying principles of fuel cell operation which distinguish them from other energy conversion devices will be given. These include the distinction between the free energy and the carnot cycle, and the main sources of irreversibility preventing attainment of the theoretical limits.

Some examples of fuel cells familiar to the author will be discussed including (1) the GE ion exchange membrane system and its application to space power and (2) the new direct hydrocarbon cell and its application to ground power. A brief set of predictions will conclude the talk.

Dr. Eugene A. Oster is in charge of the Fuel Cell Laboratory of the Direct Energy Conversion Operation of General Electric in Lynn. For the last three years he has been involved in various aspects of fuel cell research and is primarily currently concerned with optimization of electrochemical fuel cells employing both solid and liquid electrolytes and hydrogen and hydrocarbon fuels. Prior to joining General Electric in 1956, Dr. Oster spent five years at MIT's Division of Sponsored Research on experimental metallurgy, ram-rocket combustion design, auto ignition combustion, etc. Dr. Oster received his B.S., M.S., and Ph.D. from MIT.



EUGENE OSTER
General Electric

(continued on page 7)

THURSDAY, SEPTEMBER 12

Dinner — 6:00 p.m. — MIT Faculty Club

Meeting — 7:30 p.m. — MIT Room 5-134

Solid State Energy Conversion

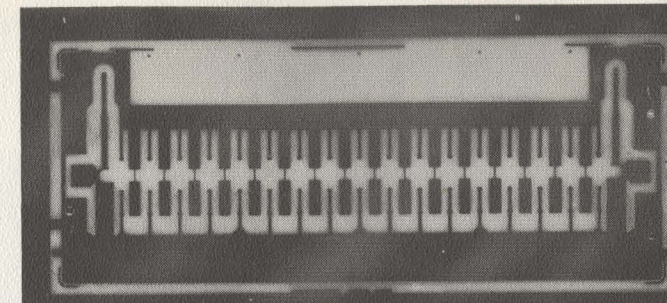
THERMOELECTRIC and photovoltaic conversion devices will be discussed as a means for the direct conversion of solar energy and thermal energy. These device classes each have areas of applicability where their special characteristics make their applications highly attractive. Besides efficiency, such factors as electrical power output to weight ratios, long-term reliability, resistance to radiation damage, and economics of fabrication are major considerations. The capabilities and limitations of solid state energy conversion devices will be discussed with these factors in mind.

Some of the new devices currently under investigation at the MIT Energy Conversion Laboratory, such as heterojunction converters and graded semi-conducting energy gap structures, will also be discussed.

Dr. John Blair is an Associate Professor of Electrical Engineering at MIT and carries on research in the Energy Conversion Laboratory of the Research Laboratory of Electronics. Professor Blair is also the chairman of the Energy Conversion Division of the IEEE-PTG on Electron Devices.



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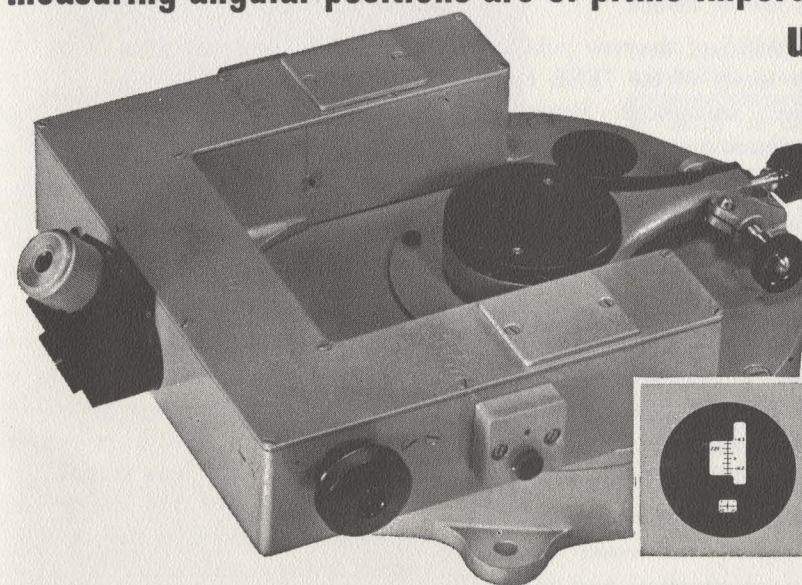
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First Chairman of Boston IEEE Receives Jackson Gavel



DEAN RONALD SCOTT, the first chairman of the Boston Section IEEE, is shown receiving the Jackson Gavel from H. F. White, vice chairman of the former AIEE. The Jackson Gavel was instituted in the AIEE as a memorial to Professor Dugald Caleb Jackson who pioneered in

electrical engineering education and in the professionalization of engineering.

Dugald Caleb Jackson came to MIT and Boston in 1907 from the University of Wisconsin where he headed, organized and built up the Electrical Engineering Department to national prominence. He was chosen to head

Continued on page 10

New Publications Program for the IEEE

DETAILS of the new publications program of the IEEE have recently been announced. Heart of the plan is the inauguration of a major new publication to serve the Institute and the interested public.

Beginning in January 1964, the IEEE will publish a totally new "core" publication titled *IEEE Spectrum*, which will be distributed to all IEEE members except Student Members. Its primary editorial purpose will be to present technical articles of high professional quality written so as to be meaningful to a wide audience. The subject matter will cover the entire spectrum of electrical and electronics engineering. Special emphasis will be placed on the clarity of the articles—both staff-written and contributed by leading authorities in the field—to ensure that members can keep abreast of important technical developments out-

side their own particular fields of specialization.

The *IEEE Spectrum* will include review, tutorial, and application papers; occasional theoretical papers of outstanding significance; news of the profession and of the Institute; letters to the editor; abstracts; and book reviews.

A second monthly periodical, *Proceedings of the IEEE*, will be available to members and non-members on a subscription basis. A continuation of the present *Proc. IEEE*, but expanded to embrace all fields served by the IEEE, it will be a research-oriented journal for advanced papers of broad and lasting significance.

Publication of the proliferating *IEEE Transactions*, the *IEEE Student Journal*, and various special convention and conference records will continue, but *Electrical Engineering* will be dropped, since its present functions will be carried on by the *IEEE Spectrum*.

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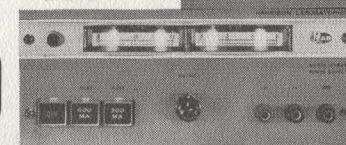
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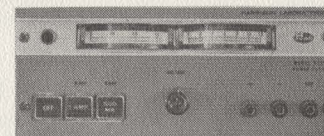
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SEPTEMBER, 1963

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(Continued from page 8)

the newly formed MIT Electrical Engineering Department and remained in this position until his retirement in 1935. During this period, Professor Jackson built the Electrical Engineering Department so well that it had national and international repute as being one of the best.

During World War I, Professor Jackson served in France with Edward Moreland to evaluate their electrical power system. Following the close of World War I, he organized the engineering firm of Jackson and Moreland.

He was very active in the engineering profession. From 1909-1910 Professor Jackson was chairman of the Boston Section AIEE, from 1911-1912 being President of the same organization. He was active in many other professional societies.

For many years at MIT he taught an undergraduate subject, Organization and Administration of Public Utility Companies. This subject was scheduled for Thursday afternoons from two until five. Very seldom did the class adjourn prior to 5:30 unless Professor Jackson ran out of cigars before that time. The subject was attended by a great many of MIT's alumni graduating in the period of the 1920's and early 1930's. He was a forceful and dynamic leader and those who served with him on the staff recognized him as a leader who knew what was going on in his department.

Utility Systems Tour

THE newly formed IEEE Professional Technical Group of Utility Systems has chosen a tour of the operation nerve center of a large power company for its first meeting. Automatic economic generation, transmission and distribution of all electrical power in the Boston Metropolitan Area plus interconnection with power companies in the power grid is controlled from this point.

The tour will begin at 7:30 p.m., Tuesday, September 17, 1963 at the System Dispatcher's Headquarters of the Boston Edison Company, Cambridge Street, Boston (opposite the Charles Street MTA Station).

There is adequate parking in the Cambridge Street area. No cameras will be allowed; only citizens of the U.S.A. may attend. Since this meeting can only accommodate 35 persons, we urge you to call W.F. Hamm early at HI 2-9000, ext. 135 for reservations.

TUESDAY, SEPTEMBER 17
Meeting - 7:30 p.m. - Boston Edison Co.
System Dispatcher's Headquarters

The Utility, the Consulting Engineer, and the User

A. F. ANDERSON, W. J. GROSSI and J. H. WATSON

ANOTHER IEEE Professional Technical Group, specializing in Industrial Systems, has been formed. Their first meeting will be of interest to both suppliers and users of commercial and industrial power.

At an increasingly fast pace, prospective customers and existing customers with growth plans are asking their electric utilities to produce and sell more power. A variety of technical problems exist whenever a power consumer prepares to tie in to a utility. Many users find it necessary to employ a consulting engineer. The consultant becomes, in these cases, his client's liaison with the power company. In any event, close relationships with the utility must begin

early and continue throughout the entire installation.

The three speakers from Boston Edison are thoroughly familiar with the details, challenges, and satisfactions of supplying their customers with new power service entrances. Users of downtown low voltage network systems will be the topic of A. F. Anderson, head of the street design section of Edison's engineering and construction department.

W. J. Grossi, supervising engineer in the distribution division, will discuss high voltage services with particular emphasis on suburban industrial users. Metering situations, both primary and secondary, will be handled by J. H. Watson, Division Head, meter installations for Boston Edison.

WEDNESDAY, SEPTEMBER 18
Meeting - 8:00 p.m. - MIT 4-231

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ELECTRON DEVICES - See pages 6 and 7

"Tutorial Session on Energy Conversion"

- 1) Fossil and Nuclear Fuels - Harold Vann, Jackson & Moreland
- 2) Photovoltaic and Thermoelectric - John Blair, MIT
- 3) Fuel Cell - Eugene Oster, General Electric

Panel Discussion and Questions - Chairman, Richard G. Seed, Northeastern U.

SEPTEMBER 17
Tuesday, 7:30 p.m.

UTILITY SYSTEMS - See page 10

Tour of Operation Nerve Center of a Large Power Company
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Cambridge St., Boston Meeting Chairman: W. F. Hamm, Boston Edison Co.
opposite Charles St. Reservations necessary - Call W. F. Hamm, HI 2-9000, x135
MTA Station

SEPTEMBER 18
Wednesday, 8:00 p.m.

INDUSTRIAL SYSTEMS - See page 11

MIT, Room 4-231 "The Utility, the Consulting Engineer and the User"

W. J. Grossi, A. F. Anderson and J. H. Watson,
Boston Edison Company

SEPTEMBER 23
Monday, 7:30 p.m.

MERRIMACK VALLEY SUBSECTION - See page 14

Student Union Building, Merrimack College, North Andover

"Motivation of Technical Personnel"

Edgar F. Huse, General Electric Co.

Dinner - Butcher Boy Restaurant, Routes 133 and 125, N. Andover - 6:00 p.m.

SECTETING

Engineering in the Face of Life & Man

DR. ROSENBLITH
Director of MIT Instrument Office in the
Biological Sciences

Dr. Rosenblith will discuss applications of science and technology to biology and the life-sciences. Computer technology is revolutionizing the Biomedical Sciences. Dr. Rosenblith's various degrees, awards and positions, etc., are too numerous to list here. His major fields of interest include quantification of electrical activity of the nervous system; handling of sensory information by organisms; timing and effects of technological change on science and society. Dr. Rosenblith's work has appeared in approximately thirty principal publications throughout his illustrious career.

TUESDAY 8

Meeting 8:00 D. Little, Inc.

September 24
Tuesday, 8:00 p.m.

AVCO R & D
201 Lowell St.
Wilmington

INSTRUMENTATION AND MEASUREMENTS

See page 18

"A Review of Length Measurement and Instrumentation"
Stanley P. Cholewa, AVCO

SEPTEMBER 24
Tuesday, 8:00 p.m.

Executive Offices
Raytheon Company
Route 2 & 128, Lexington

PRODUCT ENGINEERING AND PRODUCTION

See page 17

Panel Discussion
"High Density Electronic Interconnections"

Moderator: Leonard R. Bradford, Raytheon Co.

Dinner - Raytheon Company Executive Offices - 6:30 p.m.

SEPTEMBER 26
Thursday, 7:45 p.m.

Raytheon Executive Offices
Route 2 & 128, Lexington

RELIABILITY - See page 19

"New Concepts and Latest Techniques in Reliability Engineering"

Ronald A. Howard, MIT

Dinner - Raytheon Company Executive Offices - 6:30 p.m.

Reservations: \$4.50 to Ray Barnes, Sylvania, Woburn

SEPTEMBER 26
Thursday, 8:00 p.m.

MIT, Room 4-231

JOINT MEETING MICROWAVE THEORY & TECHNIQUES, COMMUNICATION SYSTEMS AND ANTENNAS & PROPAGATION - See page 20

"Terrestrial Millimeter-Wave Links"

Cocktails and dinner - Coach Grille, Harvard Square, Cambridge - 6:30 p.m.

ELECTRICAL DESIGN OF INDOOR AND OUTDOOR SUBSTATIONS

SUBJECT AREAS

- Overall Factors Determining Design
- Equipment Selection and Specifications
- Protection
- Disconnecting Devices
- Instrument Transformers

Speakers and all other details will be held in the October REFLECTOR

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- Power Sources
- Components
- Government Views

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Motivation of Technical Personnel

EDGAR F. HUSE
General Electric Co.

A MANAGER'S understanding of the motivations and needs of his personnel can lead to mutually beneficial results in any endeavour. Nowhere is this more true than in the technical and scientific field where the evaluation of effectiveness poses many difficulties. In recent years, research psychologists have paid more specific attention to the motivations and needs of technical and scientific personnel. Dr. Huse will review and summarize the more recent findings in this field, and will also discuss the implications of these findings for the management of technically trained individuals and engineering work groups.

Dr. Huse is Consulting Psychologist at the General Electric Company, West Lynn, Massachusetts and is a part-time faculty member of the Graduate School of Business Administration, Boston College. He was previously manager of Selection and Counselling (Corporate) with the Raytheon Company, Lexington, Massachusetts, and has had a wide experience in the field of personnel management and research. Dr. Huse is the author of several papers on psychology dealing particularly with various aspects of personnel management.

MONDAY, SEPTEMBER 23
See Center Spread For All Details

Dean Willenbrock Nominated for IEEE Board

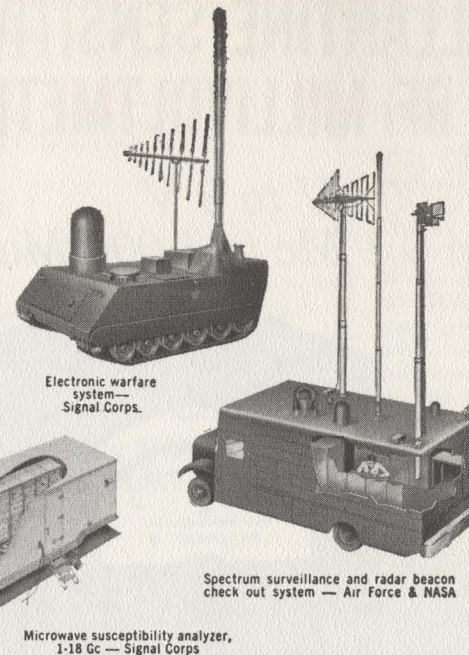
DR. F. KARL WILLENBROCK, Associate Dean and Director of Laboratories of Engineering and Applied Physics at Harvard University, has been nominated one of twelve candidates for Director-at-Large of the IEEE. Six of these candidates will be elected to the Board in a world-wide ballot of the voting members.

Dr. Willenbrock is currently an IEEE Director. He was active in IRE affairs for many years preceding the IRE-AIEE merger, having served as Chairman of the Boston Section of the IRE, as Chairman of the Technical Program Committee of NEREM, and as IRE Director for Region 1. He has been active as a consultant for both government and industry. At present he is a Consultant for the Sperry Rand Research Laboratory, Sudbury, and a Consultant to the Research Director of the Office of Naval Research, Washington.



F. K. WILLENBROCK
Harvard University

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Voltage Range..... 300 μ V to 3 V	Crest Factor..... 100 to 3 depending on voltage range
Frequency Range..... 0.1 Mc to >1,000 Mc; calibrated to 700 Mc	Scales..... Two logarithmic voltage scales, 0.95 to 3.3 and 3.0 to 10.6. One decibel scale, 0 to 10
Indication..... True-RMS on all ranges, all voltages	Mean Square DC Output... 0.1 V to 1.0 V dc. Internal resistance 20 kilohms. (For connection to recorder.)
Accuracy...% of Reading	
0.1 Mc — 100 Mc, 4%;	
100 Mc — 700 Mc, 10%;	
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Nuclear Science Chapter Reactivated

THE interest of the Boston Section IEEE members in nuclear physics and nucleonics is being rekindled with the reactivation of a professional group on nuclear science. The new group will be known as the Professional Technical Group on Nuclear Science. Dr. Arthur Winston of Space Sciences, Inc. is Group Chairman. Mr. Charles Pescatore of Jackson and Moreland is Vice Chairman and Mr. Albert Doskocil of Raytheon Space and Information Systems Division is Secretary-Treasurer.

Four meetings will be held this year. These are tentatively scheduled for October 23, December 19, February 25 and May 14. The activities of the Group will cover the fields of plasma physics, controlled fusion, nuclear instrumentation.

The first meeting will be a joint meeting with the Professional Technical Group of Microwave Theory and Techniques and the Professional Technical Group on Electron Devices. Professor A. Bears of MIT will speak on beam plasma interactions and will include in his talk considerations of the theory of heating of plasmas and applications to fusion.

Chapter of PTGSET Being Organized

ORGANIZATION of a Boston Chapter of the Professional Group on Space Electronics and Telemetry is well under way, and meetings sponsored by the new chapter are planned for the coming season. Members who have suggestions for the technical program or who are interested in participating in the organization of the chapter should get in touch with Jack Larsen at the MIT Instrumentation Laboratory or with M. D. Rubin of the MITRE Corporation.

Panel Discussion on High-Density Interconnections

PRECISION SPOT WELDING — PRINTING WIRING SOLDERED

TWO years ago PTGPEP sponsored a panel discussion comparing precision spot welding with printed-wiring soldering in high density electronic interconnections. Techniques used in this controversial field are changing rapidly. The latest developments, and the advantages and limitations of each method as applied to the demands of reliable space age electronics will be discussed.

The moderator of the panel discussion is Leonard R. Bradford, Staff Engineer at the Raytheon Company, Wayland.

The advocates of welded electronics are:

Samuel Francis, Vice President and Technical Director of Francis Associates, Marion;

James Hilker, President of the Welded Electronics Manufacturing Association, American Bosch Arma, Garden City, L.I., N.Y.;

Charles Heslin, Quality and Reliability Engineering Manager, Raytheon Company, Industrial Components Division, Newton.

The proponents of printed wiring soldered are:

Robert Swiggett, Executive Vice President of the Photo Circuits Corporation, Glen Cove, L.I., N.Y.;

Paul J. Bud, Executive Vice President and Technical Director of Electrovert Inc., New York 16, N.Y.;

Howard Manko, Director of Solder Research, Alpha Metals Inc., Jersey City 4, New Jersey.

TUESDAY, SEPTEMBER 24

Raytheon Company Executive Offices

Routes #2 and 128, Lexington

Dinner — 6:30 p.m. — Meeting — 8:00 p.m.

Reservations for dinner must be in to the IEEE office by Sept. 18 (cost \$3.00)

WE TAKE THE HEX AWAY

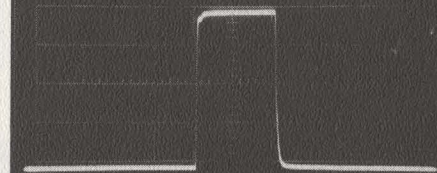
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UNRETOUCHED PHOTO OF OUTPUT PULSE, MODEL L2005 (Horizontal scale: 5 μ sec/cm)



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Model	Center Freq.	Bandwidth	Dynamic Range	Risetime Capability
L0502	5 mc	2 mc	80 db	0.5 μ sec
L1003	10 mc	3 mc	80 db	0.3 μ sec
L1505	15 mc	5 mc	80 db	0.2 μ sec
L2005	20 mc	5 mc	80 db	0.2 μ sec
L3002	30 mc	2 mc	90 db	0.5 μ sec
L3010	30 mc	10 mc	80 db	0.1 μ sec
L6002	60 mc	2 mc	90 db	0.5 μ sec
L6010	60 mc	10 mc	80 db	0.1 μ sec
L6020	60 mc	20 mc	80 db	0.05 μ sec
L7002	70 mc	2 mc	90 db	0.5 μ sec
L12020	120 mc	20 mc	80 db	0.05 μ sec

GENERAL NOTES:

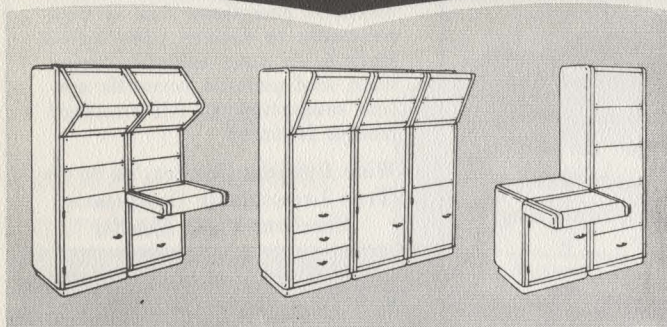
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A Review of Length Measurement & Instrumentation

STANLEY P. CHOLEWA
 AVCO-RAD

ACCURACIES and capabilities in the field of length measurement have increased through the years by constant research and the use of new developments in every area of science and engineering. Today's requirements for critical tolerances between mating parts have created the need to divide the inch finer and finer. This has been accomplished by the development of extremely accurate, high magnification, dimensional amplifying systems.

Information will be presented on the state-of-the-art in dimensional metrology. The importance and the extent of use of electronic amplifying equipment in dimensional gaging will be discussed. The presentation will be slanted toward introducing electronic engineers to the field of length measurement. It will cover the history and development of length measurements and length standards; the theory and use of mechanical, pneumatic, electrical and electronic gaging equipment; the calibration of gage blocks using high-magnification electro-mechanical comparators; the absolute measurement of gage blocks using interferometry; the effects of environment on the accuracy of dimensional measurements.

Slides will be used to clarify and expand on verbal descriptions of instruments and measurement techniques.

Mr. Stanley P. Cholewa received his Bachelor of Science degree in Mechanical Engineering from the Bradford Duffee College of Technology in 1953. He was instrumental in planning and organizing the following departments; mechanical division of the Quality Evaluation Laboratory, U. S. Naval Central Torpedo Office, 1953 to 1956; the Metrology Laboratory at AVCO-RAD 1953 to 1956; Physical Standards Laboratory at Cape Canaveral; the Metrology Laboratory, Autometrics, a division of North American Aviation. From October 1961 to the present, Mr. Cholewa has been Group Leader in the Physical Measurements Laboratory Section at AVCO-RAD, Wilmington, Mass.

TUESDAY, SEPTEMBER 24
 Meeting — 8:00 p.m. — AVCO RAD
 201 Lowell St. — Wilmington, Mass.

Newest Concepts & Latest Techniques in Reliability Engineering

THE Boston Professional Technical Group on Reliability has launched its 1963-1964 Technical Sessions by inviting Dr. Ronald A Howard, professor of Electrical Engineering and Industrial Management at MIT. Dr. Howard is primarily concerned with operations research and systems engineering. His research areas are stochastic dynamic programming, probabilistic system theory, and computer-directed instruction.

Dr. Howard's talk will be on advanced techniques in reliability and maintainability and new concepts that are emerging in these disciplines. He will discuss briefly some of these tools such as flow diagrams applied to reliability models, systems effectiveness, maintainability prediction, and operations research.

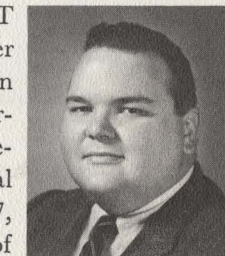
A major portion of his talk will be devoted to the Bayesian reliability theory. The analysis of failure data to produce estimates of item lifetime is an important interest of the reliability engineer. Recent developments in statistical decision theory show that the 200-year-old theory of the Reverend Bayes can be applied to this problem. The Bayesian theory is particularly important in the increasingly-encountered

situations of high experimental costs and, consequently, small sample size; it has proved to have conceptual advantages even when its application involves practical difficulties. The discussion will illustrate the advantages and limitations of Bayesian philosophy in approaching reliability problems.

Professor Howard received the bachelor of science in economics and the bachelor of science in electrical engineering from MIT

in 1955, the master of science degree in electrical engineering in 1956, the degree of electrical engineer in 1957, and the doctor of science degree in 1958. During the

summers of the years 1950-54 he was associated with Grumman Aircraft Corporation; in 1957 he was associated with Ramo-Wooldridge Corporation; and he has been a consultant for Arthur D. Little, Inc., since 1956. He became a teaching assistant at MIT and then an assistant professor in 1958, and was appointed associate professor in 1962. He is the author of the book *Dynamic Programming and Markov Processes*.



R. A. HOWARD
 M.I.T.

Advance Notice
 PTG - Reliability

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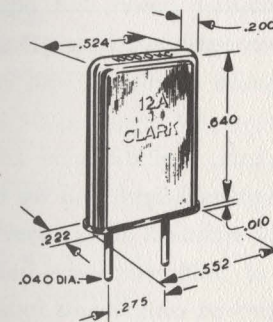
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Meeting — 7:45 p.m.

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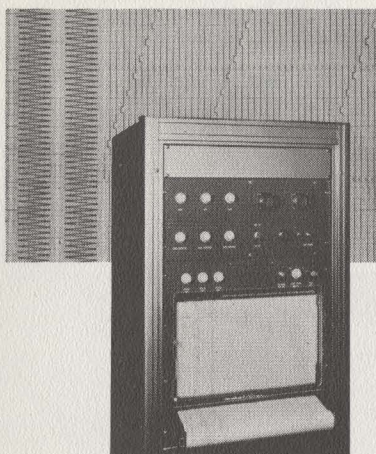
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Terrestrial Millimeter— Wave Links

THERE has recently been much discussion on the feasibility of terrestrial millimeter-wave communications systems. It is sometimes held that, because of atmosphere attenuation, such systems would have to use sheltered, low-loss wave-guide structures. In this talk the limitations imposed by the atmosphere are carefully re-examined, and performance characteristics that do not appear to be generally recognized are predicted.



G. E. WEIBEL
Gen. Tel. & Elec.
Laboratories, Inc.

A systems analysis of millimeter-wave links is made. Systems-design criteria are obtained from a statistical analysis of meteorological parameters relevant to the propagation of sharply bundled beams.

One of the basic relations in the design of a link is between transmitter power, hop distance, and reliability of transmission. Because of high antenna gain, links with short hop distance can use extremely low transmitter power and still have high reliability. Such links may allow all solid-state-circuit techniques. Links with medium hop length, on the other hand, would require somewhat higher transmitter power, but offer the attractive possibility of efficient operation with power-level switching. Estimates are made of the reliability under changing propagation conditions, and various methods of diversity operation are proposed.

Also discussed are the size of the antenna structure, limitations on antenna gain imposed by atmospheric refraction, required antenna height, and the choice of multiplexing and modulation methods. Finally, the technical advantages, limitations, and broad areas of potential applications of millimeter-wave links are summarized, and some systems requirement for improved components indicated.

Gerhard Weibel was born in Zurich, Switzerland. He studied at the Swiss Federal Institute of Technology, obtaining the M. S. degree in electrical engineering in 1946 and the Ph. D. degree in 1954. After joining the General Telephone & Electronics Laboratories, Dr. Weibel did theoretical work on microwave beam tubes with cascaded structures, retarding field velocity detectors, and developed analog computer methods used for design purposes. Since 1956 Dr. Weibel has been in charge of research on millimeter-wave tubes, semiconductor millimeter-wave components, paramagnetic spectroscopy and masers. He is a member of the Institute of Electrical and Electronics Engineers, the American Physical Society and the Scientific Research Society of America.

THURSDAY, SEPTEMBER 26
Dinner — 6:30 p.m. — Coach Grille — Harvard Sq.
Meeting — 8:00 p.m. — MIT Room 4-231

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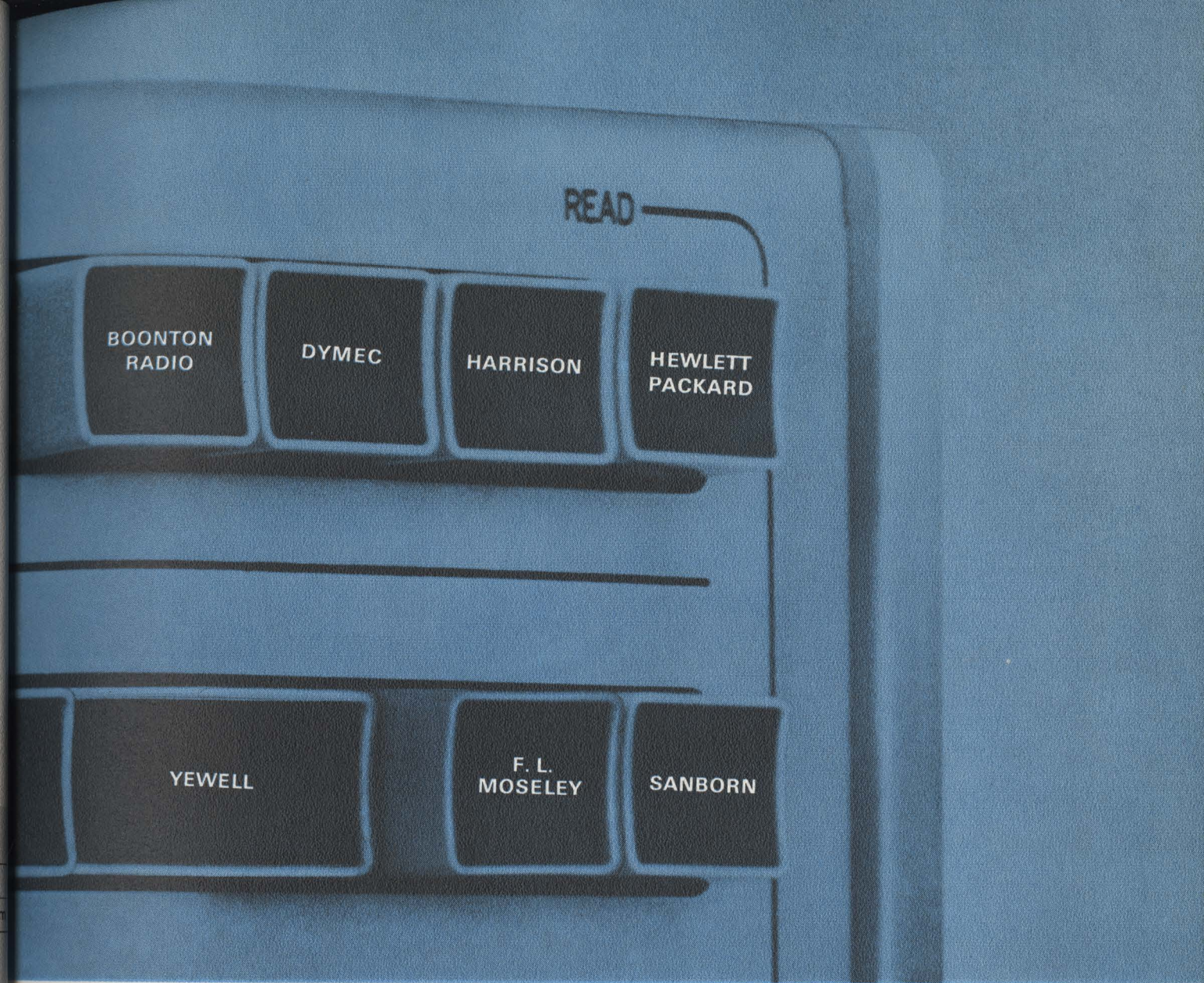
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TENTATIVE NEREM 63 SCHEDULE OF SESSIONS AND SPECIAL EVENTS

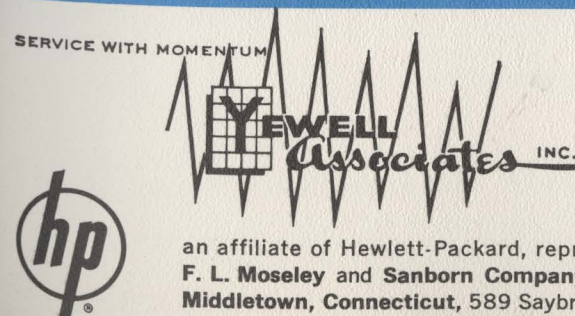
	COMMONWEALTH ARMORY		SOMERSET HOTEL		
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MONDAY NOVEMBER 4	1:45-2:20 PM				
	2:30-5:00 PM	1 Microwave Measurements and Techniques	2 Instrumentation	3 Space Electronics	4 Plasmas
	8:00 PM			5 Large Scale Project Management	
TUESDAY NOVEMBER 5	10:00 AM-12:30 PM	6 Antennas	7 Transistor Circuit Design-Status Report	8 Quantum Electronics Optical Sources	9 Automatic Control
	2:30-5:00 PM	11 Antenna Feed Systems	12 Microwave and Solid State	13 Submarine Cable Communication Systems	10 Energy Conversion I
WEDNESDAY NOVEMBER 6	10:00 AM-12:30 PM	15 Biomedical Electronics	16 Microelectronics Technology	17 Quantum Electronics Modulation	18 Advanced Radar Technology
	2:30-5:00 PM	19 Information Technology	20 Microelectronics Applications	21 Coherent Propagation	14 Energy Conversion II
	6:00 PM	EXHIBITORS ALL INDUSTRY PARTY (CURTIS GUILD HALL)			



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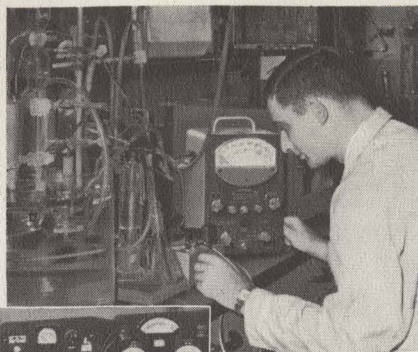


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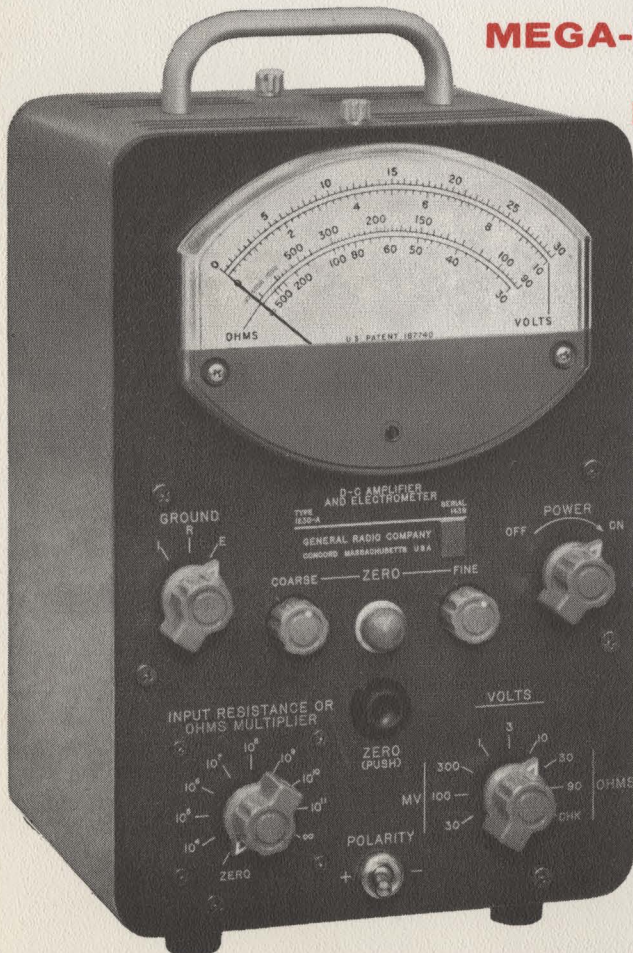
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