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DECEMBER

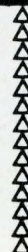


FALL
ISSUE

FEATURED IN THIS ISSUE:

IRE TOUR OF THOMPSON RAMO-WOOLDRIDGE

Published by the Denver Section of the IRE



VOL. V NO. 2

DENVER SECTION of IRE TOURS

THOMPSON RAMO-WOOLDRIDGE, Inc.

The Denver Section of the IRE Tours Thompson Ramo-Wooldridge, Inc. Facility in Littleton, Colorado. Probably one of the largest IRE meetings in months, approximately 176 persons, turned out for the tour of Thompson Ramo-Wooldridge facility. The tour, arranged by Frank R. Norton, Technical Director at Thompson Ramo-Wooldridge and Vice Chairman of the Denver Section, was termed a complete success by fascinated viewers.

The facility (see cover photo) embodies approximately 140,000 square feet floor area. The site, which was selected in 1954 after an extensive survey by Ramo-Wooldridge, houses two divisions; the Denver Manufacturing Division (Electronic Components) and Data Systems Laboratories (Evaluation of Special data).

In his introduction, Mr. William Vance, Assistant Manager of the Denver Division, outlined the projects which are now or will be carried on in the production areas which the IRE members were to view. The projects include: Counter Measures, Intellectronics, Infrared System, RW 300 Process

Control Computer, RW 40 Computer, Telemetry Calibrator, Voltage Controlled Oscillator, Mortar-Locating Target Simulator, Microwave Delay Line, Command-Destruct Receiver, and Microwave Strip Line Components.

Following the introduction, the IRE members were assembled in groups of about 25 persons and were then turned over to tour hosts Mel Parish, T. W. Elam, Keith Bogard, Brian Moore, William C. Bennett, Don Porter, and Mike Ruskai. The hosts conducted their groups through most of the Thompson Ramo-Wooldridge Plant--starting at the test equipment production department then on through the maintenance shop, printed circuit production and plating areas, computer assembly, computer test and checkout, fabrication area engineering offices, and the development laboratories.

From the very inception of Ramo-Wooldridge, Thompson Products

provided a sizeable portion of the financing. The name Thompson Ramo-Wooldridge emerged in 1958 when Thompson Products and Ramo-Wooldridge merged. The facility will grow to even larger proportions in the future. Work is currently in process for expansion of the plant for additional area to house the Data Systems Laboratory. In the future, they hope to produce approximately two or three RW 300 Process Control Computers and two RW 40 Computers per year.

Thompson Ramo-Wooldridge has headquarters in both Cleveland and Los Angeles. In addition to the Denver Manufacturing Division, the corporation includes such firms as Tapco, Dage, Bell Sound, Pacific Semi-Conductor, Space Technology Laboratories, as well as facilities in Michigan, Virginia, Canada, Mexico and South America.

ITEMS ON DISPLAY

TRANSISTOR RISETIME Plug-In Unit

Type R

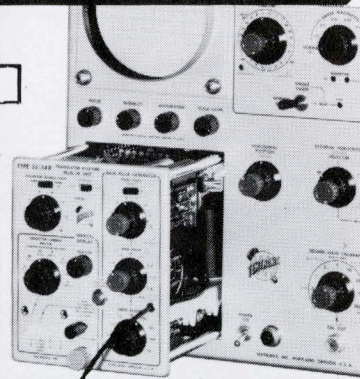
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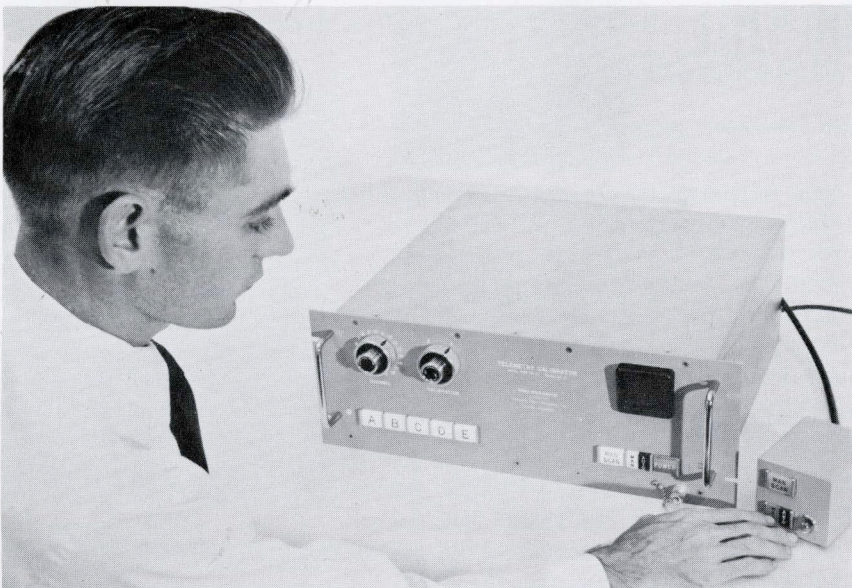
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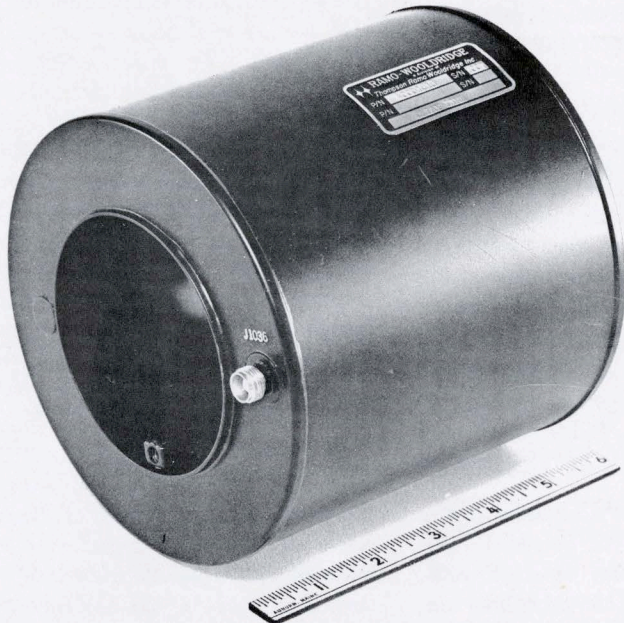


TELEMETRY CALIBRATOR

The Model TG-72 Telemetry Calibrator is crystal controlled, completely transistorized, utilizes high quality miniature components. All circuitry is built up on easily removable printed circuit cards. Eighteen IRIG channels can be simultaneously monitored or checked individually. All channels are scanned between the $\pm 7.5\%$ of center frequency limits and the upper five channels are scanned between the $\pm 15\%$ of center frequency limits. Either 3 or 11 point calibration per channel is available. Model TG-71, a 5 point calibrator is also available. All frequencies are crystal controlled to an accuracy of 0.01%. The calibrator measures 7 x 19 x 16-3/8 in. and weighs 40 pounds.

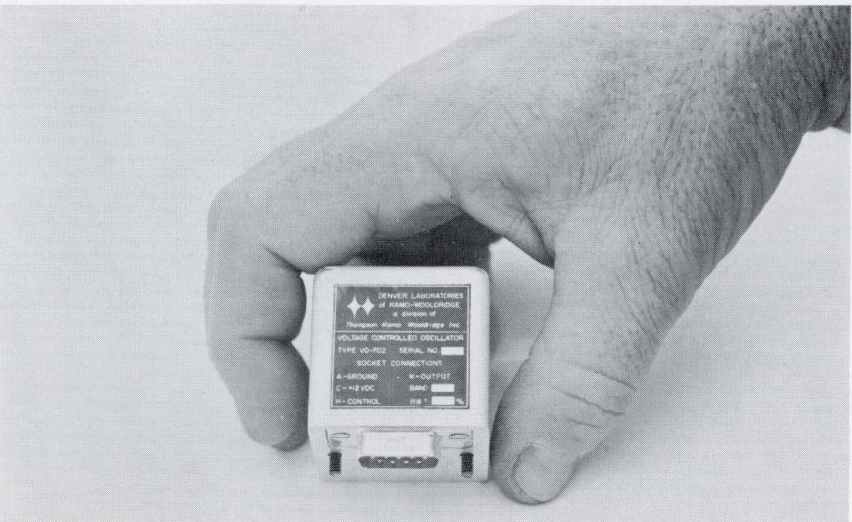
MICROWAVE DELAY LINE

These compact units provide a time delay of 0.1 microsecond for signals in the 2 to 4 Kmc range. Made of a helix of low loss high dielectric constant ceramic material, this unit replaces 100 feet of coaxial cable. The unit is packaged in a cylinder 6 inches in diameter by 6 inches long and weighs 25 oz. The unit can be made to cover other frequency ranges both higher and lower including video and IF and also other values of time delay.



VOLTAGE CONTROLLED OSCILLATORS

The V.C.O. provides FM subcarrier voltages whose deviation is proportional to the amplitude of the a-c or d-c input voltage. Silicon transistors and thermal compensating devices provide a high degree of frequency stability through an extremely wide temperature range. This unit has the following features; small size, low power consumption, high input impedance, high degree of linearity and high reliability.



SPACE AGE and the IRE...

Dr. Ernst Weber, President of the IRE sheds light on the role of the IRE in the Space Age in Denver Section meeting, September 22, 1959.

Many unsolved mysteries of the universe are now being solved as satellites are being propelled into outer space. But is the IRE playing a significant role in the solution of these mysteries? Dr. Weber provided the answer as he covered new space age accomplishments and problems, dissemination of technical information, and the need for revision of educational procedures to meet space age requirements.

What have we learned and what theories have we solved? In this regard, we have learned a few facts about physical parameters, ie, the exact shape of the earth, the variance of the earth's magnetic pattern, and existence of belts of radiation at distances of about 2,000 miles and 14,000 miles from the earth. These and other facts have helped prove existing theories of long standing, but in reality the facts have posed more problems than they have solved. Since many prominent men in the "space field" are members of the IRE, one of the most significant sources on space facts, problems, and solutions is the Proceedings of the IRE.

In the future, as it has been in the past, the IRE and its members will play a prominent and leading role. They will solve such problems as: SPACE TRAVEL: How important a



role will magnetohydrodynamics play? Can the magnetic fields in outer space be harnessed for space propulsion? Can the electromagnetic pressures generated by the sun be harnessed for space propulsion? Will the energy in the sun's atmosphere be harnessed to make nuclear-fusion propulsion practical? ASTRONOMICAL OBSERVATORY: Will the establishment of an astronomical observatory prove the true evolution of the stars? Will the true evolution of the planets be established? As you can see, the above problems pose a true challenge. However, our range of exploration has become so broadened that our education means will have to be adapted to the future. We must anticipate the future and reorganize our science and engineering curriculum. We will have to cease training engineers for special purposes and train them more in basic thinking. Through the IRE we are bringing these shortcomings in our educational system to the attention of everyone in the electronic fields; feeling that we cannot maintain our national position as leaders in the scientific field with our outmoded present curriculum.

Dr. Weber concluded that if the IRE and its influence are to continue to to grow as it has since its inception, we will have to make sure that we retain the "spirit of youth" in our thinking and in our approach to the problems of the space age.

After completing his speech, Dr. Weber answered questions. A resume of the questions follows:

1. Q: How many new professional groups will be added? A: It appears that there will be a few additions to the present number of 28 professional groups.

2. Q: Why does the IRE not promote classified technical symposiums? A: Dr. Weber stated that the objectives of the IRE do not permit the sponsoring of such symposiums. However, there has been a practice that individual region or section activities (conferences) can "associate symposiums with their program".

3. Q: What steps are currently being taken for reorganization of college curriculum to streamline education for the space age? A: Dr. Weber indicated that many steps have been taken but, as with anything, change comes hard. The prime problem is to change the curriculum in all departments rather than just one. Also, both the head of the department and the department faculty must support curriculum change.

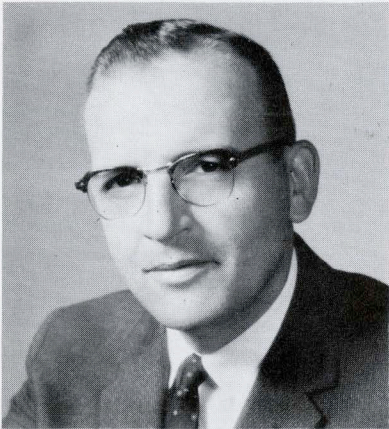
Continuing on, Dr. Weber indicated that mathematic departments will have to shift from rote or formula methods to "logic" mathematics. Chemistry departments will have to stress fundamental and structural chemistry. Physics textbooks have to be up dated so that the majority of the text pertains to current activities and here again the application in teaching physics should be via the "logic" and the basic thinking modes. In almost every case we will have to depart from "established" teaching methods.

1959

WHO'S WHO

1960

in the Section



CHAIRMAN

Willis G. Worcester received his B. S. in Electrical Engineering, with Honors, from the University of Colorado in 1939, and his M. S. from the California Institute of Technology the following year. During the period 1941-45 he worked as a test and development engineer for General Electric Co. In 1946 he returned to the University of Colorado as Assistant Professor of Electrical engineering, a position he held until receiving his Ph. D from Stanford in 1952. During

the period 1952-56 Worcester was Associate Professor of Electrical Engineering. From 1956 to date Worcester has been Professor of Electrical Engineering and Executive Director of the Engineering Experiment Station.

Mr. Worcester has published many papers in connection with his work in the experiment station. One well known paper dealt with his work on, "Light-Weight Solenoids of Aluminum Foil". He is active in I. R. E. and AIEE.



VICE CHAIRMAN

Mr. William D. George was born in Spartanburg, South Carolina. He received his B. S. in Electrical Engineering from Georgia Institute of Technology in 1929. He participated in the NBS Graduate school both as a student and instructor. Mr. George was an engineer with NBS 1929-1946 when he was appointed Section Chief High Frequency Standards. Principle technical contributions involved standards of frequency and time and

the extension of services and accuracy of broadcasts from NBS radio stations WWV and WWVH. Since 1956, Mr. George has served as acting Chief Radio Standards Division of NBS Boulder Laboratories. He is the author of many published papers principally dealing with frequency standards and time interval. Mr. George is a member of IRE and past chairman of committee 25.1 Basic Standards and Calibration Methods.



SECRETARY-TREASURER

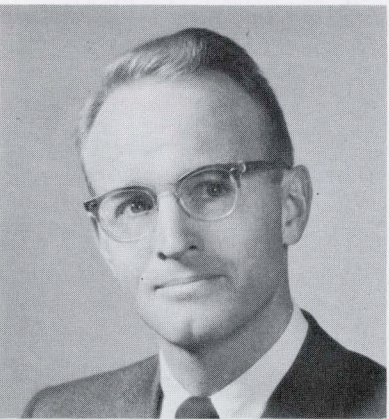
Howard S. Johnson was born in Flatbush, New York.

He started in radio engineering with KLZ in 1932 and specialized in construction, maintenance and designed studio circuitry. Mr. Johnson worked with KLZ, KOA and left KFEL as Chief Engineer to enter Military service in 1944.

Mr. Johnson held positions with Gates Rubber Company and Dow

Chemical Company in Instrument Departments. He left Dow Chemical to come to Martin-Denver. At Martin-Denver he set up an Engineering Test Instrument and Maintenance Laboratory. His present title is Supervisor of Primary Standards Laboratory which he has held since November, 1958.

Professional organizations in which he holds active membership include I. R. E. and I. S. A.



ASSISTANT SECRETARY

Jack C. Twombly received his B. S. degree in Electrical Engineering from the University of Colorado in 1944, and his M. S. from Stanford in 1950. Upon returning to the University of Colorado he conducted classified and vacuum tube research projects from 1950 to 1959. He received his Ph. D degree from the University of Colorado in 1959. Twombly is currently employed as Project Director Engineering Experiment Station University of Colorado. He is a member of the IRE and AIEE.

FRANK R. NORTON

TRANSFERRED

We are sorry to announce that the executive board accepted the resignation of Frank R. Norton our 1959-60 vice chairman at the September meeting. Mr. Norton was transferred to Los Angeles early in October. Before he resigned he was able to arrange several meetings for this year.



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T-210-B	0-10	0-30	.02% or 6mV	.01%	0.0003	0.7	5 1/4"	725
T-215-B	0-32	0-1	.02% or 3mV	.01%	0.01	0.7	3 1/2"	450
T-220-B	0-32	0-3	.02% or 3mV	.01%	0.006	0.7	3 1/2"	525
T-225-B	0-32	0-10	.02% or 5mV	.01%	0.002	0.7	5 1/4"	695
T-230-B	0-150	0-0.75	.01% or 1mV	.03%	0.05	2.0	3 1/2"	545
T-235-B	0-150	0-2	.01% or 4mV	.03%	0.02	2.0	5 1/4"	625



CHAIRMAN PGMTT

Howard E. Bussey was born in Tabor, South Dakota. He attended Yankton College in South Dakota, and George Washington University, receiving from the latter the B. A. degree in mathematics in 1941, and the M. S. degree in physics in 1951. His military service included meteorological and radar-weather courses, weather engineering and survey and weather forecasting.

In September, 1946, Mr. Bussey joined the Central Radio Propagation Laboratory of the National Bureau of Standards to do tropospheric propagation research. In 1951 he joined the microwave standards branch of the NBS Boulder Laboratories to work on microwave dielectric and magnetic measurements, and at present is leader of this project. He is a member of the American Physical Society, The American Meteorological Society, Sigma Pi Sigma, and an Associate Member of Sigma Xi.

1960 Electronic Components Conference

Technical papers are wanted for the 1960 Electronic Components Conference sponsored by the IRE-PGCP, AIEE, EIA and WEMA, which will be held May 10-12, 1960 in Washington, D. C.

Abstracts of 150-200 words are desired by 15 December 1959. Manuscripts of selected papers are due by 1 February 1960. Please send in triplicate to: Gilbert B. Devey, Technical Program Chairman, Sprague Electric Company, North Adams, Massachusetts.

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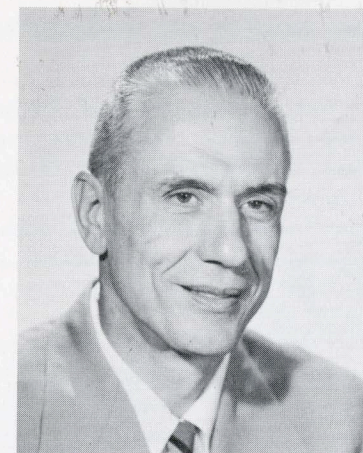
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CHAIRMAN PGAP

William C. Coombs was born at Harrington, Washington. He received a B. S. degree in 1933 from the University of Washington. Later he did

graduate work at the University of Washington, the University of Buffalo, and Cruft Laboratory Graduate School of Harvard University.

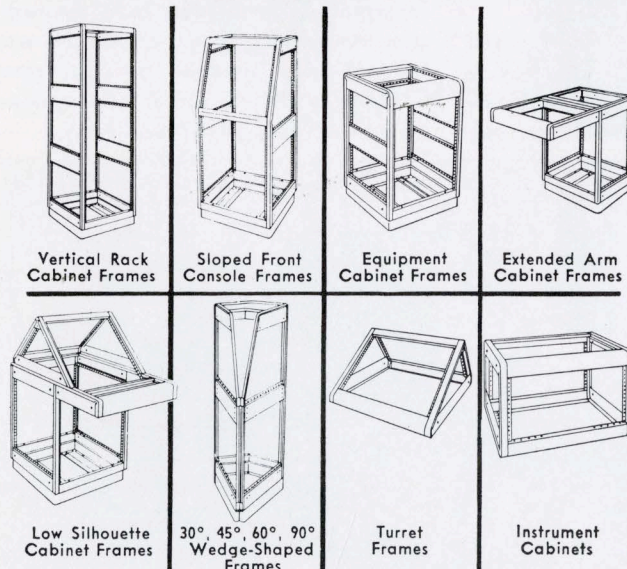
From 1937-40, Coombs worked as a development engineer at the Colonial Radio Corporation. He was principal engineer in charge of radio direction finding at the U. S. Navy Bureau of Ships, Washington, D. C., from 1941-47. Mr. Coombs worked for Boeing Aircraft Co., Seattle, Washington, from 1948-49 as a research engineer, doing research and development studies of guided missile control systems. From 1951-56 he was affiliated with the Denver Research Institute of the University of Denver and as section head, Electronics Division, conducted an analysis of

missile test base antenna systems, and did research in the field of television modulation. While with Denver Research Institute, he developed a new theory of information control in missile systems. He was manager, Radio Systems Laboratory, Colorado Research Corporation, from 1956-59. His research work involved space measurements, the development of a new digital television system, and a study of air traffic information systems.

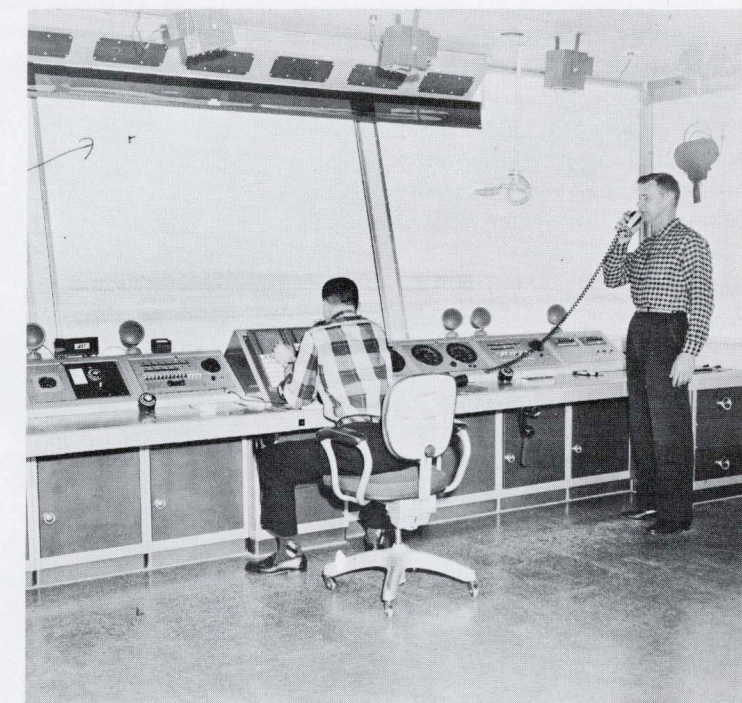
In June 1959 he joined the staff of the National Bureau of Standards as chief, Systems Analysis Section.

Mr. Coombs has authored numerous technical papers and reports. He is a senior member of the Institute of Radio Engineers.

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Harry Bishop

PGAP NEWS

By Wm. Coombs

The Denver-Boulder Chapter of the Professional Group on Antennas and Propagation held a luncheon meeting on 1 July 1959 for installation of officers for 1959-60.

J. W. Herbstreit, 1958-59 Chairman, was presiding officer of the meeting and introduced as honored guests: Dr. H. Bremmer, of the Phillips Research Labs., Eindhoven, Holland, world-renowned for his theoretical work on wave propagation; Dr. Gerhard Piefke, of the Siemens Research Laboratories, Munich, Germany; and Prof. A. L. Cullen of the Department of Electrical Engineering, University of Sheffield, Sheffield, England. Each of the three visitors has been participating in a lecture series on electromagnetic wave propagation at the Boulder Laboratories of the National Bureau of Standards.

Prof. Cullen gave a brief account of the operation of the British Institution of Electrical Engineers and explained the system of papers selections for the different divisions of the I. E. E. Proceedings.

Dr. James R. Wait reported on his participation as delegate to the International Symposium on Electromagnetic Theory at the University of Toronto on June 15-20th inclusive. The topics discussed at this symposium were radio telescopes, surface waves, scattering, diffraction, and boundary value problems. Dr. Wait reported that the proceedings of meeting are to be published as a supplement to the Transactions of the I. R. E., at a cost of \$8.00 per copy for PGAP members, \$10.00 for other I. R. E. members, and \$12.00 for non-members of the I. R. E.

Mr. Herbstreit introduced the following new officers of the Denver-Boulder Chapter of PGAP: R. E. McGavin, Secretary; W. C. Utlaug, Vice-Chairman; and W. C. Coombs, Chairman.

Mr. Coombs gave a brief discussion of recent advances in radio frequencies systems performance, brought about in part by molecular electronics under the impetus of space research. Implications were cited for new requirements for antenna and propagation problem solutions necessitated by advances of other facets of the communications art in the space program.

Recognition by propagation engineers of a general responsibility to take the initiative in formulating problems of space communication was indicated as being a vital factor in advancing space progress. It was suggested that such a charge of responsibility should most appropriately belong to the Denver-Boulder Group because of its uniquely intimate professional association with the Central Radio Propagation Laboratory.

A series of three radio propagation colloquies on "Surface Wave Research" was conducted on July 6-8 at the Boulder Laboratories of the National Bureau of Standards. Lecture presentations were by Prof. A. L. Cullen of the University of Sheffield, England.

The introductory lecture showed how the surface-wave concept for E and H waves is built up from consideration of evanescent modes in wave-guides. Possible types of guiding structures and the problem of launching surface waves were treated theoretically.

The EH₁₁-mode on a dielectric rod was discussed in relation to Poynting vector behavior, and an approximate method was presented for calculating between two such modes.



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culating between two such modes.

In the final colloquium, Prof. Cullen discussed possible and actual applications of surface waves in the following areas:

(1) The Goubau waves as a means of communication or as a means of guiding waves in measurement systems.

(2) The EH₁₁ mode as a technique for dielectric measurements at millimeter wavelengths.

(3) The EH₁₁ dielectric strip modes as alternative to wave-guides, with reference to directional coupler design.

(4) The use of surface waves in studies of two-dimensional diffraction problems.

(5) Circulating surface waves in radiating systems, and a possible application to supergain antennas.

(6) An electromagnetic theory of the induction motor.

In the latter application, the torque developed by an induction motor was interpreted as arising from the radiation stress set up by a surface wave tangentially incident on the rotor.

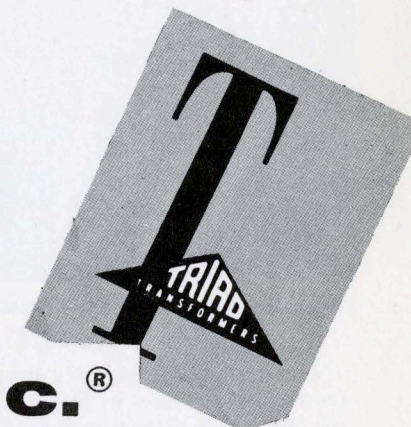
These colloquia are jointly sponsored by the local PGAP and NBS.

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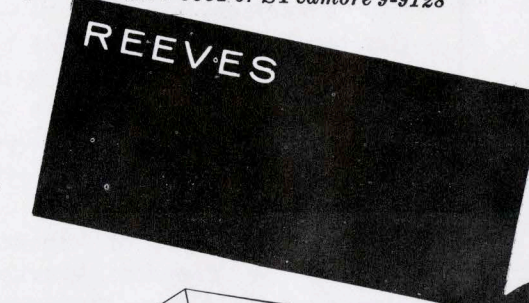
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Harry Diamond Memorial Award

For the second consecutive year a scientist from the Boulder Laboratories, National Bureau of Standards, will receive the highest award that is offered to a government employee in the field of radio and electronics.

Kenneth A. Norton, chief of the Radio Propagation Engineering Division, will receive the Harry Diamond Memorial Award during the 1960 annual convdntion of the Institute of Radio Engineers in New York next March.

This award is presented annually to a person in Government service in the field of radio or electronics for

outstanding contributions as indicated by publication in scientific journals. Jack Herbstreit, assistant chief of the same division, was the 1959 choice for the honor.

Mr. Norton's citation is "For contributions to the understanding of radio wave propagation." His experience in this field spans the past three decades, beginning in 1929 when he first joined the radio section of the National Bureau of Standards. From 1934 to 1942 he was a member of the technical information section of the Federal Communications Commission.

MEETING NOTICE

Dr. Muller will address the section on November 19th in Room 111 Denver Public Library at 8 P.M.



G. E. Muller is Vice President and Associate Director of the Research and Development Division, Space Technology Laboratories, Inc.

Dr. Muller has had 20 years of technical experience. He was a Research Fellow at Purdue University. He conducted television and microwave research at Bell Telephone Laboratories. For more than 10 years, he served as professor of electrical engineering at Ohio State University. More recently, he was a consultant for the Ramo-Wooldridge Corporation.

The author of five technical publications, Dr. Muller also has six patents in the electron tube and antenna fields.

Dr. Mueller is affiliated with the Institute of Radio Engineers, American Institute of Electrical Engineers and the American Physical Society.

Scholarship

San Francisco, Aug. 19 ---
— Outstanding science projects by western high school students were honored at WESCON with the awarding of \$2,500 in scholarships to five top exhibits out of 37 on display.

The announcement of winners was made by Theodore Moreno, chairman of the Future Engineers Show committee, at a special luncheon at Hunter's Point.

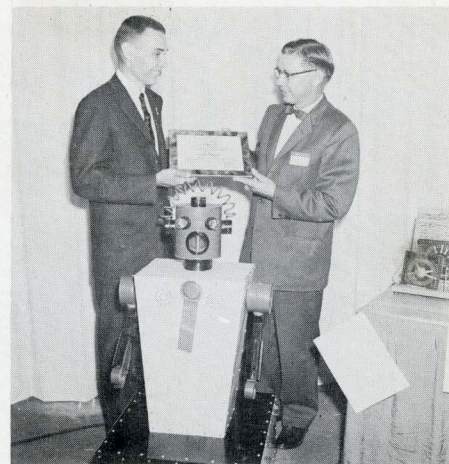
First prize, a \$1,000 scholarship, went to David Milne of San Diego, California for his electronic exhibit, "Beta-Braille Electronic Translator Automatic", which converts a conventional typewriter into braille automatically.

David Skaar, China Lake, California won a \$600 scholarship for

his exhibit, "Automatune"; Sydney Hoover of Los Altos, California took the third place award of a \$400 scholarship for his display, "Spark Photography"

Fourth prize was awarded to Theo Thomspson of Logan, Utah for his project, "Raedar-Robot".

FOURTH PRIZE WINNER PICTURED BELOW.



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