EDITOR'S PROFILE of this issue

from a historical perspective …

with Paul Wesling, SF Bay Area Council GRID editor (2004-2014)

February, 1963:

Cover: A laser ("… simulated emission of radiation") is shown over the micro-photograph of a damaged chromium-plated steel reflecting mirror. More on page 6.

Page 20: IRE member Charles (Chuck) House moves to the SF Bay Area, where he starts at Hewlett Packard. At HP, Chuck received the only award for Meritorious Defiance, from Dave Packard, "for contempt and defiance beyond the normal call of engineering duty" in 1982. HP was, indeed, different. Yes, it's an interesting story (see "The HP Phenomenon", a book by Chuck House and Ray Price).

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Grid

FEBRUARY 1, 1963
SAN FRANCISCO SECTION
INSTITUTE OF RADIO ENGINEERS

mindor

February 6 (Wednesday) PGI, First of Spring Series
February 12 (Tuesday) PGEC
February 20 (Wednesday) PGMTT
February 26 (Tuesday) PGPEP
February 27 (Wednesday) PGAP/PGEC/PGMTT/PGSET, *First of Spring Laser Series*
February 28 (Thursday) PGIT
March 13 (Wednesday) PGAP/PGEC/PGMTT/PGSET
March 27 (Wednesday) PGAP/PGEC/PGMTT/PGSET

POSTMASTER: RETURN REQUESTED
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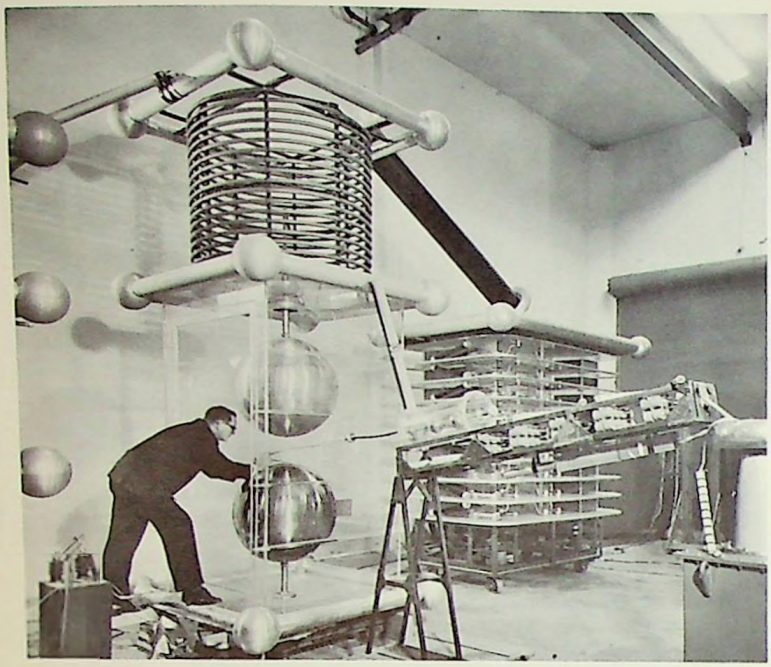
ENGINEERING OPPORTUNITIES



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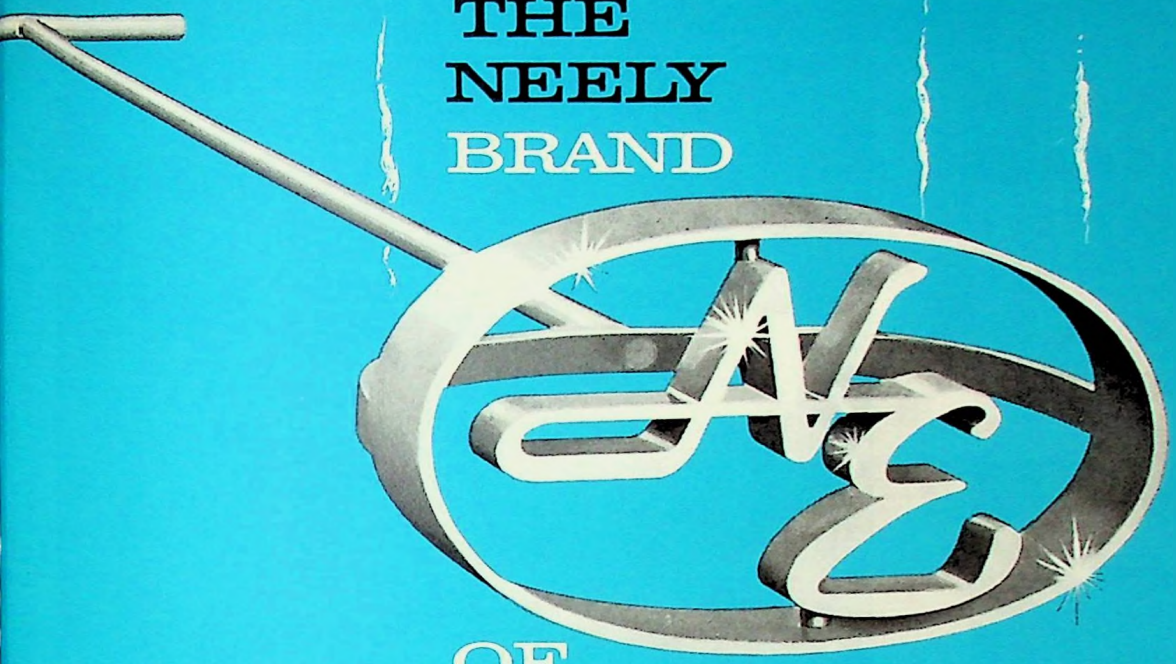

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with a new

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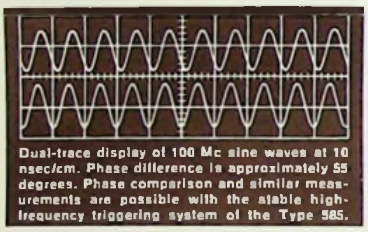
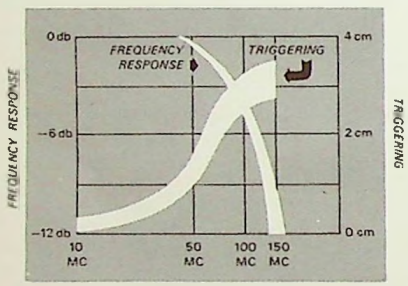
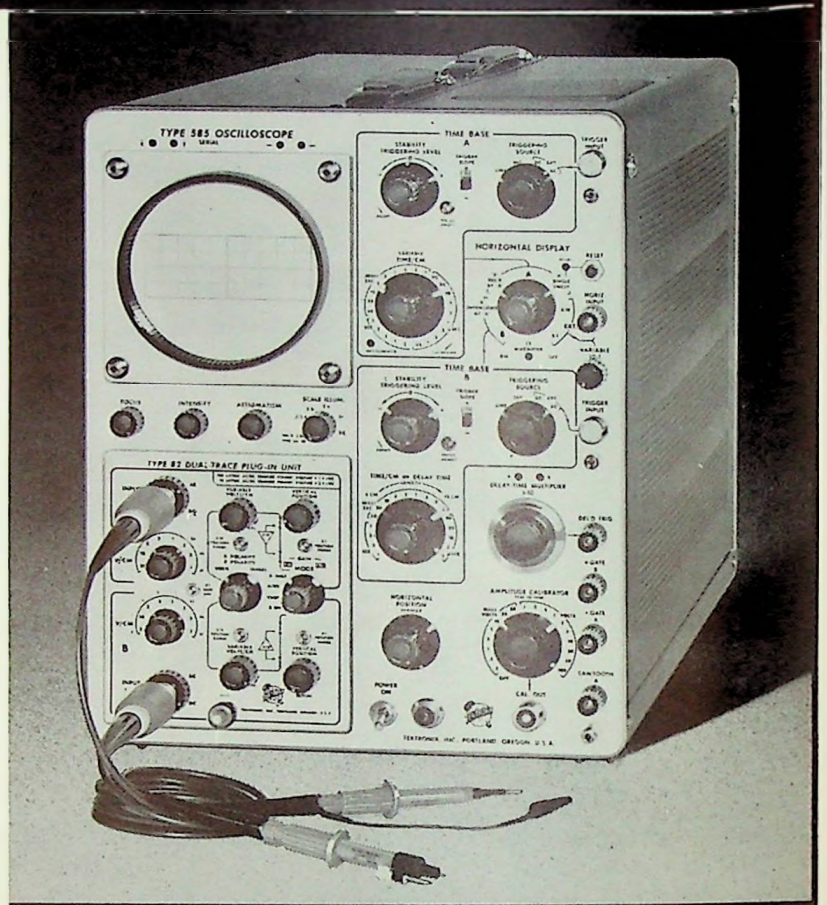
Tektronix Type 82 Plug-In Unit in a Type 581/585 Oscilloscope



Dual-trace display of 100 Mc sine waves at 10 nsec/cm. Phase difference is approximately 55 degrees. Phase comparison and similar measurements are possible with the stable high-frequency triggering system of the Type 585.



Typical frequency response and triggering characteristics of 580/82 combination—showing minimum number of centimeters necessary for triggering.



Supplied small size passive probes provide high input impedance characteristics. Probes increase input R to 10 megohms and decrease input C to approximately 7 pf.

Risetime (of supplied probe, plug-in unit, oscilloscope) at overall sensitivity of 0.1 v/cm is approximately 5¼ nsec.

OTHER CHARACTERISTICS
of plug-in and oscilloscope

- RISETIME — nominally 4.3 nsec at 10 mv/cm and 4.0 nsec at 100 mv/cm.
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enhances versatility of the oscilloscope

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Grid volume 9, number 11 February 1, 1963

Published twice a month except July and August by San Francisco Section, Institute of Radio Engineers

EXECUTIVE EDITOR: James D. Warnock

Address Editorial and Advertising to:

IRE OFFICE, SUITE 2210, 701 WELCH ROAD, PALO ALTO, CALIFORNIA

SECTION MEMBERS: Send address changes to IRE national headquarters, 1 East 79 Street, New York 21. MAILING OFFICE OF PUBLICATION: 394 Pacific Ave., Fifth Floor, second-class postage paid at San Francisco, California

SUBSCRIPTION: $2.00 (members); $4.00 (others); $5.00 (foreign) per annum

contents

cover

High peak power of a laser beam is sufficient to damage physically the reflecting mirror as shown in this electron-microscope pattern of the surface of chromium-plated steel mirror. For more on the laser, your attention is called to page 6, announcing a four-lecture tutorial series to commence on February 27. Our thanks to Dr. R. C. Honey, Stanford Research Institute, for our cover (carbon contact replica, shadowed with evaporated chromium, and viewed through electron microscope with approximately 5000X magnification). Laser photo courtesy Drs. A. E. Siegman and Rolf Dyce.

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Communicom is now in expanded quarters in Palo Alto. Half of the plant is devoted to research and development and half to manufacturing.

Communicom specializes in the development of transmission systems, such as: data-multiplex, voice-multiplex, and related equipment for use on microwave or cable. Technical capabilities also include design of precision oscillators, discriminators, switching circuits, frequency multipliers, and the like.

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MEETING CALENDAR

SAN FRANCISCO SECTION

6:30 P.M. • Tuesday, February 12

(Joint meeting with PGED, SFS, AIEE, and IRE-AIEE student branch, San Francisco State College)

"Electronic Engineering Support of a Weapons Test Program"

Speaker: Edward H. Hulse, head, electronic engineering dept., UC Lawrence Rad Lab, Livermore

Dinner-Meeting: 6:30 P.M., Cafeteria, San Francisco State College

Reservations: Mrs. Doris Gould, Section Office, DA 1-1332, for information and reservations

PROFESSIONAL GROUPS

Antennas & Propagation — **8:00 P.M. • Wednesday, February 27**

(Four-part Tutorial Lecture Series: "Laser Theory, Technique, and Application" —Joint with PGEC, PGMTT, and PGSET)

"Optically Pumped Lasers—Cesium Vapor to Solid State"

Speaker: Professor Arthur Schawlow, Stanford University

Place: Physics Lecture Hall, Stanford University

Dinner: To be announced

Antennas & Propagation — **8:00 P.M. • Wednesday, March 13**

Lecture No. 2: "Gas Discharge and Semiconductor Lasers"

Speaker: Dr. Arnold Bloom, Spectra-Physics Inc., Mountain View

Place: Physics Lecture Hall, Stanford University

Dinner: To be announced

Antennas & Propagation — **8:00 P.M. • Wednesday, March 27**

Lecture No. 3: "Laser Techniques and Applications"

Speaker: Professor Anthony Siegman, Stanford University

Place: Physics Lecture Hall, Stanford University

Dinner: To be announced

Antennas & Propagation — **8:00 P.M. • Wednesday, April 10**

Lecture No. 4: "Laser Developments Overseas—Report on Third International Quantum-Electronic Conference, Paris, 1963"

Speaker: Dr. Malcolm Stitch, Hughes Aircraft Co., Culver City

Place: Physics Lecture Hall, Stanford University

Dinner: To be announced

Electron Devices — **6:30 P.M. • Tuesday, February 12**

(Joint meeting with SFS, AIEE, and IRE-AIEE student branch, San Francisco State College, see above)

Electronic Computers — **8:00 P.M. • Wednesday, Feb. 27, Mar. 13, 27**

(Tutorial Lecture Series: Joint with PGAP, PGMTT, and PGSET, see above)

Information Theory — **8:00 P.M. • Thursday, February 28**

"On Multivariate Prediction"

Speaker: Dr. Frederick J. Beutler, University of Michigan

Place: Philco Auditorium, Bldg. 56, 3825 Fabian Way, Palo Alto

Dinner: 6:00 P.M., Sakura Gardens, 2116 N. El Camino Real, Mountain View

Reservations: Mrs. Radl, YO 8-6211, Ext. 2460, 2522, or 2244

MEETING CALENDAR

Instrumentation — 8:15 P.M. • Wednesday, February 6

(Five-part Tutorial Lecture Series: "Space Instrumentation")

"The Scientific Measurement Requirements of Space Probes"

Speaker: Dr. Francis S. Johnson, head, atmospheric and space sciences division, West Coast Center for Advanced Studies, Graduate Research Center of the Southwest, Dallas, Texas

Place: Physics Lecture Hall, Room 101, Stanford University

Dinner: 6:15 P.M., L'Omelette Restaurant, 4170 El Camino Real, Palo Alto

Dinner Reservations and Information: Mrs. Marje Andrews, 321-3300, Ext. 273

Instrumentation — 8:15 P.M. • Wednesday, February 27

Lecture No. 2: A panel discussion moderated by Dr. J. W. Muehlner, senior member, communications & controls research, electronic sciences laboratory, Lockheed Missiles & Space Co.

Place to be announced

Instrumentation — 8:15 P.M. • Wednesday, March 27

Lecture No. 3: "The Instrumentation and Performance of the Mariner Experiments"

Speaker, place to be announced

Instrumentation — 8:15 P.M. • Wednesday, April 24

Lecture No. 4: "Detection of Planetary Life"

Speaker, place to be announced

Instrumentation — 8:15 P.M. • Wednesday, May 29

Lecture No. 5: "Instrumentation for Man in Space"

Speaker, place to be announced

Microwave Theory & Techniques — 8:00 P.M. • Wednesday, February 20

"A Step-Recovery Diode Microwave Frequency Mark Generator"

Speaker: Robert B. Mouw, engineer, microwave division, Melabs, Palo Alto

Place: Physics Lecture Hall, Room 100, Stanford University

Dinner: 6:00 P.M., Happy Hour; 6:30 P.M., Dinner, Red Shack, 4085 El Camino Way, Palo Alto

Reservations: 324-0631

Microwave Theory & Techniques — 8:00 P.M. • Wednesday, Feb. 27, Mar. 13, 27

(Tutorial Lecture Series: Joint with PGAP, PGEC, and PGSET, see above)

Product Engineering & Production — • Tuesday, February 26

"Components for Computers—**Micrologic**"

Place: Fairchild Semiconductor, Mountain View

Information: W. Dale Fuller, DA 4-3311, Ext. 45821

Space Electronics & Telemetry — 8:00 P.M. • Wednesday, Feb. 27, Mar. 13, 27

(Tutorial Lecture Series: Joint with PGAP, PGEC, PGMTT, see above)

SAN FRANCISCO SECTION OF AIEE — 6:30 P.M. • Tuesday, February 12

(Joint meeting with SFS, PGED, and IRE-AIEE student branch, San Francisco State College, see above)

remarks from the chairs

Now that top side has shown the way on how to combine, and the IEEE has been formed and is being organized, why shouldn't we carry out this practice a little further?

From experience gathered here in the Bay Area over the past several years, it seems that there are just too many chapters, groups, etc., competing against one another.

The result is that there is great competition for facilities, for speakers, and for the average engineer's or executive's time. This means that when some group does obtain a really first-class speaker of national reputation it still may be difficult or impossible to get the audience of a size that is appropriate.

We have now in the San Francisco Section of the IRE eighteen active Professional Groups soon to be augmented by the AIEE Divisions under the IEEE banner. It would appear that many of these must have overlapping interests, or at least many areas of common interests, so that the number of groups could be reduced by half with obvious advantages to all concerned. Too many people go to meetings now because they feel they have to go. They know the speaker, they have had their arms twisted, or some such condition forces their attendance.

How does the average member feel about this situation? Let's have a show of hands on this question.

JEROME J. DOVER
CHAIRMAN, PGMIL
SAN FRANCISCO CHAPTER

meetings ahead

LASER SERIES

On four alternate Wednesday evenings the rapid expansion of the laser field will be examined by four well-known contributors. The generation of coherent light in the laboratory has already shown its impact on communication, radar, national defense, biology, welding, cutting, plasma diagnostics, space telemetry, and earth-bound space radar. There are now many forms of the laser, each having certain advantages such as: small line-width, high peak power, extremely narrow beam width, Doppler sensitivity, high total energy, etc. To treat specific subjects with some of the care they deserve, a series of four lectures is scheduled to be given at Stanford, on February 27, March 13, March 27, and April 10. Joint sponsorship reflects the wide impact of the laser on the IRE community.

As kickoff lecturer, Dr. Arthur Schawlow, now active in laser research at Stanford (author of the pioneering laser paper with Townes), will present "Optically-Pumped Lasers—Cesium Vapor to Solid States." His emphasis will be on theory and principles of operation from the historical first form to a modern type in wide usage.

Next, Dr. Arnold Bloom, Spectra-Physics, Inc., will similarly discuss "Gas Discharge and Semiconductor Lasers," Wednesday, March 13. The semiconductor type has been in existence for only a few months and undoubtedly will develop significantly even before the scheduled lecture date.

Turning to the techniques for handling the laser output for useful aims, Professor Anthony Siegman will describe his field of interest, the modulation of laser beams. Q-switching, traveling-wave mixers, and electro-optic and magneto-optic effects are familiar tools in this art.

Dr. Malcolm Stitch of the Hughes Aircraft Company will speak on April 10, after his return from the Third International Symposium on Quantum Electronics, Paris. Second to the United States, France is successfully running in the laser race, followed by Holland and England. This will also give Dr. Stitch opportunity to present recent accomplishments by Hughes, a leading pioneer industry with commercial laser ranging instruments already to its credit.

Francis S. Johnson

meeting ahead

PGI SPRING SERIES

Space probes offer a great opportunity for earth-bound scientists to conduct experiments on the nature of the extraterrestrial universe. The relatively small size of the vehicle payloads makes one very thoughtful about what experiments should be performed and, in turn, how to accomplish the instrumentation most efficiently.

The spring series of PGI meetings is planned to give some perspective for these problems. Dr. Francis S. Johnson's lead-off lecture (see calendar) will set the stage for the more specific, or detailed, program to follow.

What (and why) do we want or need to know about outer space? Obviously some answers are required in preparation for man's eventual personal exploration of space. Some answers, undoubtedly, have application to our life on earth. Dr. Johnson is eminently qualified to discuss this exciting subject and to give a clearer picture of what we are trying to do in space, and why.

Dr. Johnson is professor and head, upper atmosphere and space sciences division, Southwest Center for Advanced Studies. He received the B.S. degree in physics from the University of Alberta in Edmonton in 1940.

While he was in graduate school at the University of California at Berkeley in 1941, Dr. Johnson joined the Air Force. He was then sent to the University of California at Los Angeles as a flying cadet in meteorology; he received the M.S. in physics-meteorology there in 1942.

After the war, Dr. Johnson joined the Naval Research Laboratory, where he started to work on rocket instrumentation in the V-2 rocket. Here he was also occupied with a major effort directed toward solar ultraviolet spectroscopy in rocket vehicles and laboratory investigations in the vacuum ultraviolet.

Leaving the Naval Research Laboratory in 1955, Dr. Johnson worked for Lockheed Missiles and Space Company as a research scientist in the general physics department, investigating upper-atmosphere phenomena; in 1957 he was made acting manager of that department. In 1958, as staff scientist, Dr. Johnson was assistant to the head of the development division, satellite systems. From 1959 to 1962 he was manager of space physics research at Lockheed.

Dr. Johnson was awarded the Ph.D. in meteorology at the University of California at Los Angeles in 1958. His thesis was entitled, "The Heat Budget and Temperature Distribution in the Ionosphere."

Among the special activities carried on by Dr. Johnson are: consultant to planetary atmospheres subcommittee of the space science steering committee, NASA; member, advisory panel for atmospheric sciences, National Science Foundation; chair-

(Continued on page 9)

meeting ahead

RADIOMETRIC TECHNIQUES

"Infrared Radiometric Techniques" will be the topic for a joint meeting of the Instrumentation & Controls Division, AIEE, and the Santa Clara Valley Section of ISA. Herbert L. Berman, director for optics at Applied Systems Corporation, will describe the basic properties of infrared optical materials and detectors with reference to the design and performance of radiometers and radiation thermometers. The application of radiometric techniques to military-space measurements and a variety of industrial problems will be discussed.

The meeting will be held on Monday, February 18, 8:15 p.m., at the Balkan Village, 4898 El Camino Real, Los Altos. A social hour and dinner ($3.50) will precede the meeting at 6:30 and 7:00 p.m., respectively. Phone reservations to Louis Gado, EM 9-4871. Visitors and guests will be welcome.

For further information contact Ronald K. Church, Hewlett-Packard Company, DA 6-7000, Ext. 2118.

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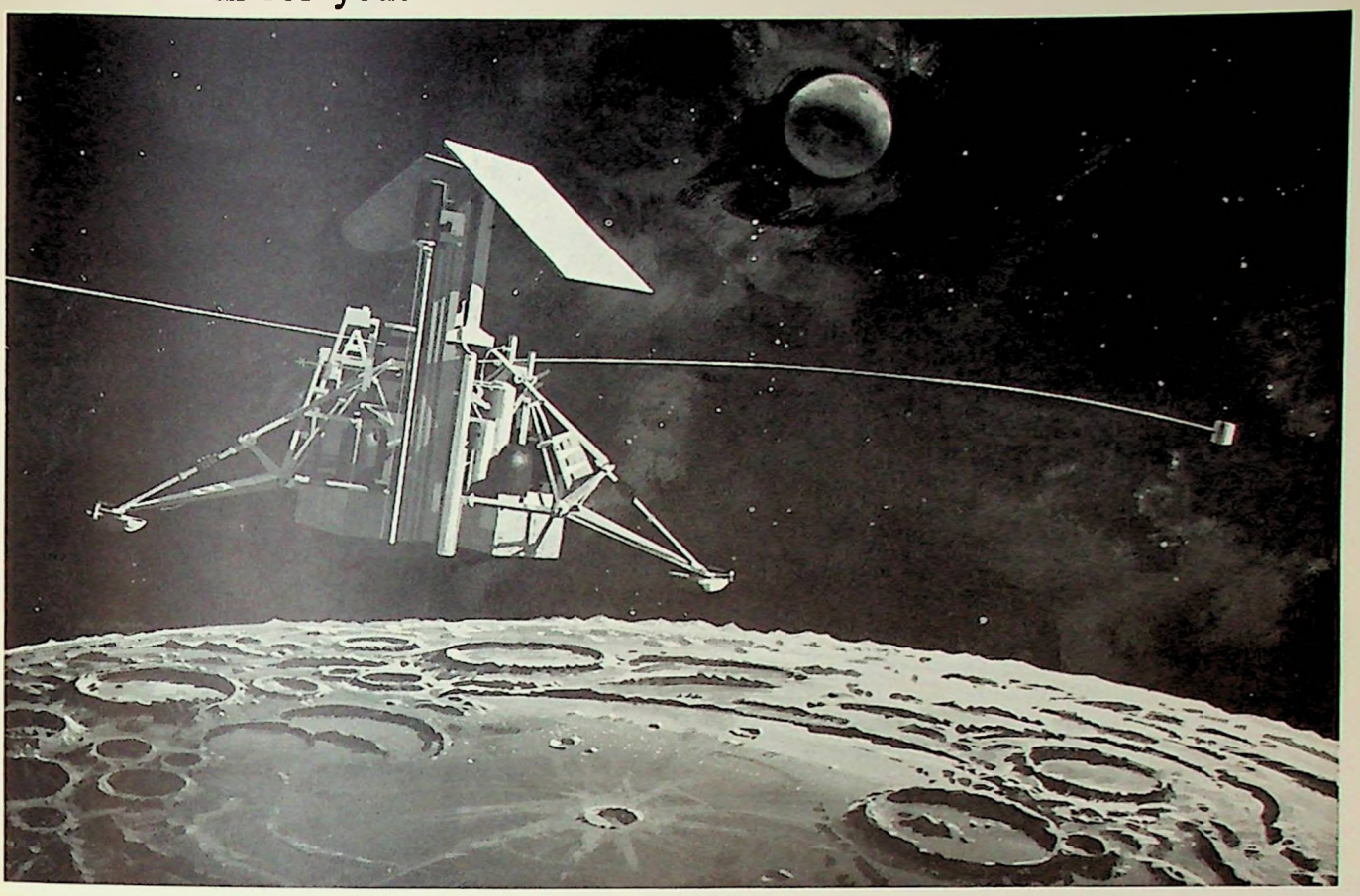

Soft land this vehicle on the moon

This spacecraft is SURVEYOR, one of the many important projects now under way at Hughes. It will "soft" land on the moon sometime in 1964. Its mission: to pierce and analyze the moon's surface; to transmit back to earth high quality television pictures; and to measure the moon's magnetic and radiation characteristics. To accomplish these demanding objectives. Project Surveyor requires the talents of many imaginative junior and senior engineers and physicists to augment its outstanding staff. A degree from an accredited university and U.S. citizenship are required. Experience in Aerospace Vehicles is preferred but not necessary. A few of the openings include:

CONTROLS ENGINEERS. Concerns airborne computers and other controls related areas for: missiles and space vehicles, satellites, radar tracking, control circuitry, control systems, control techniques, transistorized equalization networks and control servomechanisms.

CIRCUIT DESIGNERS. Involves analysis and synthesis of systems for: telemetering and command circuits for space vehicles, high efficiency power supplies for airborne and space electronic systems, space command, space television, guidance and control systems, and many others.

INFRARED SPECIALISTS. To perform systems analysis and preliminary design in infrared activities for satellite detection and identification, air-to-air missiles, AICBM, infrared range measurement, air-to-air detection search sets, optical systems, detection cryogenics and others.

SYSTEMS ANALYSTS. To consider such basic problems as: requirements of manned space flight; automatic target recognition requirements for unmanned satellites or high speed strike reconnaissance systems; IR systems requirements for ballistic missile defense. Inquire today. Please airmail your resume to:

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Several years ago, we formed the nucleus of our Space & Missile Systems Group. Its assignment: to originate ideas for new missions, define their feasibility and determine how to accomplish them.

To make this group successful, we obviously needed the exceptional engineer. More specifically, we agreed that only around one engineer in X,000 had the experience and ability needed for such demanding work. This decision paid off.

Our young Space & Missile Systems Group has proven so valuable on vital projects such as Apollo that we believe it is one of the most important keys to our future growth.

Because of its fine record, we're ready for another step—adding the handful of experienced systems engineers whose ideas and talents will help create a breakthrough to even bigger things.

To these few engineers, we offer the opportunity to get in on the ground floor of a specialized group that's just starting to realize its potential.

Maybe you're one of these men? Maybe you're not?

You'll have to be a real pro. You can tell this from the qualifications at right. But there's more to it than that. You'll have to spark others with suggestions and ideas. Take charge of your end and follow through without *any* supervision.

You'll have to be human, too. Big enough to shoulder some of the blame when little things go wrong. Big enough to pass along some of the credit for success.

On the other hand, we expect you to take some time to get your feet on the ground. We'd be delighted, of course, if you could come up with some brilliant ideas your first week or so. But we admit that this would be asking quite a bit.

You'll have to enjoy variety. Some engineers don't like change. If you feel this way, you'd be unhappy from your first day on. In our Space & Missile Group, variety isn't the exception . . . it's the *rule!*

You'll have to earn your own way. As you might suspect, our starting salary for such specialized work is quite liberal. But from then on, it's up to you. We pay on merit only. *You* set the rate at which you advance. This applies to promotions, too. We'll move you ahead as fast as you can handle the work. Frankly, this is as much to our advantage as yours. As far as fringe benefits are concerned, we have retirement, insurance, stock purchase plans . . . and all the rest.

You'll have to work hard. This job is anything but a snap. We'd be dishonest if we didn't tell you now. Most of the engineers in our Space & Missile Systems Group put in occasional nights and weekends. You probably will, too. In addition, it would be unusual if you didn't find yourself up against problems that would keep you awake more than one night.

What we would like from you . . . now. We've briefly covered a few of the advantages (and what some may consider disadvantages) of joining our Space & Missile Systems Group. If you meet the requirements at right and want to learn more, we'd appreciate hearing from you immediately.

There's no need to send a detailed resumé, however. Just mail a brief list of your qualifications along with a rough idea of your salary requirements to:

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Section Head—(MS Eng.), 8-10 years' experience. Responsible for aerospace warfare study, concept formulation and evaluation of optimum weapons and vehicles to meet future needs.

Staff Engineer, Operations, Analysis—(MS Eng.), 6-8 years' experience. Responsible for developing, presenting and justifying total weapons systems.

FLIGHT TECHNOLOGY

Section Head—(BSAE), 10 years' experience in analytical field of weapon development. Responsible for areas of Performance, Aerodynamics, Thermodynamics, Space Mechanics and Trajectory Analysis.

PROJECT MANAGEMENT

Staff Engineer—Armament Systems—at least 10 years' experience in airborne armanent systems. Manage advanced design programs in missile systems and avionic armament equipments.

Staff Engineer, Electronics—(MSEE), 8 years' experience in electronics systems including guidance, controls, radar, instrumentation. Responsible for making decisions, getting jobs done.

If you meet qualifications in these areas, write Mr. Richard A. Friedrichs. See address at left. He will contact you personally.

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F. J. Beutler

R. B. Mouw

meeting ahead

MULTIVARIATE PREDICTION

On February 28, Dr. Frederick J. Beutler will address PGIT. The title of his address is "On Multivariate Prediction."

The minimum mean-square error linear predictor for a vector process whose n components are possibly nonstationary and correlated involves the solution of n^2 simultaneous integral equations and, not unexpectedly, no general results are available. Solutions are available, however, for the special class of multivariate wide-sense Markov processes which are completely characterized by their covariance matrix. These optimization solutions are extended to a determination of finite memory filter optima and to some cases of nonperiodic sampling. Dr. Beutler's work in this area has been supported by NASA.

Dr. Beutler received his S.B. in 1949 and his M.S. in 1951, both from MIT, and his Ph.D. in 1957 from the California Institute of Technology. His experience includes the MIT Instrumentation Laboratory, Autonetics Division of North American Aviation, Ramo-Wooldridge Corporation, and consulting in systems analysis. He is now an associate professor of instrumentation at the University of Michigan.

meeting ahead

STEP-RECOVERY DIODES

The generation of frequency markers from .5 to 12 Gc/s over octave and higher bandwidths with the step-recovery diode will be discussed by R. B. Mouw of the microwave components branch of Melabs at the February 20 meeting of PGMTT.

The step-recovery diode approximates an ideal, finite, nonlinear capacitor characterized during reverse conduction by sharply discontinuous voltage and current. Pulse rise and decay time may be improved with delay, and fairly efficient higher order harmonic generation can be achieved. Single step multiplication by ten with 10 db conversion loss has been reported for a tuned harmonic generator.

The diodes and associated microwave circuitry may be arranged to generate a "Microwave Ruler Spectrum" in which 10, 100, and 1000 Mc/s markers are easily distinguishable on a single display of a microwave receiver or swept laboratory system. Other applications will also be discussed.

R. B. Mouw joined the microwave components branch of Melabs in August, 1962, where he is now engaged in microwave component and harmonic generator development.

MORE PGI

man, physics of the upper atmosphere and space committee, American Rocket Society, and member of the executive committee, USA Commission 4, International Scientific Radio Union.

Articles and papers written by Dr. Johnson on atmospheric structure and composition and solar radiation have been published in such journals as "Astrophysical Journal," "Journal of Geophysical Research," "Nature," and many others. Many papers presented by Dr. Johnson before international scientific conferences have also been published.

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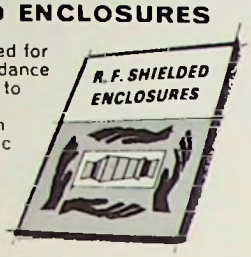

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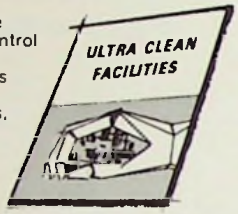

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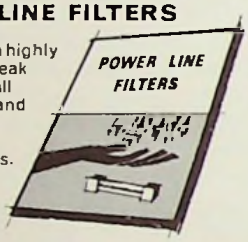

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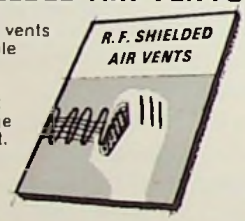

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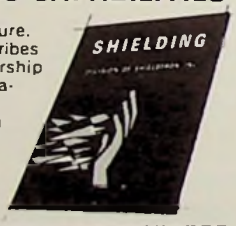

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meeting review

LASER EXCITEMENT

More than 100 attended the January 15 meeting of PGSET to hear Dr. A. E. Siegman of Stanford describe laser work being done at the university and at Sylvania microwave development laboratories.

Stimulated emission, which is the basis of laser operation, occurs when atoms which have previously been raised to an excited quantum state are struck by outside photons having the frequency of the photons that would otherwise have been emitted spontaneously. When this occurs the incoming photons, or the wave, are amplified, due to the energy given up by the excited atoms.

By constructing a resonant cavity, which in the case of a laser may be two parallel reflecting mirrors, it is possible to oscillate plane waves through the laser, sweeping the unit of the energy stored in the excited atoms. Each wave given up by an excited atom falls in phase with the wave that triggered its release. Thus, when sufficient round-trip gain is present, the laser breaks into coherent oscillations. The output is usually taken through one of the reflecting surfaces, which is only partially silvered. Monochromatic output light waves with plane wavefronts result.

Currently, gas lasers, solid-state lasers (most often with rare earth active atoms), and semiconductor injection lasers are being built. Of these, some of the more common ones are the helium-neon visible-gas laser at 6328A, an O_2 laser at 8400A, numerous gas lasers in the 1.0μ - 4.0μ range, glass with gadolinium ions at 3125A, aluminum oxide with chromium (ruby) at 6943A, and the GaAs injection laser.

A one percent bandwidth at laser frequencies represents 10^{12} cps. A 10-cm aperture will project roughly a 10-cm spot at a distance of 10 km from the laser source. To utilize these tremendous communication possibilities of lasers, effective modulation and demodulation techniques must be developed. Dr. Siegman described light demodulation experiments currently being performed at Stanford and at the Sylvania microwave development laboratories under Dr. B. J. McMurtry, a recent Stanford graduate. These consist of a microwave phototube, a light modulator using KDP, and a laser light source (Figs. 1 and 2). He also described an optical heterodyne receiver. The "signal" coherent light beam enters with the "local oscillator" light beam (Fig. 3) into the phototube, and the photocurrent then contains an i-f beat component at the difference frequency, which will be amplified and detected by the remainder of the phototube. Such a receiver will have high sensitivity, selectivity, and spatial directivity. To function properly, the signal

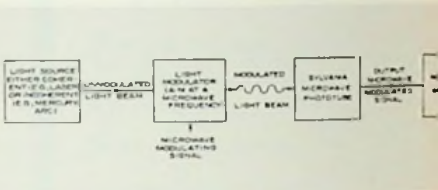

Fig. 1. Block diagram of microwave (3000 Mc) light modulation/demodulation experiment first performed at Stanford University by S. E. Harris, B. J. McMurtry, and A. E. Siegman.

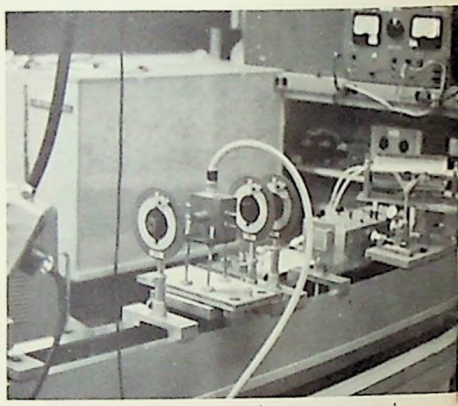

Fig. 2. Photograph of similar setup currently operating at Sylvania. The prominent cable feeds the electro-optic light modulator. The cylindrical microwave phototube is mounted at the end of the optical bench, while the gas laser is out of the picture at the left.

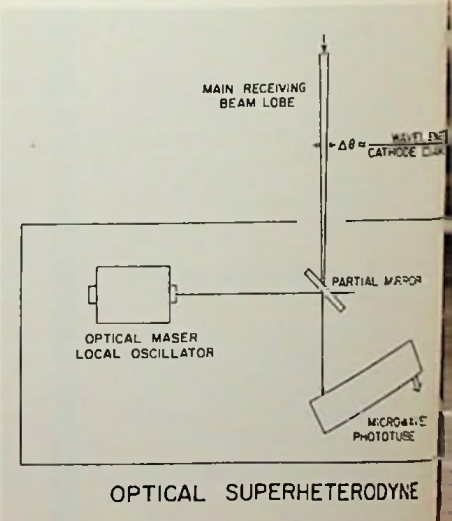

Fig. 3. Block diagram of an optical heterodyne receiver.

EDDYHAUSEN EFFECT

The December 19 meeting of the PGED heard a talk by Dr. Kermit E. Cuff, research scientist, Lockheed Research Labs., on the subject, "Thermomagnetic Cooling." Dr. Cuff first discussed devices which operate without a magnetic field, using the "Peltier effect" to accomplish the exchange of heat between a heat source and a heat sink. The figure of merit for the device which relates the cooling capability to the electrical resistivity and thermal conductivity has a value of the order of 3×10^{-3}. Since this figure of merit indicates a rather limited cooling capacity, more efficient devices are needed.

Thermomagnetic cooling is accomplished by devices using the "Eddyhausen effect." The device consists of an intrinsic semiconductor with a longitudinal electric field and a transverse magnetic field. The direction of heat flow in this device is perpendicular to both the electric and magnetic field. Carriers with high energies are deflected by the magnetic field toward one side of the semiconductor with a net transport of energy.

The figure of merit of this device is of the order of twelve times that of a Peltier-type device. In addition to the increased figure of merit, these intrinsic semiconductors may be stacked in series much more easily than the Peltier-type devices because of the use of only one piece of semiconductor material. The material used should have equal concentration of

(Continued on page 13)

and light beams must arrive at the cathode with wavefronts which are parallel.

The signal light must arrive within the main beam lobe of Figure 3, which is the diffraction pattern of the phototube cathode in that direction. Techniques must be developed for steering and pointing narrow beams if the communications potentials of coherent light are to be fully utilized.

An "Applied Optics Supplement on Optical Masers" has recently been published containing "all you would want to know and more" about lasers. In addition, the January 1963 issue of the Proc. IRE will cover laser technology.

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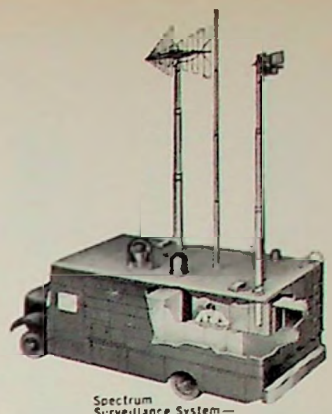

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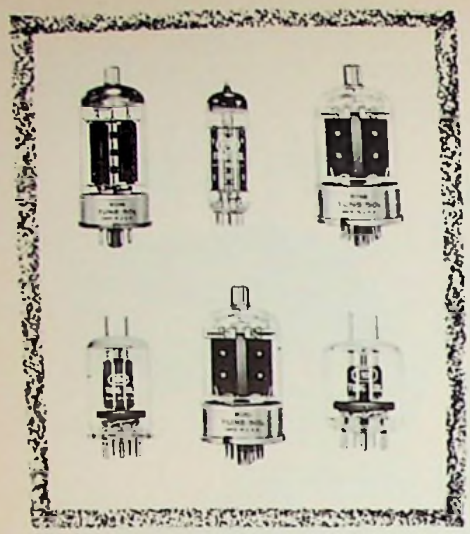

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meeting review

MANPOWER WASTE

PGEM was pretty badly jolted at the January 9 meeting. Harold Barrett, Jr., San Francisco representative, Bureau of Apprenticeship and Training, U.S. Department of Labor, discussed the neglect he sees in our industry's failure to develop training programs for the increasing number of skilled jobs which must be filled.

"Today we are faced with a social problem of real magnitude. High rates of joblessness exist side by side with demands for many skilled workers. This is because the skill levels of the hard-core jobless, and of youth entering the world of work for the first time, do not match the skill requirements for the waiting jobs.

"There is an appalling lack of planned, on-the-job training systems to produce job-seasoned workers. All-time records are being made in capital equipment investment, but still the high jobless rates persist. Yet we are at a point in history where we cannot afford the luxury of four million idle hands, minds, and hearts.

"It would be a disastrous national policy to ignore this waste of human resources. As Labor Secretary Willard Wirtz pointed out last November, 'We have lost in this country more potential production man hours from unemployment in the past eleven months than we have from strikes in the past 35 years!'

"The solution to this problem must be reached not only for those now affected. Future young persons who will enter the world of work will be used, or lost, in proportion to how well we now plan to develop their latent skills. Many of today's jobless workers would be employable had they had adequate and full training at the initial part of their careers.

"Many future industrial workers will be unemployable unless better training opportunities are more widely made available beginning here and now. The problem is not resolvable by any one segment of our society. It will require the active and intelligent cooperation of labor, management, schools, and other public agencies—with heavy emphasis on voluntary participation, private initiative, and enlightened self-interest."

A lively discussion followed Mr. Barrett's talk, at the conclusion of which he pleaded for active participation by engineers in helping to develop our human resources for the benefit of society as well as our own industry.

Samuel Silver

meeting review

SPACE AND EDUCATION

On January 9, Professor Samuel Silver, of the University of California, addressed PGAP on the impact of space research on university education.

The present possibility of space exploration has initiated a re-design of education in engineering and the sciences that is remarkably parallel to the "electromagnetic revolution" following World War II.

During the war years, MIT Radiation Laboratory was a success because "unlabelled," teamed experts from various fields applied themselves to the challenges of radar. The emphasis immediately after the war was on the re-discovery of Maxwell's equations and the applications of field theory to the new electronics.

Similarly, the physics of materials was regarded as thoroughly understood, prior to the invention of the transistor, when suddenly solid-state physics showed itself to be filled with unknowns. These two occurrences required the mating of many disciplines in order to have full understanding and full usage of the phenomena involved. Finally, this new blend of varied studies became the exhilarating "engineering science" of the postwar years.

Our present commitment to space exploration is also giving impetus to technique developments and to scientific interrelationships. Unfortunately, the need for techniques im-

L. M. JEFFERS

provement reaches the university long after the call has been heard by industry and laboratories closer to the government. This, then, gives the basis for the need for a "space science" laboratory to be set up within the university. Fortunately, the interdisciplinary nature of the new requirements causes departmental boundaries to be crossed. Happily, "space science" combines old principles in new ways and is likely to generate self-motivated inquiry across the accepted compartments of the university.

The "space science" laboratory already in operation at Berkeley provides the means for interdisciplinary studies in a tangible way by dealing directly with the problems presented by space research. Examples of such research currently being pursued are:

- Properties of materials and solid-state phenomena in interplanetary environment requiring a synthesis of nuclear and solid-state physics and even a combination of those with structural engineering.
- Study of planetary atmospheres, calling for integration of chemistry, physics, and radio wave propagation.
- Exobiology (study of extraterrestrial life), requiring a closely related program of planetary physics, biochemistry, and biology.
- Space biology (man in space), which makes real use of medical electronics in conjunction with physiology and the physics of the interplanetary medium.

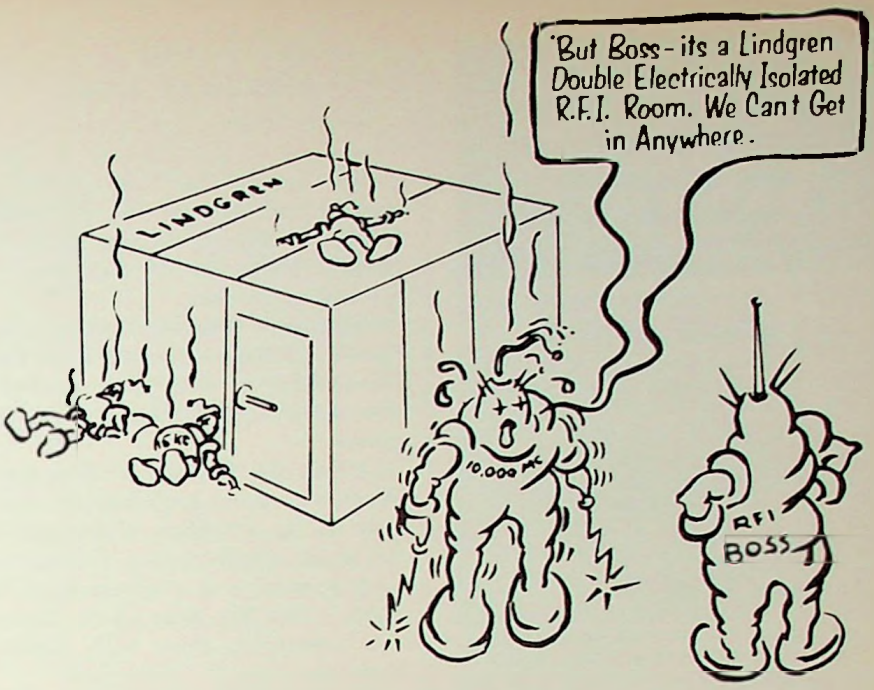
ROLF B. DYCE

MORE PGED

carriers, high mobility, good electrical conductivity, and very low thermal conductivity. Bismuth doped with antimony meets most of the above requirements, and this semiconductor has been used in these devices.

Dr. Cuff pointed out that the figure of merit drops off at both high and low temperature and is maximum in the range around 150°K. In the future, it should be possible to cool from 150°K down to liquid nitrogen temperature at a magnetic field of 3000 gauss with a device of this type.

M. FISHER



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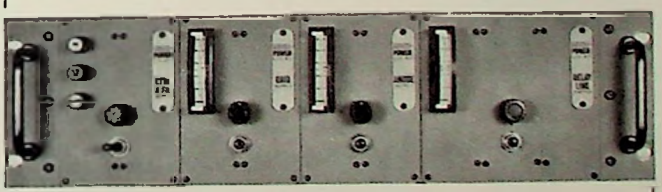

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engineers' week

COCHAIRMEN NAMED

Arnold Olitt, vice president of Woodward, Clyde, Sherard & Associates, Oakland, has been appointed general chairman of the Bay Area Engineers' Week committee. Dr. R. M. Fulrath, University of California, is general cochairman.

Engineers' Week is observed nationally each year during the week of the birthday of George Washington, who was one of America's great engineers.

"While the function of Engineers' Week is to bring engineers and their work to the attention of the public, the major effort goes in finding the best science and mathematics students in the Bay Area's high schools and presenting them with scholarships and awards," Olitt said.

The Bay Area is divided into ten zones. Each high school selects its outstanding student in science or mathematics. These students are then interviewed and a zone winner chosen by a committee of working engineers and science teachers. The ten students are further interviewed and examined. From this group come the

Olitt *Fulrath*

top scholarship winner and two runners-up. The scholarships, which are supported by donations from Bay Area industries and engineering societies, amount to about $3,500. The top scholarship is $1,000.

The scholarship winners will be announced, and the awards presented, at the annual banquet at the Sheraton-Palace on February 20.

Olitt graduated from the University of California with a B.S. degree in civil engineering. He took graduate work at the university and was a member of the teaching staff from 1943 to 1950. That year he cofounded the Oakland consulting firm of which he is vice president. Olitt still teaches in the University Extension. This semester he is conducting a graduate-

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Olitt has announced the following appointments to his executive committee:

Assistant to the chairman, James F. Vivrette, County Surveyor and Road Commissioner, County of Alameda, Oakland; secretary, James T. Moynihan, University of California; treasurer, Donald R. Olander, University of California; finance, Richard V. Bettinger, Pacific Gas and Electric Co.

Public relations, W. J. Eisenlord, Shell Development Company, Emeryville; scholarship awards, Daniel H. Condit, California Research Corp., Richmond; counseling, Ray Cayot, Pacific Gas and Electric Co.; contacts and speakers, Peter Karpa, Bechtel Corp.

The central judging committee for the scholarship competition consists of six outstanding educators and engineers. The chairman is Dr. John R. Whinnery, dean of the college of engineering at the University of California. The other five members are: Dr. David M. Mason, professor of chemical engineering, Stanford University; Dr. Henry J. Bertin, Jr., head of the chemistry department, San Francisco State College; M. Carleton Yoder, consulting engineer, Berkeley; Robert B. Freeman, chief engineer, Columbia Geneva Steel Company, Pittsburg; and Leonard Burt, curriculum assistant, Pleasant Hill High School, Pleasant Hill.

PAPERS CALL

April 15 is the closing date for submission of papers for the technical program of WESCON.

Authors should submit abstracts and summaries to Jerre D. Noe, WESCON technical program chairman, Suite 2210, 701 Welch Road, Palo Alto.

To be furnished are three copies each of abstracts running 100 to 200 words, and summaries of from 500 to 1000 words indicating related work and new contributions.

Advance clearances should be made where needed.

Submissions should note an IRE professional group classification as an indicator of the technical field into which the subject falls.

Radiation Counter Laboratories, Inc., is pleased to announce the appointment of William D. Underwood as manager of RCL Service for Northern California. In his new capacity Mr. Underwood will operate our nuclear instrument maintenance and field service department.

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IT IS REPORTED:

Joseph B. Kennedy has been appointed senior development engineer at Microwave Electronics Corp., Palo Alto. He is former engineering group head in the microwave tube division of Hughes Aircraft Co., where he was engaged in advance development of traveling-wave tubes, including those for the Syncom and Surveyor programs.

Philco Corp. has signed a contract under which California will become the first state in the nation to use a large-scale digital computer in the registration of automobiles, nine million of which will be processed through a Philco 210 computer system, including a central processor with a 10-microsecond magnetic core memory and 8000 words of memory capacity and seven magnetic tape transports on-line. Off-line hardware will include two other magnetic tape units, two Model 280 universal buffer-controllers, two high-speed printers, a card reader, and a card punch.

Delcon Corp., Palo Alto, has received two additional contracts from the Federal Aviation Agency, totaling $107,000, for the development and production of air navigational aids. One is for a clearance glide slope transmitter to improve the instrument landing systems at airports. The other is for frequency deviation monitors for use with the FAA doppler for navigational systems.

Sylvania Electric Products, Inc., has been awarded a $2 million contract for the development and production of twt to be used in the countermeasures systems of the B-58 Hustler being built by General Dynamics/Fort Worth.

Walter Associates, Menlo Park, has embarked on a cooperative advertising program with the lines it now represents: Chalco Engineering Corp.; Micro-Power, Inc.; MSI Electronics, Inc.; Omni Spectra, Inc.; Electronic Modules Corp.; Hughes Aircraft Co., instruments; Micro-Tel Corp.; Microwave Technology, Inc.; and RHG Electronics Laboratory, Inc.

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March 25-28 — **IEEE INTERNATIONAL CONVENTION.** Coliseum and Waldorf-Astoria Hotel, New York. Exhibits: W. C. Copp, IRE Adv. Dept., 72 W. 45 St., New York 36, N.Y. Program: Dr. D. B. Sinclair, IRE Headquarters, 1 E. 79 St., N.Y. 21, N.Y. *DL-10-19-62. Convention Record order from IRE Headquarters.

Apr. 10-11—**Fourth Symp. on Engineering Aspects of Magnetohydrodynamics.** Univ. of California, Berkeley, Calif. Program chairman: Dr. G. Sargent Janes, Avco-Everett Research Lab., 2385 Revere Beach Parkway, Everett 49, Mass. Preprints by the symposium; authors may submit their papers to journals for publication.

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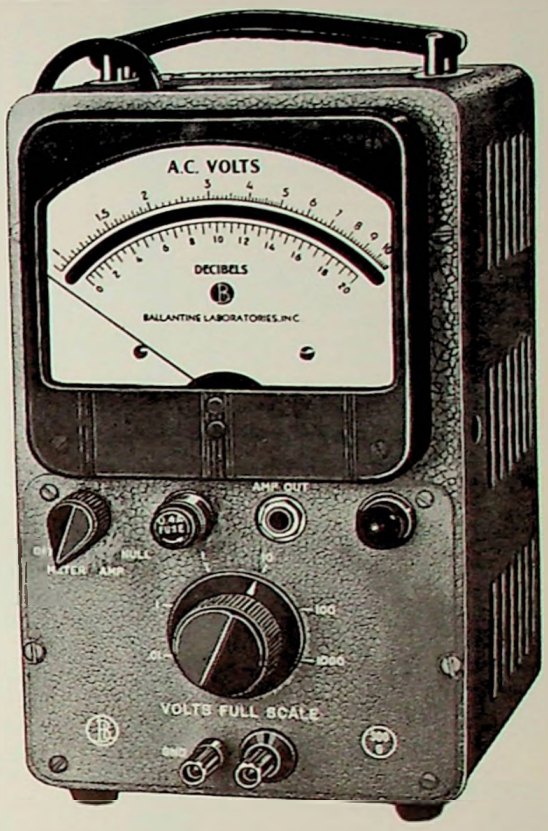

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SR. ELECTRONIC ENGR.: BSEE (or Physics) to $13M; 6 yrs. exper. electronic development including 3 yrs. solid-state digital circuit design and analysis.

ELECTRONIC ENGRS. (2): BSEE to $12M; 6 yrs. exper. in production engineering including circuit design; or 4 yrs. solid-state circuits.

ASSOC. ELECTRONIC ENGR.: BSEE (pref. math. minor); $8,200/$10M; 2 yrs. solid-state digital electronic R & D.

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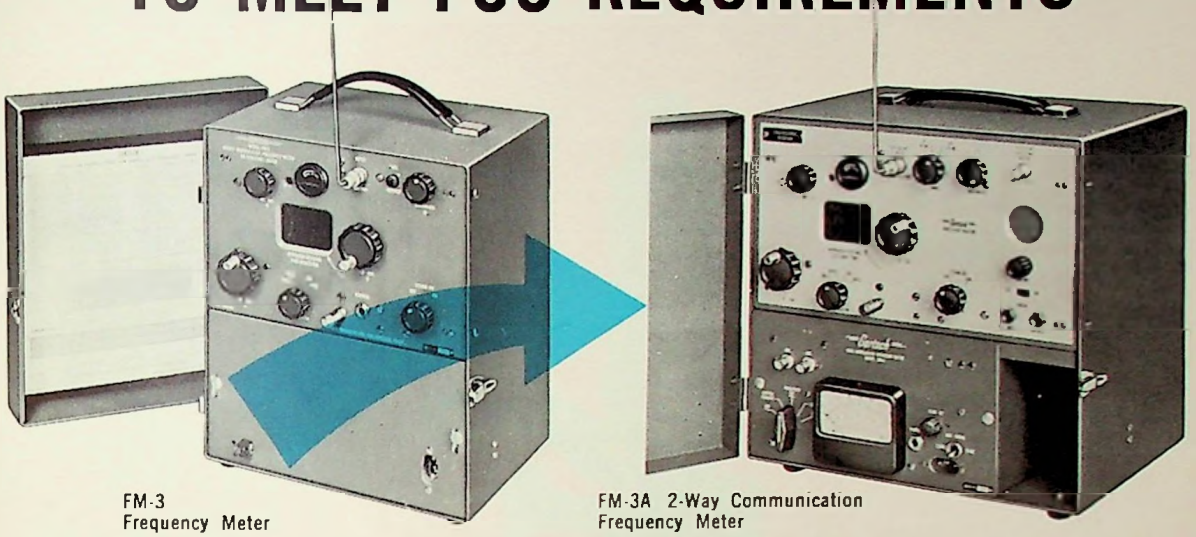
YOUR GERTSCH FM-3 FREQUENCY METER CONVERTED TO MEET FCC REQUIREMENTS



FM-3
Frequency Meter

FM-3A 2-Way Communication
Frequency Meter

— factory conversion provides direct reading of all allocated channels in the 150-170 mc band

All Gertsch Model FM-3 frequency meters can now be factory-converted to measure and generate *all* assigned channels in both 150-170 mc, and 450-510 mc bands.... with ±.00025%(2.5ppm) accuracy. Instrument features a single 1-mc crystal which is easily standardized against WWV.

Converted units can also be operated as standard FM-3 instruments through 20 to 1,000 mc, at .001% accuracy.

Conversion includes: an all transistorized converter module, a new front panel and carrying case, and a built-in amplifier (with speaker). Also, a front-panel jack allows input of external audio signals, such as those from a Gertsch Model DM-3 deviation meter. Space for a DM-3 is provided in the case.

Compact size — only 13½" W x 11½" D x 13¾" high.

New Gertsch frequency meters are also available in both battery operated and AC power supply units. New meters incorporate same features as converted instruments.

Send for literature on FM-3A series.

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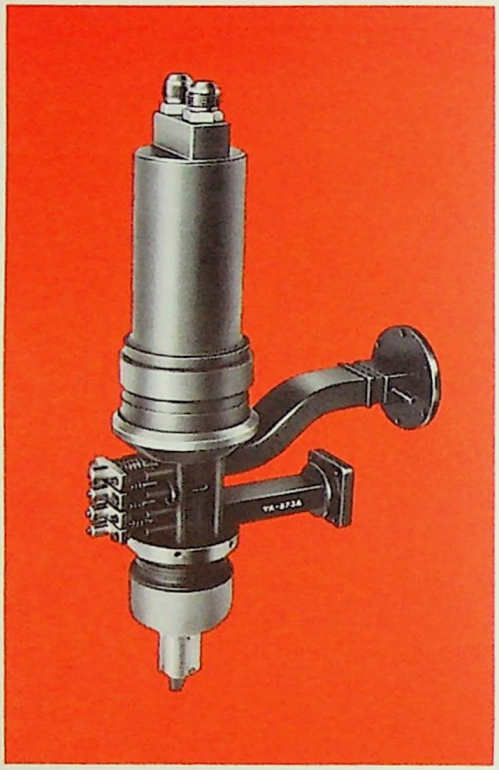

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