EDITOR'S PROFILE of this issue

from a historical perspective …

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

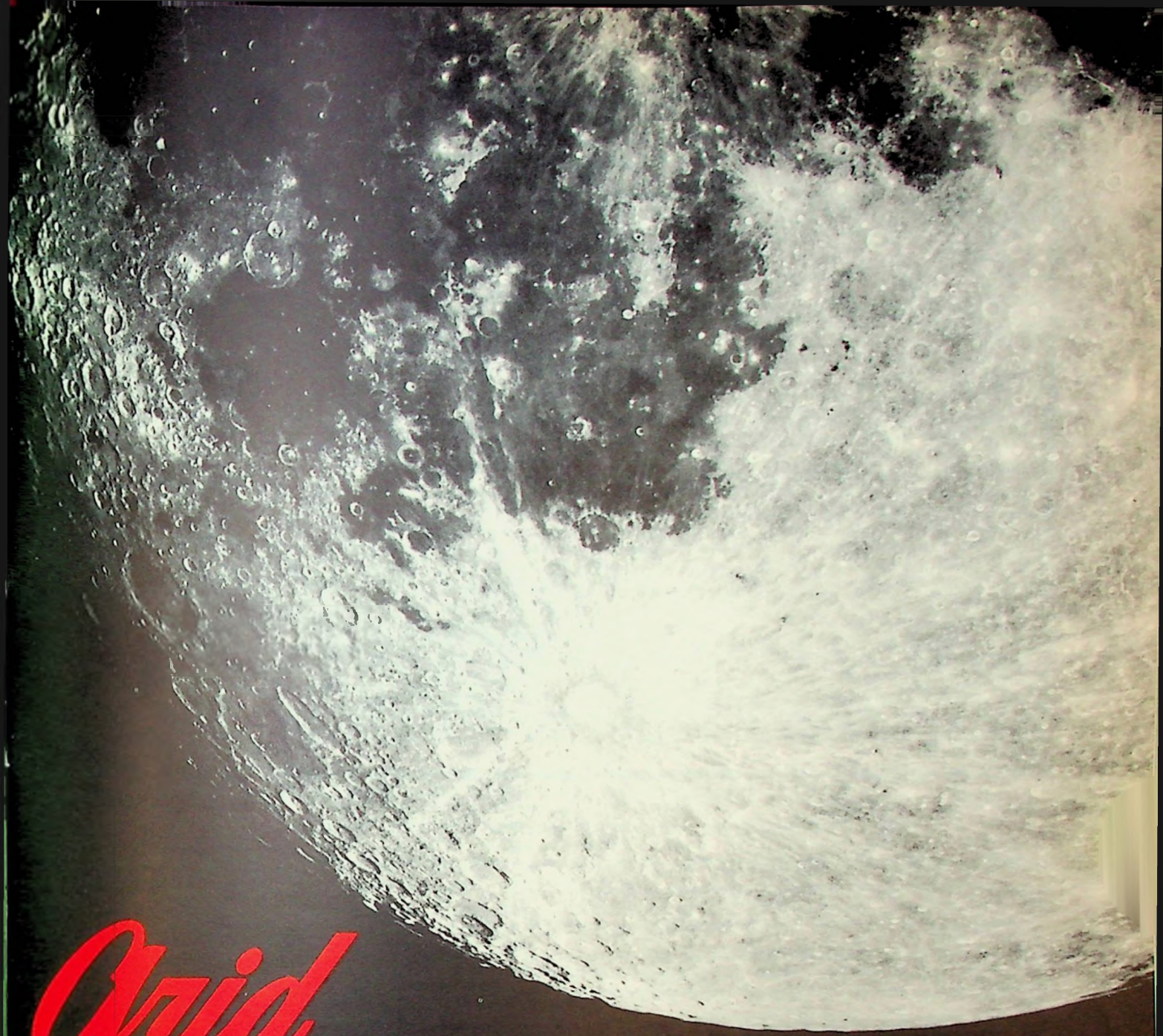
October, 1962 (mid-month):

Cover: A photo of the moon, showing Tycho crater, was taken by a new astrometric camera built by SRI and used with the Lick Observatory 36" telescope. More about the camera on page 12.

Page 18: William Shockley, co-inventor of the transistor and a Nobel prize winner, finally joins our Section of the IRE.

IRE member Dennis Fairclough moves to the SF Bay Area. In 1974 he was VP of Operations for a small startup -- Braegen Corp ("braegen" means "brain"), located near Wolfe and Arques in Sunnyvale. I joined Braegen and worked directly for Dennis. I recall doing some assembly-code programming on the Intel 8008 microprocessor (the "brain" of our terminal controller), as well as trouble-shooting design and manufacturing problems. Startups, though, are risky places to work. One day I had been visiting National Semiconductor regarding purchasing their 1k DRAM, and arrived back to see employees using office chairs to move boxes to their cars. "Get your personal possessions out – the sheriff may be locking the doors later today!" I had managed to put in nearly a year. Most startups fail, even in Silicon Valley.

A further note: during those days, it was no problem getting a new job. I sent out some resumes, interviewed at several companies (including two divisions of HP), went on a week's vacation at Lake Tahoe, and then selected one of the resulting offers.



Grid

OCTOBER 15, 1962
SAN FRANCISCO SECTION
INSTITUTE OF RADIO ENGINEERS

IREminder

October 15 (Monday) EBSS
October 16 (Tuesday) PGSET
October 17 (Wednesday) PGED/PGMTT
October 18 (Thursday) PGRFI
October 23 (Tuesday) PGEC
October 24 (Wednesday) PGI
October 25 (Thursday) PGAC
October 25 (Thursday) PGIT
October 26 (Friday) PGEWS
November 6 (Tuesday) SFS/PGBME

POSTMASTER: RETURN REQUESTED—SUITE 2210, 701 WELCH ROAD, PALO ALTO, CALIFORNIA

ENGINEERS and SCIENTISTS

Now a *Confidential Résumé* that... PRESENTS YOUR QUALIFICATIONS TO 67 NATIONAL EMPLOYERS

Employers Convene at Career Center for interviewing in PALO ALTO, at RICKEY'S HYATT HOUSE, 4219 El Camino Real.
Dates: NOVEMBER 7 - 10 (Wed. - Sat.).

REGISTERS YOU IN ADVANCE FOR MAXIMUM NUMBER OF CONFIDENTIAL INTERVIEWS WITH SPONSORING EMPLOYERS. Fill out the form below and mail it today—before CENTER begins. This guarantees your qualifications will be among the first to be considered. National firms are sending key engineers to the Career Center expressly to interview and hire. This unique, employer-sponsored program enables you to survey, anonymously, the challenging projects—and the top salary you can command.

Registration automatically places you on the National Manpower Register. Your qualifications, but not your name, will be **flashed** to companies in every section of the country for immediate attention.

Fill out this confidential résumé now. This permits the Center to schedule as many interviews as possible for you.

The Career Center should not be confused with an employment agency. It centralizes and coordinates efforts of 67 national employers to solve their talent shortages. There are no fees of any kind.

Note: Even if unable to attend this center, fill out this registration form *now* — you will then be notified of next Career Center in your area.

CAREER CENTER

Career Centers, are coordinated by publishers of "Career for the Experienced Engineer and Scientist" and "Career for the College Man."

Partial list of participating sponsors

Douglas, Missile & Space Systems Div.

Aerojet-General Corp.

Los Angeles Div.; North American Aviation, Inc.

Pan American World Airways, Inc., Guided Missiles Range Div.

Hughes Research and Development—Fullerton

Space & Information Systems Div.; North American Aviation, Inc.

Sponsors are Equal Opportunity Employers.

Mail today to: Rickey's Hyatt House, c/o Career Center, 4219 El Camino Real, Palo Alto, Calif.

TEAR ALONG DOTTED LINE

THE NATIONAL MANPOWER REGISTER INTERVIEW DATA SHEET

TYPE OR PRINT

Where can you be reached during interview days?

Home Phone | Business Phone

PRESENT OR MOST RECENT EMPLOYER

OK to release my identity ☐ All but my present employer ☐ Any employer ☐ No employer

Your Name

Home address (present location)

REGISTRATION NO.

FOR OFFICE USE

JOB CLASSIFICATION

U.S. Citizen Yes ☐ No ☐

The above confidential portion is not shown to employers.

City Zone State

CURRENT ANNUAL BASE SALARY $

TOTAL YEARS OF EXPERIENCE

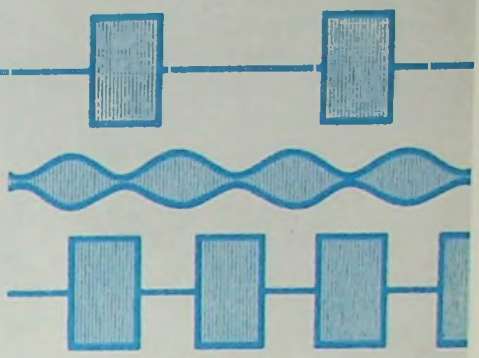
EDUCATION	Last Degree	College	Major Field	When Earned
POSITION DESIRED				

EXPERIENCE (Present or most recent job	City & State	From	To	Job Description

Please enclose a personal résumé if available.

from any signal source 800 to 2,400 MC
from any cw signal to 1 watt

PERFECT MODULATION



free of jitter and incidental FM

New hp 8714A Modulator delivers fast, jitter-free and FM-free pulses from any signal source or generator from 800 to 2,400 MC. A rise time of 20 nsec and fall time of 10 nsec are the result of using an absorption modulator composed of electrically controlled PIN diodes. Since the signal source, either klystron or BWO, is always operated in the cw mode, and the PIN diodes present a good match under all modulation conditions, pulses from the 8714A are free from incidental FM and jitter.

The 8714A has internal modulation generators providing square wave and pulse modulation 50 cps to 50 KC, with continuously variable width and delay controls. The internal square wave and pulse generators may also be externally synchronized at rates up to 1 MC for non-periodic modulation. External modulation capability in pulse and AM modes to at least 1 MC is also provided.

Push button function selection, simple controls and versatile rack or bench mount make the 8714A easy to use. Solid state design and rugged construction assure years of convenient and trouble-free service.

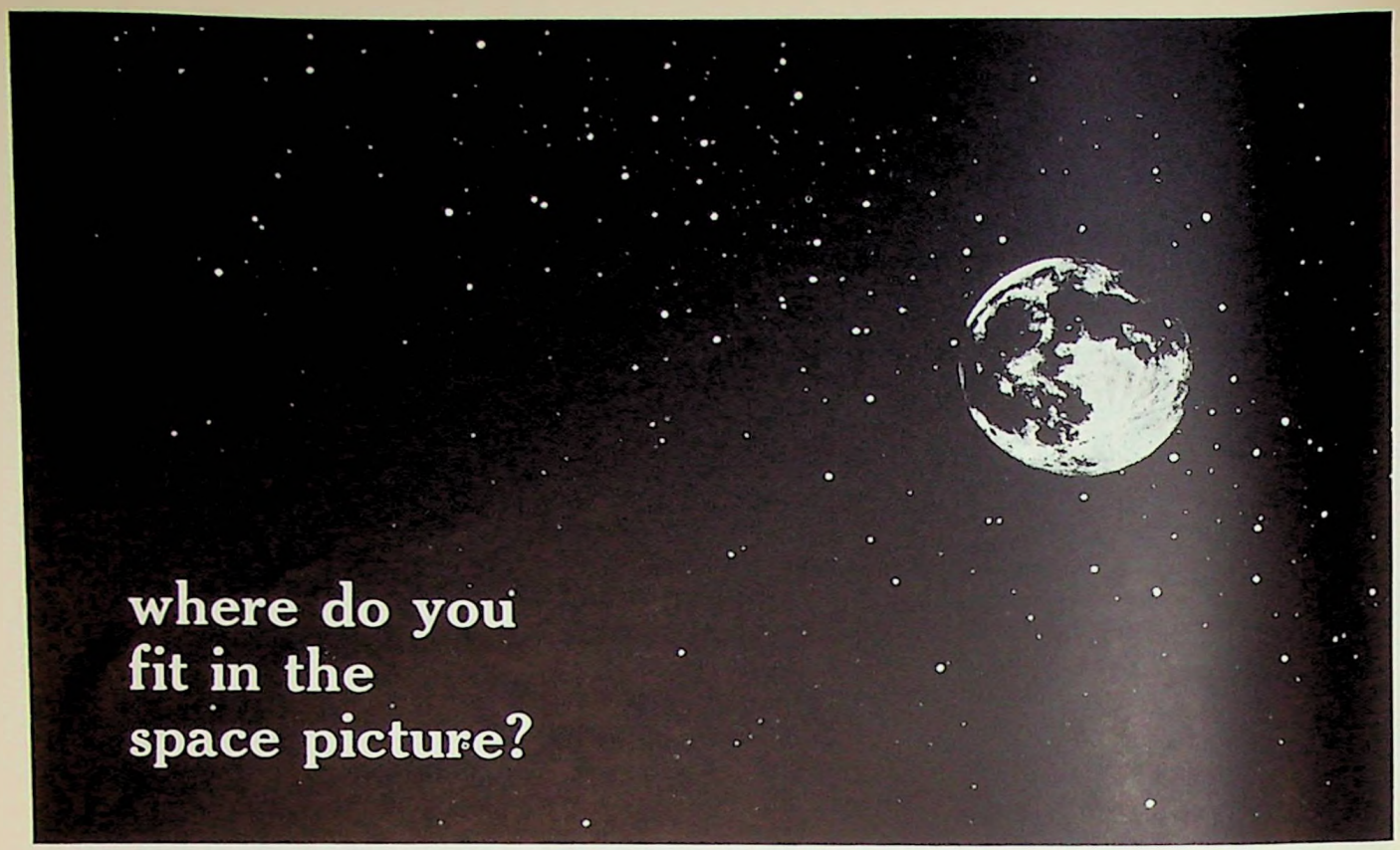
SPECIFICATIONS

Frequency range:	800 to 2,400 MC
RF input power:	Maximum 1 watt
SWR:	1.5 maximum at minimum attenuation, 2.0 maximum at 80 db attenuation
Impedance:	50 ohms nominal
On-off ratio:	Better than 80 db
Rise time:	20 nsec
Decay time:	10 nsec
Internal repetition rate:	Variable from 50 cps to 50 KC, 3 decade ranges
Jitter:	< 10 nsec
Internal pulse width:	Variable from 0.1 μsec to 100 μsec in 3 decade ranges
External sync:	0 to 1 MC depending on width/delay ratio
External AM mod:	Max. freq., 1 MC sinusoidal
External pulse mod:	Max. rep. rate, 1 MC
Dimensions:	16¾" wide x 4" high x 18⅜" deep
Weight:	23 lbs.
Price:	$850.00

7879 *Data subject to change without notice. Price f.o.b. factory*

HEWLETT-PACKARD COMPANY

CONTACT OUR ENGINEERING REPRESENTATIVES,
NEELY ENTERPRISES, FOR INFORMATION—Los Angeles, 3939 Lankershim Blvd., North H'wd., TR 7-1282 and PO 6-3811; San Carlos, 501 Laurel St., 591-7661; Sacramento, 1317 Fifteenth St., GI 2-8901; San Diego, 1055 Shafter St., AC 3-8103; Scottsdale, 771 S. Scottsdale Rd., 945-7601; Tucson, 232 So. Tucson Blvd., MA 3-2564; Albuquerque, 6501 Lomas Blvd., N.E., 255-5586; Las Cruces, 114 S. Water St., 526-2486.



Today, the design and development of space systems, vehicles and weapon systems is achieving an even greater degree of importance than before. Expenditures are increasing. The pace is being stepped up.

Hughes Aerospace Divisions are expanding with each of these progressions. Important projects such as SURVEYOR, SYNCOM, advanced POLARIS guidance and Anti-ballistic Missile Defense (boost-intercept, mid-course, terminal) are now underway. Others will begin soon. This expansion is producing new, challenging assignments which never existed before. You can now be a part of, and benefit from, Hughes further expansion into the space age.

If you hold a degree from an accredited university in Mechanical Engineering, Electronic Engineering or Physics, are a U. S. citizen and have experience or interests related to Aerospace Vehicles or Weapon Systems, you can qualify. 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, controls 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.

systems analysts
To consider such basic problems as the 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.

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

Inquire today. Fit yourself into the space picture at Hughes. Please airmail your resume to:
Mr. Robert A. Martin
Head of Employment
Hughes Aerospace Divisions
11940 W. Jefferson Blvd.
Culver City 66, California.
We promise you a reply within one week.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY
AEROSPACE DIVISIONS
An equal opportunity employer.

Grid volume 9, number 4 October 15, 1962

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

The moon at 13 days, photographed with the new astrometric camera built to order by SRI for the 36-inch refractor telescope at Lick Observatory, shows bright rays from the crater Tycho, puzzlingly parallel, as if some rolling object plowed this furrow over the lunar surface. For more on this remarkable electronic camera, see page 12.

section officers

advertising

Grid reporters

EAST BAY SUBSECTION
N. K. (GENE) LITTLE, LAWRENCE RADIATION LABORATORY

PROFESSIONAL GROUPS:

AUDIO: HERB RAGLE, AMPEX CORP.

AUTOMATIC CONTROL: A. S. McALLISTER, SAN JOSE STATE COLLEGE

ANTENNAS AND PROPAGATION: ROLPH B. DYCE, STANFORD RESEARCH INSTITUTE

BROADCASTING: BEN WOLFE, KPIX-TV

BIO-MEDICAL ELECTRONICS: JAMES BLISS, STANFORD RESEARCH INSTITUTE

COMMUNICATIONS SYSTEMS: MAURICE H. KEBBY, LENKURT ELECTRIC COMPANY

CIRCUIT THEORY: R. E. KIESSLING, ITT LABORATORIES

ELECTRON DEVICES: MAHLON FISCHER, SYLVANIA, MICROWAVE DEVICE DIVISION

ELECTRONIC COMPUTERS: WILLIAM DAVIDOW GENERAL ELECTRIC COMPUTER LABORATORY

ENGINEERING MANAGEMENT: LEONARD M. JEFFERS, SYLVANIA E. D. L.

ENGINEERING WRITING AND SPEECH: DOUGLAS WM. DUPEN, ASSOCIATED TECHDATA INC.

INFORMATION THEORY: CHARLES H. DAWSON, PHILCO W. D. L.

INSTRUMENTATION: JAMES HUSSEY, GENERAL RADIO COMPANY

MICROWAVE THEORY AND TECHNIQUES: ROBERT J. PRICKETT, HEWLETT-PACKARD CO.

MILITARY ELECTRONICS: J. WETTSTEIN, LOCKHEED

PRODUCT ENGINEERING AND PRODUCTION: W. DALE FULLER, LOCKHEED

RADIO FREQUENCY INTERFERENCE: JOHN W. WATTENBARGER, SIERRA ELECTRONICS CORPORATION

RELIABILITY AND QUALITY CONTROL: W. WAHRHAFTIG, PHILCO CORPORATION

SPACE ELECTRONICS AND TELEMETRY: TOM LINDERS, LOCKHEED

HISTORIAN: EARL G. GODDARD, VARIAN ASSOCIATES

production staff

EDITORIAL ASSISTANT: DORIS GOULD

ADVERTISING ASSISTANT: CAROLYN JURGENSEN KASTOR

MEETING CALENDAR

SAN FRANCISCO SECTION

8:00 P.M. • Tuesday, November 6

"Porpoises and Sonar"

(Joint meeting with PGBME)

Speaker: Dr. Winthrop N. Kellogg, professor of experimental psychology, Florida State University, visiting consultant at SRI

Place: Main conference room, Stanford Research Institute, Menlo Park

Dinner: 6:00 P.M.

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

EAST BAY SUBSECTION

8:00 P.M. • Monday, October 15

"The Synthesis of Electronic Bi-stable Circuits"

Speakers: Professor D. O. Pederson and R. S. Pepper

Tour of the new high-temperature plasma and semiconductor facilities of the electronic research labs of the University of California, Berkeley

Place: Room 277, Cory Hall, University of California Campus

Meet-the-Speakers Dinner: 6:30 P.M. (place to be announced)

Reservations and information: Berkeley, TH 3-2740, Ext. 5434; or Livermore, HI 7-1100, Ext. 8011

PROFESSIONAL GROUPS

Automatic Control

8:00 P.M. • Thursday, October 25

"MH1 A Computer Operated Mechanical Hand or How to Send a Computer to Kindergarten"

Speaker: Dr. Hans Ernst, Control System Research Department, IBM Research Laboratories, San Jose

Place: Stanford University, Physics Lecture Hall

Dinner: 6:30 P.M., Rickey's Hyatt House, 4219 El Camino Real, Palo Alto

Reservations: Mrs. Pauline Elkman, DA 1-3300, by noon, Wednesday, Oct. 24

Bio-Medical Electronics

8:00 P.M. • Tuesday, November 6

(Joint meeting with San Francisco Section, see above)

Electron Devices

8:00 P.M. • Wednesday, October 17

(Joint meeting with PGMTT)

"Quantum Noise in Optical Masers"

Speaker: Dr. William H. Louisell, Stanford University

Place: Physics Building, Stanford University

Electronic Computers

8:00 P.M. • Tuesday, October 23

"An Approach to General Pattern Recognition"

Speaker: Martin A. Fischler, Lockheed Missiles and Space Company

Place: Lockheed Auditorium, 3251 Hanover Street, Palo Alto

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

Reservations: None required

Engineering Writing & Speech

8:30 P.M. • Friday, October 26

(Joint meeting with the Society of Technical Writers and Publishers)

"How Proposals Are Evaluated"

Speaker: Mr. Harold Hornby, Ames Aeronautical Laboratory, Moffett Field

Dinner-Meeting: 6:30 Cocktails—7:30 Dinner

Place: To be announced

Reservations: Paul Jensen, YO 8-6211, Ext. 2795

MEETING CALENDAR

Information Theory — 8:00 P.M. • Thursday, October 25
"Report on the Brussels International Symposium on Information Theory"
Speaker: Charles S. Weaver, project engineer, Philco, WDL
Place: Philco Auditorium, Building 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 or 2522

Instrumentation — 8:30 P.M. • Wednesday, October 24
"Time Domain Reflectometry"
Speaker: Bernard M. Oliver, Hewlett-Packard Company, Palo Alto
Place: Hewlett-Packard, 1501 Page Mill Road, Palo Alto
Dinner: 6:00 P.M., L'Omelette, 4170 El Camino Real, Palo Alto
Reservations: Mrs. Salter, DA 1-3300, Ext. 273

Microwave Theory & Techniques — 8:00 P.M. • Wednesday, October 17
(Joint meeting with PGED, see above)

Radio Frequency Interference — 8:00 P.M. • Thursday, October 18
"The Frequency-Control Function on the Pacific Missile Range"
Speaker: Representative, Commander, Pacific Missile Range
Place: Auditorium, Building 202, Lockheed Missiles and Space Company

Space Electronics & Telemetry — 8:15 P.M. • Tuesday, October 16
"Fuel Cells and Batteries for Space Applications"
Speakers: Dr. Morrin Eisenberg, Martin Klein, Electrochimica Corp., Menlo Park
Place: Lockheed Auditorium, Bldg. 202, 3251 Hanover St., Palo Alto
Dinner: 6:30 P.M., Red Shack, 4085 El Camino Way, Palo Alto
Reservations: Tom Linders, RE 9-4321, Ext. 28394 or 28453

pep conference

EXHIBITORS ANNOUNCED

A partial list of exhibitors at the 6th National Conference on Product Engineering and Production, November 1 and 2 at the Jack Tar Hotel, San Francisco, has been announced by W. Dale Fuller, Lockheed Missiles and Space Company, exhibits chairman.

They are Mesa Plastics Co., Los Angeles; U.S. Engineering Co., division of Litton Industries, Van Nuys; Kewaunee Scientific Equipment, Adrian, Michigan; Hull Corp., Hatboro, Penn.; Blue M Engineering Co., Los Angeles; McGill and McGill, electronic representatives, Palo Alto; United Aircraft Corp., East Hartford, Conn.; Piddington and Associates, Pasadena; Photocircuits Corp., Glen Cove, N.Y.; Aerojet-General Corp., Azusa; and Stewart Engineering Co., Santa Cruz.

For full particulars on the conference, including the complete program, see the October 1 issue of **Grid**.

remarks from the chairs

Inasmuch as the section by-laws assign to the secretary the responsibility for operation of the section office, it may be appropriate to review here the current operation, some of the events that led up to it, and the outlook for the future.

The problems with which the office is faced stem from its efforts to serve purposefully and efficiently the needs of the section membership in local activities. These activities consist primarily of the technical meetings arranged through the professional group chapters, in addition to section meetings and social events. As the size of the membership has grown, so has the number and variety of meetings. Keeping members accurately and promptly informed of this activity becomes a sizeable and expensive undertaking.

To that end, the **Grid** was established eight years ago as a section publication, carrying news and meeting reports as well as notices of scheduled events, and being financed through advertising. From small-scale beginnings, the **Grid** has now grown to an operation about four times as large financially as that of the rest of the section.

In order to keep all this under control, the entire operation has now been consolidated under one roof. The day-to-day functioning is carried out under the supervision of one man, James Warnock, who is both executive secretary for the section and executive editor for the **Grid**. This arrangement permits closer control of over-all section finances to insure that the **Grid** is paying its own way in serving the needs of the section. A rigorous accounting and auditing system, difficult to implement under the previous split operation, is being established.

The past year has been one of costly transition. The new arrangement has now been completed, and the situation appears to be under control for the coming year. Life will get complicated again when we start to merge locally with the AIEE, but having our own house in order should ease that next transition.

ALAN T. WATERMAN, JR.
SECRETARY
SAN FRANCISCO SECTION

meeting ahead

PGED'S NOISY MASERS

The advent of amplifiers at optical frequencies has opened new frontiers in the field of communications, according to Dr. William H. Louisell, a member of the technical staff of Bell Telephone Laboratories on leave of absence for a year as visiting associate professor of electrical engineering, Stanford University.

At the joint meeting of PGED and PGMTT on October 17 at Stanford, he will describe the increase in available bandwidths as but one of the attractive features of the optical part of the spectrum.

The limit of sensitivity of the optical maser is determined not by thermal noise, shot noise, or the like, but rather by what is called quantum noise, according to Dr. Louisell. The optical maser introduces an amount of noise equivalent to a resistor at 10,000°A.

The speaker's purpose is to study the statistical significance of this noise in its effects on amplified or attenuated signals as well as to show the quantum origin of this noise.

Professor Louisell attended the University of Florida, Kenyon College, and the University of Michigan. He received the B.S., M.S., and Ph.D. degrees in physics from the latter institution. He has been engaged in research on the gyromagnetic ratio of a free electron, broadband directional couplers, slalom electrostatic focusing of electron beams, parametric amplifiers, and quantum statistics of linear amplifiers.

He is the author of a recent book, "Coupled Mode and Parametric Electronics." He is a member of the American Physical Society, Sigma Xi, and Phi Kappa Phi.

meeting ahead

PGEC PATTERNS

Pattern recognition, one of the most arresting challenges of modern electronics, will be the subject of the October 23 meeting of PGEC.

In his talk, "An Approach to General Pattern Recognition," Martin A. Fischler, Lockheed Missiles and Space Company research laboratories, Palo Alto, will consider the challenge to be composed of two subproblems.

The first subproblem is one of abstracting significant features or characteristics from the patterns being dealt with, while the second is concerned with identifying the pattern which gave rise to a particular set of features (i.e., a decision-making problem). A switching-theory approach is taken in designing the decision procedure.

The talk will describe some of the theoretical problems, laboratory equipment constructed for performing experiments, and results produced (theoretical and experimental) by the investigation.

The talk will be based on a paper by the same title published in the IRE Transactions on Information Theory (September, 1962—Proceedings of the International Symposium on Information Theory) coauthored by Fischler, R. L. Mattson, O. Firschein, and L. D. Healy, but will be supplemented by additional experimental results and descriptions.

meeting ahead

PULSE ECHOES FOR PGI

For years reflection measurements in the UHF and microwave regions of the spectrum have involved CW or swept CW techniques using slotted lines or directional couplers.

The advent of fast-pulse generators and sampling scopes, making it possible to use a pulse-echo approach, will be described by Dr. Barney Oliver, vice president, research and development, Hewlett-Packard Company, at the October 24 meeting of PGI.

Under the title, "Time Domain Reflectometry," he will discuss the interpretation of the echoes in terms of the impedance discontinuities which produce them. A demonstration of the method on a VHF antenna will be given.

Widely known to Bay Area electronic engineers, the speaker is a Fellow in IRE and a nominee for the board of the IEEE.

meeting ahead

PGIT BRUSSELS REPORT

From the end of July to the middle of October, Charles S. Weaver of Philco WDL journeyed eastward around the world, stopping in Brussels from September 3 to 7 to attend the International Symposium on Information Theory and deliver a talk on "Adaptive Communication Filtering." At PGIT's meeting on Thursday, October 25, he will present a report on

(Continued on page 10)

WINNERS' CIRCLE

Eleven of the leading entries in today's "Electronic Sweepstakes" wear the Neely colors. The Neely Enterprises track is a big one covering the entire states of California, Arizona, Nevada and New Mexico. When you have a problem that involves thoroughbred knowledge of electronic equipment, be sure to call your Neely Field Engineer. He's highly trained and from starting gate right down to the wire you can bet he'll bring you into the Winners' Circle every time.

NEELY *enterprises*

ELECTRONIC MANUFACTURERS' REPRESENTATIVES

BALDWIN LIMA HAMILTON CORPORATION
Electronics Division
Waltham, Massachusetts

BOONTON RADIO CORPORATION
Rockaway Township, New Jersey

DAGE DIVISION
Thompson Ramo Wooldridge Inc.
Michigan City, Indiana

DYMEC
A Division of Hewlett-Packard Company
Palo Alto, California

EMCOR Ingersoll Products Division
Borg-Warner Corporation
Chicago, Illinois

HARRISON LABORATORIES, INC.
A Division of Hewlett-Packard Company
Berkeley Heights, New Jersey

HEWLETT-PACKARD COMPANY
Palo Alto, California

McLEAN ENGINEERING LABORATORIES
Princeton, New Jersey

F. L. MOSELEY COMPANY
Pasadena, California

SANBORN COMPANY
Waltham, Massachusetts

VARIAN ASSOCIATES
Palo Alto, California

ONE OF NEELY'S EIGHT OFFICES IS LOCATED CONVENIENTLY NEAR YOU, FULLY STAFFED TO HELP YOU FILL YOUR ELECTRONIC NEEDS

NORTH HOLLYWOOD 3939 Lankershim Blvd. • Ph: TR 7-1282 • TWX: N-Hol 7133
SAN CARLOS 501 Laurel St. • Phone: 591-7661 • TWX: SCARBEL 94
SACRAMENTO 1317 Fifteenth Street • Phone: Gilbert 2-8901 • TWX: SC 124
SAN DIEGO 1055 Shafter Street • Phone: AC 3-8103 • TWX: SD 6315
ALBUQUERQUE 6501 Lomas Boulevard, N. E. • Phone: 255-5586 • TWX: AQ 172
LAS CRUCES 114 S. Water Street • Phone: 526-2486 • TWX: Las Cruces NM 5851
SCOTTSDALE 771 S. Scottsdale Road • Phone: 945-7601 • TWX: SCSDL 547
TUCSON 232 South Tucson Boulevard • Phone: MAin 3-2564 • TWX: TS 5981

selected papers from the Brussels meeting.

A project engineer in the communication sciences department of the advanced technology laboratory, the speaker joined Philco's WDL in 1958 and has since been responsible for advanced studies in communication theory. These have concerned modulation, phase-locked-loop reception, and communication systems.

He is currently working on techniques for the detection of very weak signals in noise, applications of computers in the detection process, optimal filtering, and adaptive techniques. He is also working toward the Ph.D. at Stanford in the honors cooperative program.

He received the B.A. in mathematics from the College of Idaho in 1951, worked on low-noise microwave receivers in Philco's research division from 1951 to 1953, served as an electronics officer in the U.S. Navy from 1953 to 1956, and attended the University of California from 1956 to 1958, working as a research assistant in aircraft servo design and as a summer engineer on the Bevatron. He received the M.S. in electrical engineering there in 1958.

meeting ahead

TECHNICAL PROPOSAL REVIEW

What part of a proposal weighs most with a technical reviewer? How much does a beautiful (and costly) art cover mean? Does anyone really read biographical résumés? Under what circumstances may the technical reviewer be evaluating proposals and how do these influence his evaluation? Some answers and opinions on these questions and others regarding technical proposal review from a qualified and experienced technical reviewer from the NASA Ames Research Center in Mountain View will feature the October 26 meeting of PGEWS joint with the Society of Technical Writers and Publishers.

The speaker will be Harold Hornby, chief of systems, mission analysis group at Ames, who has had an extensive and varied experience in reviewing technical proposals on various NASA programs.

Since joining NASA in 1959, he has engaged in numerous space rendezvous and energy management

(Continued on page 11)

MOORE HEADS MEET

John R. Moore, vice president, North American Aviation, Inc., and president of its autonetics division, will be chairman of the 1963 National Winter Convention on Military Electronics at the Ambassador Hotel in Los Angeles, January 30-31, and February 1.

A full program of secret sessions will highlight the fourth annual Los Angeles convention sponsored by PGMIL. Moore said the secret sessions will supplement the confidential and unclassified sessions previously held.

Initial schedules call for approximately 80 technical papers on a variety of subjects relating to military electronics, and exhibits from military and commercial organizations. "More than 34 booth reservations have already been received within two weeks of the initial invitations, indicating a record number of booths probable for the convention." The basic purpose of the convention will be "to exchange and disseminate technical information on military electronics."

4TH WESTERN TECH CONFERENCE

Sponsored by the Los Angeles Section of AIEE and its committees on domestic appliances and domestic commercial applications, the day-long conference will be held October 29 at the Biltmore Hotel. It will cover the application of space technological advances to commercial and domestic applications.

Luncheon speaker will be Crosby M. Kelly, vice president, public relations, Litton Industries. For further program details and registration forms, write to Al Klika, Controls Company of America, Thermac Gas Division, 14296 E. 6th Street, Corona, Calif.

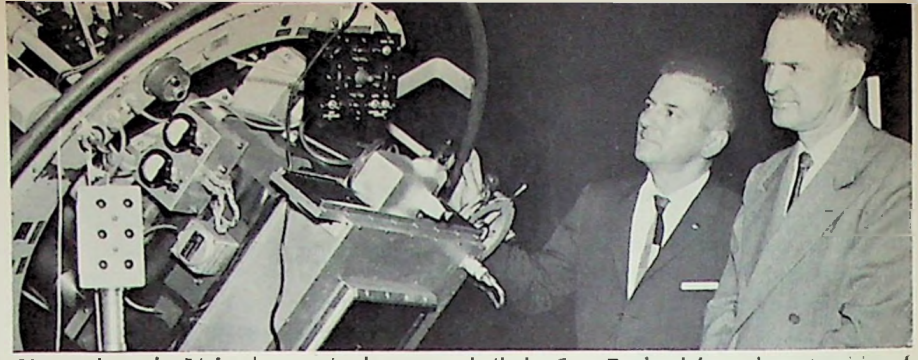
MORE MEETINGS

studies related to the solar probe, manned lunar landing, and manned interplanetary missions. He is technical manager for several study contracts, including an analysis of extra-terrestrial chemical propulsion requirements for future NASA planetary landing missions.

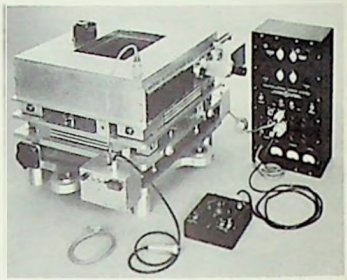
PHOTOGRAPHING THE UNIVERSE

Astronomers at Lick Observatory, Mount Hamilton, are in the forefront in their studies, using a variety of modern equipment incorporating the latest in electronic techniques. Photoelectric devices of varied types are being applied in diverse ways toward precise photometry of faint stars, studies of stellar colors, spectrum scanning, electronic photography, as well as automatic star-tracking.

Recently completed and put into routine use is a new astrometric camera, built to the observatory's order by SRI. This latest addition is used with the 75-year-old 36-inch refractor telescope, still in first-class optical condition, thus assuring its continued usefulness for many years to come. The camera features photoelectric guidance, which enables close tracking of a selected guide-star for exposures of as long as several hours, thus achieving a carefully focused, clear photograph of the celestial object under study, in spite of atmospheric refraction effects, telescope drive drifts, etc. Several hundred photographic plates have been accumulated in various observing programs such as stellar parallax and star cluster studies. The camera has been found to be reliable and easily operated.



Mounted on the Lick telescope is the camera built by Curt Roche, left, under supervision of Robert Weitbrecht, IRE member, both of SRI. Electronics operate servomasters in X and Y directions, causing camera to track stars as picked up by phototubes in aluminum box on top



Final form of the Lick astrometric camera. Assembly on left is camera proper containing servo-controlled X and Y motions. Black box, with its smaller control box, contains electronics needed to enable camera to perform its mission

SE HABLA BALGOL

Deans, department heads, and a Nobel Prize winner are among 72 Stanford University professors and administrators who recently went back to school as students.

Their course was a concentrated nine-day seminar on computers and computer language. Twice the expected number of faculty members responded to the school of engineering's invitation to the COMPSEF II seminar, the sequel to last year's COMPSEF I (Computation Seminar for the Engineering Faculty), designed to give faculty members a chance to learn about computers, their strange language, and their remarkable contributions to education and research. The program is supported under a Ford Foundation grant made in 1959 for faculty development.

Instructors for the course included six Stanford experts: Prof. Robert V. Oakford, industrial engineering; Prof. George E. Forsythe, computer sciences and mathematics, and director of the Stanford computation center; Prof. Gene F. Franklin, electrical engineering; Prof. Harvey M. Wagner, industrial engineering, statistics, and business administration; R. Wade Cole, acting associate director of the computation center; and Robert T. Braden, computer sciences. A seventh lecturer, Robert S. Barton of Altadena, was a private consultant.

Specialists in education, business, genetics, medicine, engineering, and statistics were included in the 72 scholars devoting full time to lectures and the study of BALGOL—a computer language combination of algebra and English. Afternoons were devoted to practice in preparing actual programs in BALGOL for Stanford's computation center. The center gave their lab work top priority processing, keeping pace with successive sessions of the class.

Several hundred persons learn computer languages and techniques at Stanford each year, but most are students. Faculty members have to learn in their spare time, as in the current between-quarters seminar. A new home for Stanford's computation center is now under construction, where two big computer systems—an IBM 7090/1401 and Burroughs B5000—will be located.

Corcoran

Anderson

Wolfe

Pogue

grid swings

IT IS REPORTED:

Myron C. Pogue has been appointed manager of marketing research for Ampex Corporation, responsible for domestic and international marketing research for all products divisions.

James L. Farmer has been named senior representative for Army programs of the Motorola military electronics division and will headquarter at Red Bank, N.J.

William J. Corcoran has been appointed director of the research and advanced technology division at United Technology, Sunnyvale.

Philip B. Thomas has been named manager, manufacturing, and **Charles N. Fournier** named controller for the vacuum products division, Varian Associates. **Arthur J. Rock, Harald N. Andreassen,** and **Robert L. Cooper** have been named managers of district sales offices in San Francisco, Dallas, and Los Angeles, respectively.

Robert E. Wolfe fills the new post of vice president for manufacturing at Melabs, Palo Alto, including responsibility for production control, metal fabrication, components and circuits assembly, and testing.

Russell R. Miller has been named manager of product planning, Ampex Corporation Computer Products Company, Culver City, responsible for short- and long-range planning for development of ferrite and tape memory systems and components for computers.

Gordon C. Westwood has been appointed manager of the Palo Alto office of Carl A. Stone Associates, Inc. The firm has been named sales representative in northern California for Filtron, Inc., for RF shielded enclosures.

Carl D. Herold, John K. La Galante, and **Lawrence L. Polson** are three new additions to the technical staff of the systems division of Watkins-Johnson Co.

James Lambert, former production manager for Precision Instruments, has joined The Calma Company as sales engineer.

Al Anderson has been named production engineer by Alfred Electronics after six years with H-P.

Donald L. Putt, president of United Technology Corporation, has been elected a director of Granger Associates.

PAPERS CALLS

Nov. 5: 200-word abstract for the INTERMAG Conf. on Nonlinear Magnetics to be held at the Shoreham Hotel, Washington, D.C., Apr. 17-19. Address to: Dr. J. J. Suozzi, tech. prog. chm., Bell Telephone Laboratories, Inc., Whippany, N.J.

Nov. 15: 100-word abstract for a Fourth Joint Automatic Control Conf. to be held at the Univ. of Minnesota, Minneapolis, Minn., June 19-21, 1963. The sponsoring societies of the JACC are the American Institute of Chemical Engineers (which has prime responsibility in 1963), the Institute of Electrical Engineers, the American Society of Mechanical Engineers, the IRE, and the Instrument Society of America. Abstracts and papers may be submitted through the member society headquarters, with the designation "for 1963 JACC," or to the prog. chm., Prof. Otis L. Updike, Dept. of Chemical Engineering, Univ. of Virginia, Charlottesville, Va.

Nov. 1-2—**6th National Conference on Product Engineering and Production.** San Francisco, Calif., Jack Tar Hotel. Exhibits: W. Dale Fuller, Lockheed Missiles and Space Div., P.O. Box 504, Sunnyvale, Calif. Program: George F. Reyling, Varian Associates, 611 Hansen Way, Palo Alto, Calif. IRE TRANSACTIONS on Product Engineering and Production after Conference.

Nov. 4-7—**15th Annual Conference on Engineering in Biology and Medicine. IRE, AIEE & ISA.** Conrad Hilton Hotel, Chicago, Ill. Exhibits: Professional Associates, 6520 Clayton Rd., St. Louis 17, Mo.

Nov. 5-7—**NEREM (Northeast Res. and Engineering Meeting).** Commonwealth Armory, Somerset Hotel, Boston, Mass. Exhibits: S. K. Gibson, Instruments of New England, 108 Greenwood Lane, Waltham 4, Mass. Program: I. Goldstein, Raytheon Co., Box 555, Hartwell Rd., Bedford, Mass. Digest: $7.50. Contact IRE Boston Office after Conference.

Nov. 12-15—**8th Annual Conference on Magnetism and Magnetic Materials.** Penn-Sheraton, Pittsburgh, Pa. Exhibits: J. L. Whitlock, John Leslie Whitlock Assoc., 253 Waples Mill Rd., Oakton, Va. Program: G. W. Weiner, Westinghouse Elec. Corp. Res. Labs, Churchill Bor., Pitts. 35, Pa. Proceedings: In Journal of Applied Physics, Mar. or Apr. 1963.

Nov. 15-17—**1961 Annual Display of Aerospace Electrical Society** (formerly Aircraft Electrical Society), Pan Pacific Auditorium, Los Angeles, Calif. For information, contact Ed Niles, executive secretary, 3540 Wilshire Blvd., Los Angeles, Calif.

Nov. 16-17—**2nd Canadian IRE Communications Symposium.** Queen Eliz. Hotel, Montreal, P.Q., Canada. Exhibits. Program: Alan B. Oxley, Canadair Ltd., Box 6087, Montreal, P.Q., Canada.

Nov. 19-20—**MAECON (Mid-American Electronics Conference).** Hotel Continental, Kansas City, Mo. Exhibits. Program: Dr. John Warfield, Dept. of E.E., Univ. of Kansas, Lawrence, Kansas.

Nov. 28-30—**1962 Ultrasonics Symposium.** Columbia, Univ., New York City. Program: R. N. Thurston, Bell Tel. Labs., Murray Hill, N.J. IRE TRANSACTIONS on Ultrasonics Engineering.

MANUFACTURER/REPRESENTATIVE INDEX

Ace Engineering & Machine Co.	R. W. Thompson Assoc.
Adcom Corporation	W. K. Geist Company
Aircom, Inc.	Components Sales California, Inc.
Airflow Company	Richard A. Strassner Co.
Alfred Electronics	Moxon Electronics
American Optical Co., Instrument Div.	J. T. Hill Co.
American Standard, Controls Div.	J. T. Hill Co.
Analab Instrument Corp.	V. T. Rupp Co.
Applied Microwave Electronics	Walter Associates
Applied Technology, Inc.	Moxon Electronics
Associated Engineering Corporation	J. T. Hill Co.
Associated Testing Laboratories, Inc.	Ault Associates
Astrodata, Inc.	Moxon Electronics
Avnet Instrument Corp.	W. K. Geist Co.
Baldwin-Lima-Hamilton, Electr. Div.	Neely Enterprises
Ballantine Labs, Inc.	Carl A. Stone Assoc., Inc.
Barnes Engineering Company	Costello & Co.
Bay State Electronics Corp.	Perlmuth Electronics
Beckman/Berkeley Division	V. T. Rupp Co.
Behlman/Invar Electronics Corp.	T. Louis Snitzer Co.
Block Associates, Inc.	W. K. Geist Co.
Boonshaft & Fuchs, Inc.	W. K. Geist Co.
Boonton Electronics Corp.	O'Halloran Associates
Boonton Radio Corp.	Neely Enterprises
Burr-Brown Research Corp.	W. K. Geist Co.
California Technical Industries	Perlmuth Electronics
Cascade Research	Elliott Recht Assoc.
Caswell Electronics Corp.	R. W. Thompson Assoc.
Cimron Corporation	Ault Associates
CircuitDyne Corp.	T. Louis Snitzer Co.
Clairex Corp.	Moxon Electronics
Clary Arithmetic Centers	American Wireless
Components Engineering & Mfg. Co.	Premmco
Computer Instruments Corp.	Components Sales Calif.
Computer Measurements Co.	Moxon Electronics
Consolidated Ceramics & Metalizing	Artwel Electric, Inc.
Continental Connector Co.	J. Logan & Assoc.
Continental Sensing, Inc.	Birnbaum Sales Co. Inc.
Control Switch Div., Controls Co. of America	Belsco
Coopertronix, Inc.	T. Louis Snitzer Co.
CTS Corp.	J. Logan & Assoc.
Custom Materials, Inc.	Walter Associates
Dage Div., Thompson Ramo Wooldridge	Neely Enterprises
Dale Electronics	James S. Heaton Co.
Datapulse, Inc.	O'Halloran Associates
Dielectric Products	O'Halloran Associates
Diginamics Corp.	O'Halloran Assoc.
Digitronics Corp.	Components Sales California, Inc.
Drexel Dynamics Corporation	J. T. Hill Co.
DuMont Labs, Tubes & Instruments	J. T. Hill Co.
Duncan Electronics, Inc.	Birnbaum Sales Co. Inc.
Dymec, Division of Hewlett-Packard	Neely Enterprises
Dynamics Instrumentation Co.	J. T. Hill Co.
Dynatran Electronics Corp.	G. H. Vaughan
Eastern Air Devices	James S. Heaton Co.
Edgerton, Germeshausen & Grier, Inc.	J. T. Hill Co.
E-H Research Laboratories, Inc.	V. T. Rupp Co.
Eitel-McCullough, Inc.	James S. Heaton Co.
Elco Corporation	James S. Heaton Co.
Elcor, Inc.	T. Whychell Company
Eldema Corporation	James S. Heaton Co.
Electra Manufacturing Co.	Birnbaum Sales Co. Inc.
Electro Assemblies, Inc.	Birnbaum Sales Co. Inc.
Electronic Measurements Co.	O'Halloran Associates
Electronic Modules Corp.	Walter Associates
Electronic Production & Development, Inc.	Belsco
Elgin-Advance	James S. Heaton Co.
Emcor, Ingersoll Products Div.	Neely Enterprises
Empire Devices, Inc.	Carl A. Stone Assoc., Inc.
Eppley Laboratory, Inc.	W. K. Geist Co.
Equipto Electronics Corporation	Electronic Sales Associates
Erie/Eldorado	O'Halloran Assoc.
Etchomatic, Inc.	James S. Heaton Co.
Fabri-Tek, Inc.	Costello & Co.
Fairchild/Dumont Labs	R. W. Thompson Associates
Flow Corporation	G. H. Vaughan Co.
Fluke Mfg. Co., John	McCarthy Associates
Forbes and Wagner, Inc.	James S. Heaton Co.
Franklin Systems, Inc.	Carl A. Stone Assoc., Inc.
Franklin Technical Corp.	Premmco, Inc.
General Instrument, Capacitor Div.	J. Logan & Assoc.
General Instrument, Semiconductor Div.	J. Logan & Assoc.
General Meters, Inc.	Long & Assoc., Inc.
Genistron, Inc.	James S. Heaton Co.
Globe Industries	Long & Assoc., Inc.
Hammarlund Manufacturing Co.	R. W. Thompson Assoc.
Hamner Electronics	McCarthy Associates
Harrison Labs., Div., H-P	Neely Enterprises
Hathaway Instruments, Inc.	J. T. Hill Co.
Heli-Coil Corp.	Premmco, Inc.
Hewlett-Packard Company	Neely Enterprises
Hitemp Wires	James S. Heaton Co.
Holt Instruments Laboratories	W. K. Geist Co.
Hudson Tool & Die Co., Inc.	John E. Striker Co.
Hughes Aircraft Co., Instruments	Walter Associates
Hughes Vacuum Tube Products Division	Belsco
IMC Magnetics Corp.	Richard A. Strassner Co.
Industrial Instruments, Inc.	G. H. Vaughan
Inland Motor Corp.	Costello & Co.
Instrument Systems Corporation	J. T. Hill Co.
International Resistance Co.	J. Logan & Assoc.

REPRESENTATIVE DIRECTORY

American Wireless
22 Devonshire Blvd.,
San Carlos; 591-6260

Artwel Electric, Inc.
1485 Bayshore Blvd.,
San Francisco; JU 6-4074

Ault Associates
120 Santa Margarita,
Menlo Park; DA 6-1760

Belsco
Box 907, Palo Alto;
DA 1-8501

Birnbaum Sales Company, Inc.
626 Jefferson Ave.,
Redwood City; EM 8-7757

Cain & Company
175 So. San Antonio Road,
Los Altos; 968-0995 or
948-9350

Components Sales California, Inc.
Palo Alto; DA 6-5317

Costello & Company
535 Middlefield Road,
Palo Alto; DA 1-3745

Dynamic Associates
1011-D Industrial Way,
Burlingame; 344-1246

Electronic Sales Associates
420 Market, San Francisco;
EX 2-8847

Geist Co., W. K.
Box 643, Cupertino, Calif.;
YO 8-1608, AL 3-5433

Heaton Co., James S.
413 Lathrop St., Redwood
City; EM 9-4671

Hill Company, J. T.
1682 Laurel, San Carlos;
LY 3-7693

Instruments for Measurements
251 So. Murphy Ave.,
Sunnyvale; RE 6-8680

Logan & Associates, Jack
1485 Bayshore Boulevard,
San Francisco; DE 4-1200

Long & Associates, Inc.
505 Middlefield, Redwood
City; EM 9-3324

Magnetics, Inc.
1826 Industrial Way,
Redwood City; EM 6-1210

REPRESENTATIVE DIRECTORY

McCarthy Associates
1011-E Industrial Way,
Burlingame; 342-8901

Moxon Electronics
15-41st Avenue,
San Mateo; FI 5-7961

Neely Enterprises
501 Laurel, San Carlos;
LY 1-7661; 1317 - 15th St.,
Sacramento; GI 2-8901

O'Halloran Associates
825 San Antonio Road,
Palo Alto; DA 6-1493

Perlmuth Electronics
941 Charleston Road,
Palo Alto; DA 1-5064

Premmco, Inc.
2406 Lincoln Ave.,
Alameda; LA 3-9495

Recht Associates, Elliott
175 S. San Antonio Road,
Los Altos; 941-0336

Rupp Co., V. T.
1182 Los Altos Avenue,
Los Altos; WH 8-1483

Snitzer Co., T. Louis
510 So. Mathilda Avenue,
Sunnyvale; RE 6-6733

Stone Associates, Carl A.
800 N. San Antonio Road,
Palo Alto; DA 1-2724

Strassner Company, Richard A.
Box 927, Los Altos;
WH 8-3334

Striker Company, John E.
P.O. Box 548, San Carlos;
LY 1-0736

Thompson Associates, R. W.
4135 El Camino Way,
Palo Alto; DA 1-6383

Vaughan Co., G. H.
Box 1253, Palo Alto;
DA 1-1347

Walter Associates
Box 790, Menlo Park;
DA 3-4606

Whychell Company, T.
580 Spargur Drive,
Los Altos; 948-0355

the section

MEMBERSHIP

Siera

Mulock

Following are the names of members who have recently been transferred to a higher grade of membership as noted:

Senior Member

R. B. Mulock
M. M. Siera

Member

R. L. Allen
N. G. Glaeser
G. A. Howard
Y. Satoda
J. M. Trindade

Associate

R. S. Borovoy
J. Y. Dawson
W. L. Shockley

Following are the names of IRE members who have recently entered our area, thereby becoming members of the San Francisco Section:

C. S. Abell III
W. Brewer, Jr.
R. L. Brier
J. T. Brothers
S. E. Byers
J. M. Carroll
E. S. Cole
J. L. Costanza
G. V. Dain
W. S. De Mars
R. M. Demere, Jr.
W. J. Dietrich
G. B. Duncan
D. A. Fairclough
O. K. Garriott
J. H. Hauser
R. R. Horning
L. B. Kendall
R. T. Lacoss
M. A. Moscarello
L. M. Mozzini
J. A. Palladino
W. L. Tyler
M. E. Van Valkenburg
J. A. Voss

INDEX TO ADVERTISERS

Gertsch General Purpose RatioTran®

NOW...A LOW-COST AC INDUCTIVE VOLTAGE DIVIDER

—ACCURATE TO 0.001%

In addition to the high accuracy, unit features high input impedance, low effective series impedance, and very low phase shift. You get characteristics comparable to those of more expensive instruments, in a Gertsch-quality unit.

5-decade transformer switching. Instrument is ideal for checking servos and resolvers...for voltmeter calibration, computer testing, and transformer turns ratio measurements.

Compact size—only 3½ inches high. Designed for bench mounting, and easily adapted to half-rack mounting with brackets furnished.

Send for literature on the RT-60 Series.

Gertsch

GERTSCH PRODUCTS, Inc.

3211 S. La Cienega Blvd., Los Angeles 16, Calif. • UPton 0-2761 • VErmont 9-2201

Northern California Office: 794 West Olive, Sunnyvale, California, REgent 6-7031

a New Concept

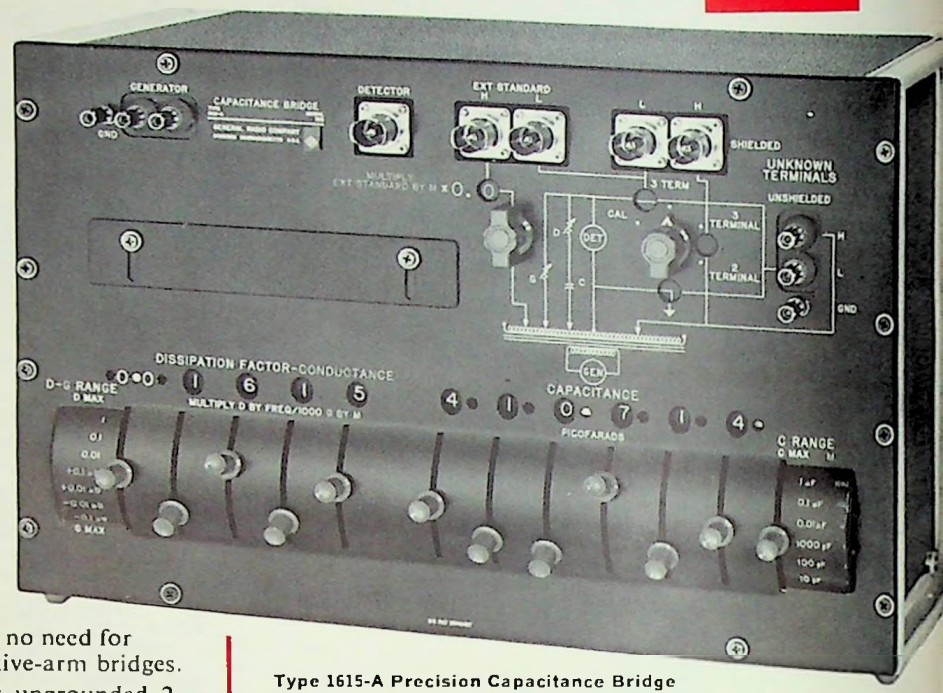
PRECISION CAPACITANCE BRIDGE

with lever balancing controls, digital readout, automatic decimal point location and unit indication greatly simplifies balancing.

RANGE, 10 μpf to 1μf

DIRECT READING ACCURACY, ±0.01%

RESOLUTION, 1 ppm



- ★ A transformer ratio-arm capacitance bridge having the capability of one-step 3-terminal capacitance measurement — no need for secondary balances as required by resistive-arm bridges.
- ★ Measures 3-terminal and grounded or ungrounded 2-terminal capacitors. A ground capacitance of 1μf produces an error of only 0.01% in the measurement of a 1000-pf capacitor.
- ★ Highly stable and accurate internal capacitance standards . . . all standards are made from Invar alloy, and the six largest are hermetically sealed in dry nitrogen, resulting in a stability of better than 5 ppm/°C.
- ★ All internal standards can be quickly checked against each other for consistency. Only a single external standard is required to establish the absolute calibration of the entire set.
- ★ Fast one-step intercomparisons of 3-terminal capacitors differing in value by 10,000 to 1 can easily be made.
- ★ When loss of unknown capacitor is less than that of standard, indication is given directly in terms of G.
- ★ Bridge circuit on panel automatically indicates proper bridge connections for each measuring situation.

Type 1615-A Precision Capacitance Bridge

Capacitance Range (6 ranges): 10^{-17} to 10^{-4} farads (10 μpf to 1μf), direct reading; 6-figure resolution, smallest division 10^{-17} farads. Ranges can be extended by use of external standards.

Dissipation-Factor Range (3 ranges): 0.000001 to 1 at 1 kc, direct reading. Directly proportional to frequency at other frequencies.

Conductance Range (2 + ranges; 2 — ranges): 10^{-8} μmho to 100 μmho; independent of frequency; 4-figure resolution, smallest division 10^{-4} μmho.

Accuracy: *Capacitance,* ±0.01%; direct reading, with internal standards; at high frequencies, error is 0.002% $C_{\mu f}\left(\frac{f}{1000}\right)^2$

Capacitance, approximately 1 ppm when comparing against external standards.

Dissipation factor, ±(0.1% + 7 ppm) of measured value.

Conductance, ±1% + 0.0001 μmho.

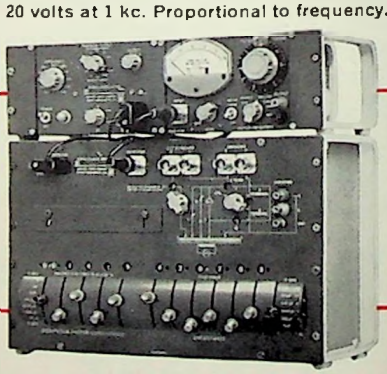
Frequency Range: Approximately 100 cycles to 10 kc.

Temperature Coefficients of Internal Standards: About 5 ppm/°C.

Maximum Voltage: 20 volts at 1 kc. Proportional to frequency.

Price: $1475

Complete Capacitance Measuring Assembly. Type 1620-A . . . includes the Type 1615-A Bridge; Type 1232-A Tuned Amplifier and Null Detector, a low-noise high-gain instrument with a 20-c to 20-kc range and a full scale sensitivity of 1μv; and the new Type 1311-A Bridge Oscillator, with 11 fixed frequencies from 50c to 10 kc. Price for the complete assembly is $2080.



Write for Complete Information

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

Branch Engineering Office in SAN FRANCISCO
1186 Los Altos Avenue, Los Altos, California
James G. Hussey • Donald M. Vagelaar
Tel.: WHitecliff 8-8233