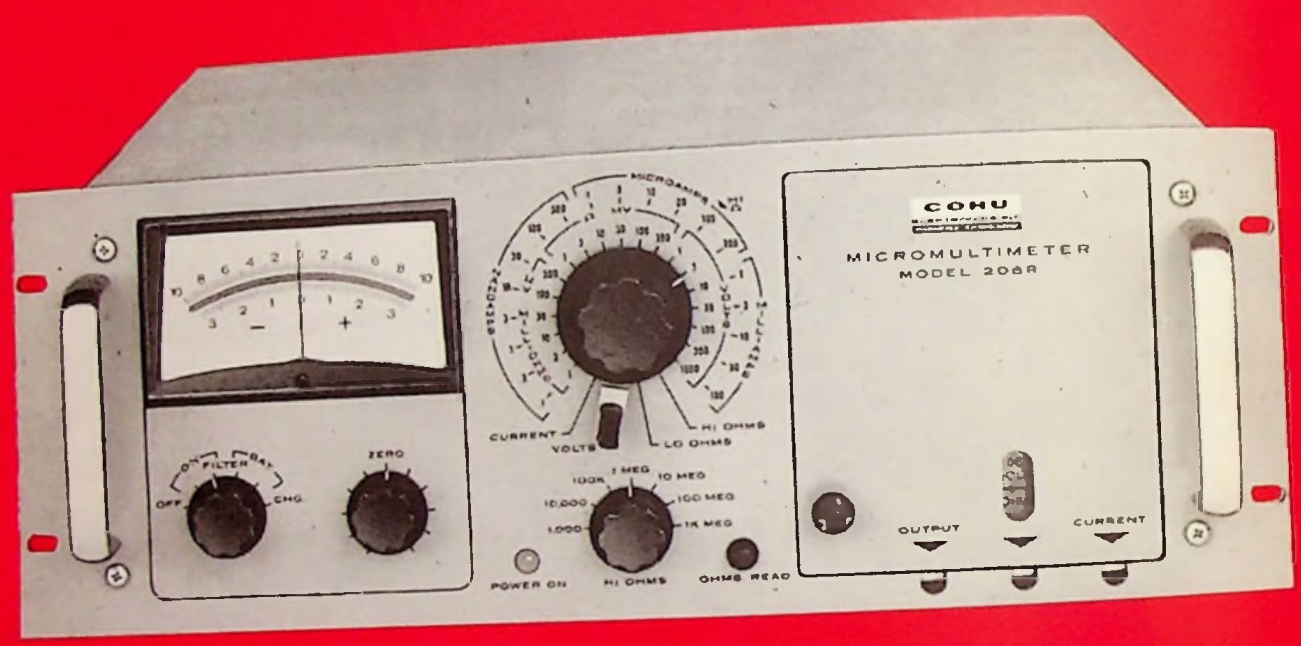
IEEE Grid

FEBRUARY 1966
SAN FRANCISCO SECTION
INSTITUTE OF ELECTRICAL
AND
ELECTRONICS ENGINEERS

meeting reminder

Aerospace & Electronic Systems, Thursday, February 24; Thursday, March 24
Automatic Control, Tuesday, February 15
Circuit Theory, Wednesday, February 16
Communication Technology, Wednesday, February 23; Wednesday, March 30
East Bay Subsection (SFS) Monday, February 28
Electron Devices, Wed., February 9; Wed., March 9; Wed., April 13
Engineering in Medicine & Biology, Tuesday, February 15
Fresno Subsection, Tuesday, February 15
Information Theory, Thursday, February 17
Microwave Theory & Techniques, Thursday, February 17
Nuclear Science, Monday, March 21
Power, Tuesday, February 15
San Francisco Section (EBSS) Monday, February 28

COHU introduces
FIVE
precision test instruments
IN ONE



Model 208R Micromultimeter

AT LESS COST, IN FAR LESS SPACE than closest equivalent instrumentation, Model 208R combines performance not previously available in one device.

HIGH RANGES AND LOW RANGES in one instrument give you the advantages of a DC microvoltmeter with ranges to 1000 volts, a microammeter, a wide range ohmmeter, an electronic galvanometer, and a narrow-band DC amplifier.

CHECK THESE FEATURES. Available for rack mounting or bench-top use, Model 208R operates from 115 or 230 volts, 50 to 400 cps, and from optional nickel-cadmium battery pack. Circuitry is solid state, chopper stabilized. Electrical output is suitable for driving a strip-chart recorder. Extra-long probes are stored on plug-in holders in a handy internal compartment, accessible from the front panel. $1495. Additional export charge.

CHECK THIS PERFORMANCE:

	VOLTAGE MEASUREMENTS	CURRENT MEASUREMENTS	RESISTANCE MEASUREMENTS
SCALES (full-scale indication)	10^{-6} to 10^{3} volts DC	10^{-10} to 10^{-1} ampere DC	10^{-3} to 10^{9} ohms
ACCURACY	1% of full scale or 10^{-7} volt, whichever is greater	1% of full scale or 10^{-11} ampere, whichever is greater	10^{-3} to 10^{8} ohms scales: 2% of full scale or 10^{-4} ohm, whichever is greater 10^{9} ohms scale: 3% of full scale
INPUT RESISTANCE	10^{-5} to 10^{3} volt scales: $>10^{8}$ ohms 10^{-6} and 3×10^{-6} volt scales: $>10^{7}$ and 3×10^{7} ohms	10^{-10} to 10^{-5} ampere scales: 10^{4} ohms 3×10^{-5} and 10^{-1} ampere scales: 10^{1} ohms	N/A
DRIFT (30 minute warmup)	$<2 \times 10^{-7}$ volts	$<2 \times 10^{-11}$ amperes	$<2 \times 10^{-4}$ ohms

Send for product information or demonstration of the COHU Model 208R Micromultimeter, or any of COHU's line of precision instruments. Representatives located in all major cities.

COHU ELECTRONICS, INC
SAN DIEGO CALIFORNIA

REGIONAL OFFICE, 406 CHANNING AVE., PALO ALTO, CALIF. 94300, PHONE: (415) 327-3911

Value round-up

Good investments are easy to come by when you trade with your local Neely field engineer. His line of Hewlett-Packard instrumentation has traditionally represented functional quality at a reasonable price. Furthermore, you can count on this quality to be consistent in the broad line of instrumentation and systems manufactured by the many divisions of Hewlett-Packard located throughout the country. Couple this with the fine service your Neely man offers you here in the West and you are assured of an instrumentation investment that will work for you.

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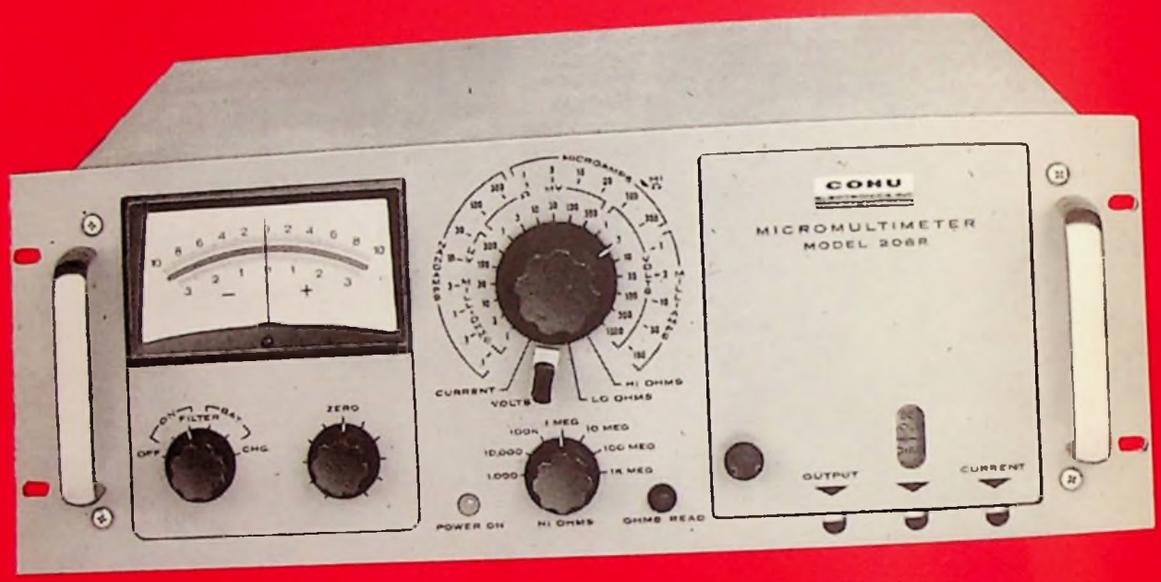
HEWLETT PACKARD hp NEELY SALES DIVISION

COHU introduces FIVE precision test instruments IN ONE



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HEWLETT PACKARD hp NEELY SALES DIVISION

student branch news

SANTA CLARA COUNSELOR

Dr. Raymond B. Yarbrough, assistant professor of electrical engineering, University of Santa Clara, has been named counselor of the Student Branch at that institution.

Prof. Yarbrough received the Ph.D. from the U. S. Naval Postgraduate School at Monterey in 1963, joining the university that year. His fields of specialty are non-linear magnetics and electronics.

Yarbrough

Granger

ieee news

GRANGER NAMED DIRECTOR

Dr. William G. Shepherd, newly elected IEEE president has announced the election to the board of directors of Dr. John V. N. Granger, president and chairman of the board, Granger Associates, Palo Alto; Thomas E. Marburger, Ft. Lauderdale, Florida; and Guillermo J. Andrews, Compania Standard Electric Argentina S.A.I.C., Buenos Aires.

Elected as vice-presidents by the annual assembly held January 5 were Hendley N. Blackman, engineering manager, association activities, Westinghouse Electric Corporation, Pittsburg, (IEEE vice-president, technical activities) and Dr. F. Karl Willenbrock, associate dean of engineering and applied physics, Harvard University, (IEEE vice-president, publications activities). The vice-president for publications activities is a newly created position established by the board.

The board has conferred on Haraden Pratt the title of director emeritus, for life, in recognition of his outstanding contributions to the IEEE for the many years he has served as secretary.

(Continued on page 15)

HELP THE SECTION GROW BY PLEDGING YOURSELF TO BRING IN A NEW MEMBER. RETURN THE CARD IN THE DECEMBER GRID.

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contents

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the section

MEMBERSHIP

Following are the names of individuals who have been elected to current membership:

N. M. Cox
B. N. Pines
P. L. Todd

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

A. M. Barbella
C. E. Brady
A. J. Chase
J. P. Corbett
Thomas P. Gilmer, Jr.
R. H. Hoge
W. G. Honsaker
G. S. Paul
D. L. Pehrson
W. J. Walsh

section news

NEW MAGNETICS CHAPTER

The IEEE executive committee, meeting on January 5, approved a petition for the establishment of a San Francisco chapter of the Magnetics Group, following approval by the section executive committee.

The chapter is being organized by David Nitzan, senior research engineer, Stanford Research Institute. Its formation will bring to 23 the total of active chapters within the San Francisco Section, 79 members of the Magnetics Group residing in the area. Interested members are invited to contact the organizer.

meeting postponement

ALVAREZ/PYRAMIDS TO APRIL

The February 15 meeting of the Nuclear Science chapter, at which Dr. Luis W. Alvarez, UC, Berkeley, was to describe his plans to x-ray the Egyptian pyramids has been postponed until April. Watch the *Grid* for details.

1966 CONVENTION

The IEEE International Convention is scheduled for March 21-25 at the New York Hilton and New York Coliseum. Watch the *IEEE Spectrum* for complete details.

cover

Action shots of the men of Sea Lab II are among the aspects of oceanography to be discussed by Dr. John Mero, Ocean Resources, Inc., La Jolla, at the February 28 joint meeting of the San Francisco Section and East Bay Subsection. See calendar and meeting ahead story for details. Sea Lab II completed a dramatic 45-day operation off La Jolla on October 12.

meeting ahead

OPTOELECTRONICS

J. Robert Johnson, -hp associates-, Palo Alto, will survey optoelectronics, a relatively young branch of solid-state electronics, at the February 9 meeting of the Electron Devices chapter.

Within the last year optoelectronic light sources, detectors, and isolators have become freely available to electronic equipment and systems designers. At the present time, manufacturers can supply these devices at a faster rate than they can be designed into circuitry, and one reason for this is the necessity for designers to accomodate circuit design to some new concepts.

Most of the physical mechanisms involved in OE devices are understood in detail, and the application of these principles to solid-state light sources and detectors will be discussed. In an area where understanding is not complete, the aging characteristics of gallium arsenide cause severe difficulties in fabricating reliable light sources, and several avenues are being explored to overcome the problem.

(Continued on page 6)

Johnson *Fredriksen*

meeting ahead

CLOSED LOOP STEPPING MOTORS

At the February 15 meeting of the Automatic Control chapter T. R. Fredriksen, staff engineer, IBM Corp., systems development div., San Jose, will present a paper on the application of stepping motors in closed loop applications.

Due to its digital behavior, the stepping motor has become a widely used device in open loop control. However, only a fraction of the potential performance of a stepping motor is utilized in such applications since, in addition to the normal open loop oscillatory characteristic, severe restriction exists as to stepping rates and load inertias. The purpose of this paper is to present a new approach to stepping motor control based on digital feedback.

It will be shown that the closing of a minor loop around the synchronous inductor motor results in substantially improved stepping rates, completely removing the load inertia restriction. A

(Continued on page 6)

MEETING CALENDAR

FEBRUARY 9, WEDNESDAY, 8:00 PM—Electron Devices
Optoelectronics
Dr. J. Robert Johnson, -hp associates-
Place: PH 101, Stanford University
Dinner: 6:00 PM, Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto
Reservations: Mrs. Beverly House, 326-4000, Ext. 2304, by Feb. 8

FEBRUARY 15, TUESDAY, 8:00 PM—Automatic Control
Closed loop stepping motor application
T. R. Fredriksen, staff engineer, IBM Corp., systems development div., San Jose
Place: 551 Engineering Center, University of Santa Clara
Dinner: 6:30 PM, Lucca Restaurant, 3160 The Alameda, Santa Clara
No reservations required

FEBRUARY 15, TUESDAY, 8:00 PM—Engineering in Medicine & Biology
Medical engineering—past, present and future
Emil Barish, director, research & development lab, University of California Medical Center, San Francisco
Place: University of California Medical Center, Room 214, Medical Sciences Bldg., San Francisco. (Parking—underground garage off Parnassus St.)
No dinner

FEBRUARY 15, TUESDAY, 7:30 PM—Fresno Subsection
Design and installation of language laboratories & video tape recorders
Richard Vaughn, chief field engineer, A.V. Electronics
Place: PG&E Bldg., 1401 Fulton, 10th floor, Fresno
No dinner

FEBRUARY 15, TUESDAY, 7:30 PM—Power
State power program moves ahead
James K. Cummings, chief. power office, Dept. of Water Resources
Place: 111 Pine St., Foremost Bldg., IBM assembly room, San Francisco
No dinner

FEBRUARY 16, WEDNESDAY, 8:00 PM—Circuit Theory
Active RC elliptic function filters
W. J. Kerwin, chief, electronics research branch, Ames Research Center
Place: SRI, Bldg. 1, conference room B, 333 Ravenswood, Menlo Park
Dinner: 6:30 PM, Red Cottage, El Camino, Menlo Park
Reservations: Jan Mulvihill, 367-3169 by Feb. 15

FEBRUARY 17, THURSDAY, 8:15 PM—Information Theory
Recent experiments in ESP
Russell Targ, president, Parapsychology Research Group, Inc., Portola Valley
Place: SRI, Bldg. 1, conference room B, 333 Ravenswood, Menlo Park
Dinner: 6:30 PM, Villa d'Este, 3401 El Camino Real, Atherton
Reservations: Miss Shirley Jackson, 966-3865 by Feb. 16

FEBRUARY 17, THURSDAY, 8:00 PM—Microwave Theory & Techniques
Application of microwave techniques to the chemical industry
Dr. Howard C. Poulter, research & development lab, Hewlett-Packard Co.
Place: Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto
No dinner

FEBRUARY 23, WEDNESDAY, 7:30 PM—Communication Technology
Communications for the power industry
Robert J. Brown, general proj. administrator, PTT Co., San Francisco
Place: The Pacific Tel. Bldg., 666 Folsom St., Room 140, San Francisco (near corner 3rd and Folsom Sts.)
Cocktails (no host): 5:45 PM
Dinner: 6:00 PM, Schroeder's Cafe, 240 Front St., San Francisco
Reservations: A. R. Dole, 399-4430; C. G. Griffith, 591-8461, ext. 525; or Miss Wynne, 291-4039 by Feb. 21

MEETING CALENDAR

FEBRUARY 24, THURSDAY, 8:00 PM—Aerospace & Electronic Systems
Tour of Federal Aviation Authority facility at Fremont
Limited to 50 persons with advance reservations
Place: 5125 Central Ave., Fremont
Dinner: 6:15 PM, International Kitchen, 555 Peralta Blvd., Fremont
Reservations for tour and/or dinner: Steve Marx, (415) 326-4350, Ext. 6048 by Feb. 17

FEBRUARY 28, MONDAY, 7:30 PM—East Bay Subsection/San Francisco Section
Review of the modern history of oceanography
Dr. John Mero, Ocean Resources, Inc., La Jolla, Calif.
Place: PG&E Oakland Service Center, 4801 Oakport, Oakland
Dinner: 5:30 PM at the Oakland Airport Inn—foot of Hegenberger Rd.
Reservations: Mrs. Emerson, Oakland—835-8500; Mrs. Grey, Concord—685-4441; Miss Dhuyvetter, San Jose—291-4852 by Feb. 25

MARCH 9, WEDNESDAY, 8:00 PM—Electron Devices
Current status of plasma research
Dr. Fred Crawford, Stanford Electronics Lab
Place: PH 101, Stanford
Dinner: 6:00 PM, Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto
Reservations: Mrs. Beverly House, 326-4000, Ext. 2304

MARCH 21, MONDAY, 8:00 PM—Nuclear Science
Radiation in space as a damaging environment to spacecraft materials and systems
William E. Price, senior engineering specialist, Philco Corp. WDL, Palo Alto
Place: Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto
Dinner: 6:30 PM at Rick's
Reservations: Mrs. D. Warner, 321-7801, Palo Alto; Mrs. Marie Garibaldi, 447-1100, Ext. 7821, Livermore, by March 18

MARCH 24, THURSDAY, 8:00 PM—Aerospace & Electronic Systems
Space suits
Place: Lockheed Auditorium Bldg. 202, 3251 Hanover St., Palo Alto

MARCH 30, WEDNESDAY, 7:30 PM—Communication Technology
Communication systems for the Bay Area Rapid Transit
David Noton, engineer, Bechtel Corp.
Place: Bechtel Bldg., 101 California St., San Francisco
Dinner: to be announced

Engineers' Week, February 20-26

TWO BANQUETS, THURSDAY, FEBRUARY 24

BAY AREA ENGINEERS' WEEK BANQUET, 7:00 PM

Speaker to be announced
Place: Grand Ballroom, San Francisco Hilton
Cocktails (no host): 6:00 PM Dinner: 7:00 PM, $6.50
Reservations: Mrs. Helmke, Section Office, 327-6622, by Feb. 23

SANTA CLARA VALLEY ENGINEERS' COUNCIL BANQUET, 7:30 PM
Santa Clara Valley Subsection of IEEE joint with the council
Reclamation around the world
Floyd E. Dominy, U.S. Commissioner of Reclamation, Washington, D.C.
Place: McCabe Hall, San Jose Municipal Auditorium
Cocktails: 6:30 PM Dinner: 7:30 PM, $6.50
Reservations: Mr. Davies, 294-6414, Ext. 2115, by Feb. 23

meeting ahead

MEDICAL ENGINEERING

Emil Barish, director of the research and development laboratory, University of California Medical Center, will discuss the problems and potentials of medical engineering at the February 15 meeting of the Engineering in Medicine and Biology chapter.

Mr. Barish is a University of California graduate holding B.S. and M.S. degrees in mechanical engineering. He was chief engineer at Industrial Process Engineers of New Jersey and J. D. Christian Engineers of San Francisco before coming to the medical center to serve as director of the research and development laboratory.

His talk will cover some of the problems and frustrations of the past faced by engineers working in medicine. Among these have been problems of inadequate education and/or experience by the engineer in the life sciences as well as lack of appreciation for what the well prepared engineer can contribute to medicine by the medical researcher and physician. The problems

(Continued on page 8)

Barish *Cummings*

meeting ahead

STATE POWER PROGRAM

J. K. Cummings, chief of the power office of the Department of Water Resources, State of California, will discuss the state power program at the February 15 meeting of the Power chapter.

The speaker will review the overall state water project briefly and bring up to date the current status. More specifically, power requirements on the California Aqueduct with off-peak method of operation and the 2000 foot lift over the Tehachapi mountains, together with power requirements for the entire project will be discussed.

Also included in the presentation will be the operational control plan for the aqueduct, sources of power from the various public and private utilities, cooperative West Branch power development, and how the Pacific Southwest-Pacific Northwest Intertie fits into the picture.

As chief of the power office, Mr. Cummings' duties include supervision

(Continued on page 7)

meeting ahead

ESP PROGRESS REPORT

Russell Targ, president of the Parapsychology Research Group, an organization of Bay Area scientists who study those faculties in man which appear to be paranormal in origin, will discuss recent experiments in extrasensory perception at the February 17 meeting of the Information Theory chapter.

The past few years have seen a substantial increase in the quality and sophistication of experiments to demonstrate point-to-point communication by extrasensory perception. A critical summary will be given of work presented at a recent national meeting of ESP investigators who are attempting to correlate certain physiological factors with the appearance of ESP in the laboratory. Some defects in past experiments will be analyzed, and remedial methods will be proposed. Finally, a possible technique for the enhancement of ESP, (i.e. reduction of probability of error) will be described.

The speaker is also a member of the optics department of Sylvania Electronic Systems, Mountain View. He joined Sylvania in 1962, where he has worked in laser and communication system research. Previously he was employed by the Technical Research Group in New York, where he was responsible for plasma and laser programs. He received his BS degree in physics from Queens College in 1954 and has done graduate work at Columbia University.

MORE STEPPING MOTORS

particular type of digital feedback converts the stepping motor to a dual-mode torque device exhibiting a high-speed servo motor, respectively.

As a closed loop device the stepping motor is ideally suited for positional bang-bang control systems providing an inherently stable terminal control. A specific plant will be used to illustrate how to generate the time-optimal control law in the state space. The instrumentation required to implement the minor loop as well as the time optimal controller will be described in some detail, and actual response curves will be presented.

Mr. Fredriksen received his BSEE degree from the University of British Columbia and later received his MSEE in automatic control from Purdue University. He has some thirteen technical publications to his credit. The paper which he will present has been selected by the International Federation of Automatic Control for presentation in London, England, in June of 1966.

Have you returned the membership pledge card carried in the December issue?

Targ *Kerwin*

engineers week

S. F. HILTON BANQUET

The Bay Area Engineers' Week banquet, sponsored by the Bay Area Engineering Council, will be held at 7 p.m. on Thursday, February 24 in the Grand Ballroom of the San Francisco Hilton and will feature the presentation of $3000 in scholarships to outstanding high school students. The principal speaker is to be announced. Tickets, at $6.50, may be ordered from Mrs. Helmke, Section Office, 327-6622.

MORE OPTOELECTRONICS

As nearly all optoelectronic devices exhibit improved overall efficiency when used in conjunction with an external optical system (often part of the package), such optical systems will be described.

Optoelectronics is a young branch and figures-of-merit and measuring standards have not yet been universally agreed upon so that an understanding of the various approaches is essential if devices from different manufacturers are to be correctly evaluated.

Certain silicon photodetectors are highly developed, and among other applications have set new standards in ultra high speed and noise free light detection.

It is expected that the years 1966 and 1967 will see appreciable expansion in optoelectronic business, and anticipated technical advances will play an important part in this upswing.

J. Robert Johnson joined -hp associates- in 1962, where he was originally associated with development of solid-state microwave and hot carrier devices. For the past two years he has been engaged on development and fabrication of optoelectronic devices, which have been an offshoot of an intensive four year R&D program at the Company.

Mr. Johnson was previously employed at the Transitron Electronic Corporation, where he worked on thin film dielectrics, and at P. R. Mallory's Canadian subsidiary in Toronto, where he was associated with the development of solid-state tantalum capacitors.

He is a graduate of the University of London.

meeting ahead

RC ACTIVE FILTERS

William J. Kerwin, chief, electronics research branch, Ames Research Center, will discuss RC active elliptic function filters at the February 16 meeting of the Circuit Theory chapter.

He will describe the development of a 6th order RC active low pass filter utilizing only simple voltage amplifiers of low gain. The design of the voltage amplifiers used will be described and design equations for the networks used will be presented. The effects of temperature and supply voltage will also be included.

Mr. Kerwin joined Ames Research Center in 1948 as an aeronautical research scientist after receiving a B.S. degree in physics from the University of Redlands. In 1954 he received a master's degree in electronic science from Stanford and in 1959 became chief of facilities instrument research at Ames. In 1962 he joined the staff of the Stanford Linear Accelerator Center for a year, and then returned to Ames where he is now chief of the electronics research branch.

engineers' week

SC VALLEY BANQUET FEB. 24

Santa Clara Valley Engineers Council's annual banquet observing National Engineers' Week will be held Thurs. night, February 24, in McCabe Hall of the San Jose Municipal Auditorium.

A social hour at 6:30 p.m. will precede the $6.50 banquet at 7:30. As before, there will be a speaker on engineering, and the annual SCVEC scholarship award will be presented to an outstanding graduating high school senior, to assist him with his engineering college expenses.

Principal speaker will be Floyd E. Dominy, U.S. Commissioner of Reclamation, who will discuss reclamation around the world.

Reservations and tickets may be arranged by telephoning Mr. Davies, 294-6414, Ext. 2115.

Chairman of SCVEC this year is Ronald R. Esau of the Santa Clara Valley Water Conservation dDistrict. Vice-chairman and banquet chairman is Joseph A. Pettis of Personal Products Company. Joseph E. Love, jr., of General Electric Company is secretary-treasurer.

Presidents of the 13 societies represented on the Engineers' Council will have a separate dinner meeting February 7 at Los Gatos Lodge with council officers and past presidents to discuss the work and plans of the council. Edward C. Stahl, chairman of the council's coordinating commitee, will be chairman.


Hulse


MacKenzie


Barkle


Damonte


Sumner


Sedam

section news

NOMINATIONS FOR 1966-67 PROGRAM YEAR ANNOUNCED BY SECTION COMMITTEE

Nominations for section officers for the 1966-67 program year have been announced and will appear on a postcard ballot to be received by the voting membership in May.

CHAIRMAN

E. H. Hulse, present vice-chairman and former secretary and group coordinator; past co-chairman of the Education and Student Relations Committee of the IEEE section and former education chairman of the AIEE section, a senior member. Head, electronics engineering dept., Lawrence Radiation Laboratory, Livermore. B.S., University of California, Berkeley. A registered engineer in California and Utah. Westinghouse, UCLA, USC.

VICE-CHAIRMAN

Fred J. MacKenzie, present secretary and former treasurer of the section; former membership chairman of the IRE section; a member. Active in WEMA and WESCON, Los Angeles Section operating & finance committee, 1959-60. A member of the IEEE committee on membership and transfers and former member of the PTGMIL administrative committee. University of Chicago and Northwestern University infra-red communications lab, 1947-49. Consolidated Electrodynamics Corp., Cal Tech Synchrotron Lab. Administrative engineer, communication and radio physics laboratories, Stanford Research Institute.

SECRETARY

J. E. Barkle, present treasurer and former chairman of the Power chapter, for which he also served as organizer; a senior member. B.S. in EE, Carnegie Institute of Technology, Westinghouse Electric Corp., Loggers and Mill Supply Co. Member, Edison Electric Institute, electrical systems and equipment committee, active in IEEE committee affairs, author of several technical papers on power generation, transmission and system protection, chief electrical engineer, power and industrial division, Bechtel Corp., San Francisco.

TREASURER

There are two nominees for the office of treasurer:

John B. Damonte, present chairman and former vice-chairman of the membership committee, former chairman of the Antennas & Propagation chapter, a senior member. Manager, microwave engineering dept., Dalmo Victor Co., Belmont since 1958, formerly assistant director of research, supervisor of microwave section, research lab, and research microwave engineer. University of California, 1948-50 as research engineer and teaching assistant. B.S. and M.S., UC. Author and co-author of numerous papers in the antenna and microwave fields.

Robert W. Sumner, district representative, atomic defense & space group, Westinghouse Electric Corp., Sunnyvale, a senior member. Joined Westinghouse in 1957 after 16 years with Jack & Heintz. Past chairman, Santa Clara Valley Subsection, 1963-64; organizer of San Francisco chapter of Aerospace Group (now merged into AES); vice chairman, air transportation division of Los Angeles Section, AIEE, 1956-57.

DIRECTOR-AT-LARGE

There is one nominee for the office of director-at-large:

Charles H. Sedam, Pacific Gas & Electric, vice president-construction. B.S., electrical engineering, University of Washington. Inspector, foreman, assistant engineer, engineer, manager of station construction since 1941 with P.G.& E. Past president, San Francisco Electric Club, and the author of technical papers on engineering

Section bylaws provide that "additional nominations by petition may be submitted no later than April 1 to the section executive committee for inclusion on the ballot. To be valid, such petitions shall carry the signatures of no fewer than 25 voting members of the section and include a statement of the willingness of the candidate to serve. Election shall be by mail ballot and shall be completed by May 15. The incoming officers shall assume the duties on or before July 1 on a date fixed by the outgoing executive committee."

Members of the nominating committee, appointed by Section Chairman Jack L. Melchor, were John C. Beckett, chairman (Section Chairman, 1964-65); William A. Edson (Section Chairman, 1963-64); Victor Kaste (Chairman, AIEE Section, 1962-63); and Peter Lacy (Chairman, IRE Section, 1962-63).

MORE STATE POWER PROGRAM

of marketing of power produced in the state water project and of purchasing of power required by the project. He became the state's first power chief in 1964 after 22 years' service with the Federal Bureau of Reclamation.

Before assuming his duties in that post, Cummings for seven years had been regional supervisor of power for the USBR, with headquarters in Salt Lake City, Utah. Previously he had held various positions in power, marketing and design and construction for the USBR in Boise, Idaho, and Denver, Colorado. He was graduated from Colorado College and performed graduate work at New York University.

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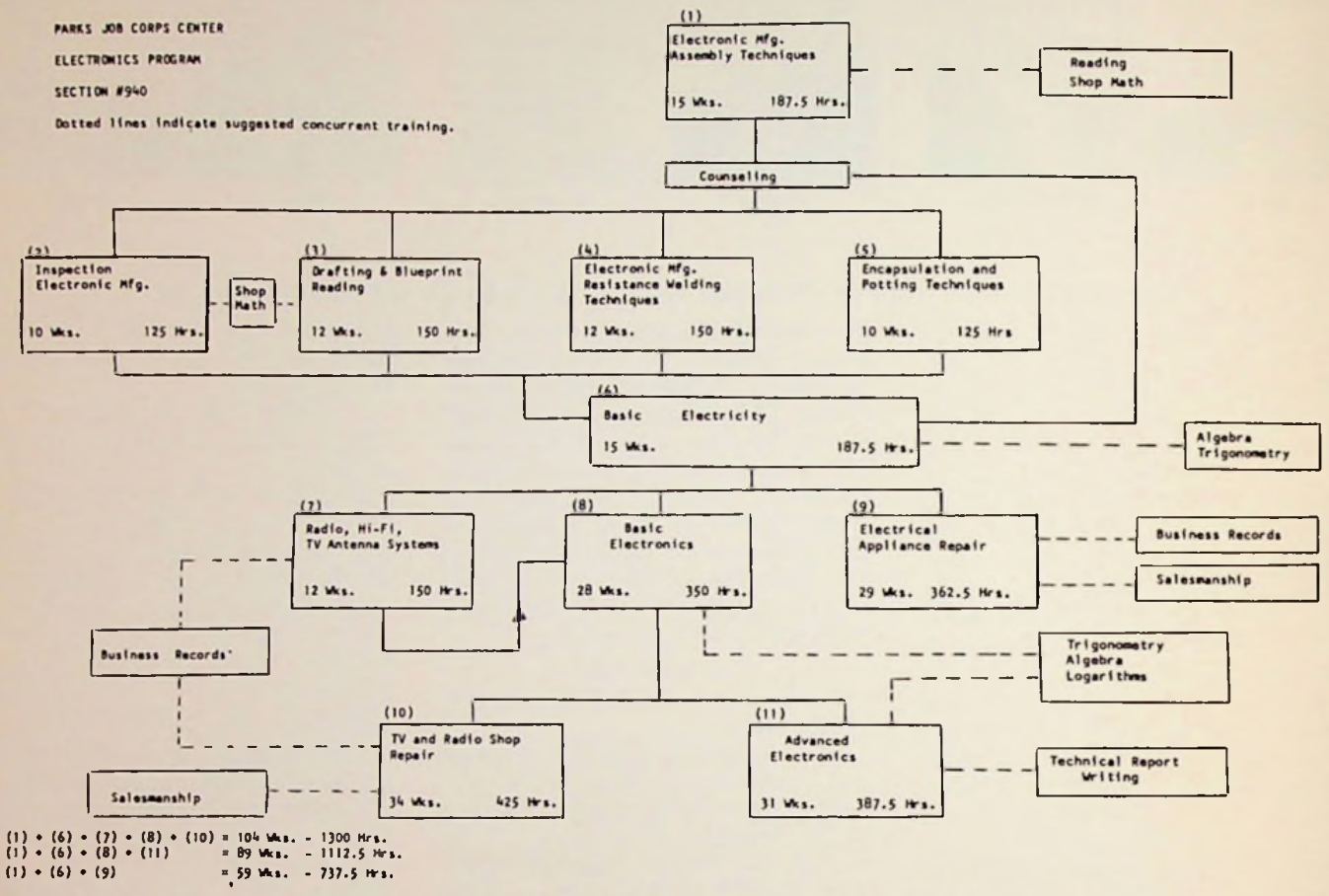
section inputs

CHANGE OF ADDRESS

If you plan to change your address, notify headquarters and the section office at least three weeks in advance of the effective date.

SHARE THE RESPONSIBILITY FOR THE SECTION

Take part in the membership pledge program. See your December Grid for details.



Flow chart of the electronics training program at Parks Job Corps Center, Pleasanton, shows the modular courses of about 550 corpsmen being trained, completion being roughly equivalent to a junior college AA degree. Sixty section members toured the facility and heard a panel discussion on placement on January 12, the engineers being impressed with the quality and scope of the program administered by Litton Industries under contract. Twenty graduates have been placed since January 1, most of them in electronic assembly, and many more will be available late in the spring. Interested firms should contact Jim Matthews, placement specialist, Parks Job Corps Center, Pleasanton, (415) 828-1000, Ext. 205

meeting ahead

AES TOUR OF FAA

The Aerospace & Electronic Systems chapter will tour the Federal Aviation Authority facility at Fremont on February 24. Directions from the peninsula: Take Dumbarton bridge and follow Thornton Ave. to Newark. Cross the Nimitz freeway, take the first right after the freeway on Blacow, continuing until the first signal light at Central Ave. Turn right; the FAA is the second building on the right. The tour begins at 8 PM and is limited to 50 persons.

San Francisco Section membership includes nearly 1300 Fellows and senior members, the largest group of its kind within IEEE.

More than 150 Fellows are members of the San Francisco Section.

MORE MEDICAL ENGINEERING

of status between the Ph.D. and M.D. on one hand and the engineer with a B.S. or M.S. on the other hand will be discussed.

Is the position of the medical engineer working in industry and medical institutions better today? Are the contributions of engineering to medicine recognized by medical personnel? Mr. Barish will comment on this aspect of the engineering / medical relationship from a position of personal experience. What does the active medical engineer of today think of his working conditions and professional status? How does he fit into the scheme of things?

The talk will be followed by a group discussion with emphasis on the future of medical engineering. Can it be defined? Where will this new breed of engineer be trained? Should he be an M.D. convert or an engineer at the M.S. level with an additional degree in the life sciences? How much medicine must he know and how should he practice his profession?

The February meeting is open to engineers and doctors alike who are presently working in the area of medical engineering and to any who are interested in a future in this area.

Nearly 3200 chapter members have mailing addresses in Santa Clara County, 855 in the East Bay, and 831 in San Mateo County, making these the largest concentrations of chapter membership. In most cases members belong to more than one Group, the average throughout IEEE being about 2.2.

Poulter

Brown

meeting ahead

CHEMICAL INDUSTRY MTT

Dr. Howard C. Poulter, research and development lab, Hewlett-Packard Co., will describe application of microwave techniques to the chemical industry at the February 17 meeting of the Microwave Theory & Techniques chapter.

The talk will cover in some detail the field of gas phase, rotational, microwave spectroscopy with the emphasis on the instrumentation and applications aspects. Other potential applications of microwave techniques will also be discussed.

Dr. Poulter was graduated from the Illinois Institute of Technology in 1946 with a bachelor's degree in electrical engineering, and the following year he received his master's degree from the institute. He later attended Stanford University and was awarded his doctorate in 1955.

From 1951 to 1954 Dr. Poulter was a full time research associate at the Stanford University Electronics Research Laboratory. During that period he worked on high power traveling wave tubes and holds a patent from the work, "Slow Waveguide for TWT's."

Dr. Poulter joined the staff of the Hewlett-Packard Company in 1954 working in the area of microwave instrumentation. He was engineering manager of the microwave division from 1959 through 1964. Recently he has returned to more technical pursuits working in the area of application of microwave techniques to other fields.

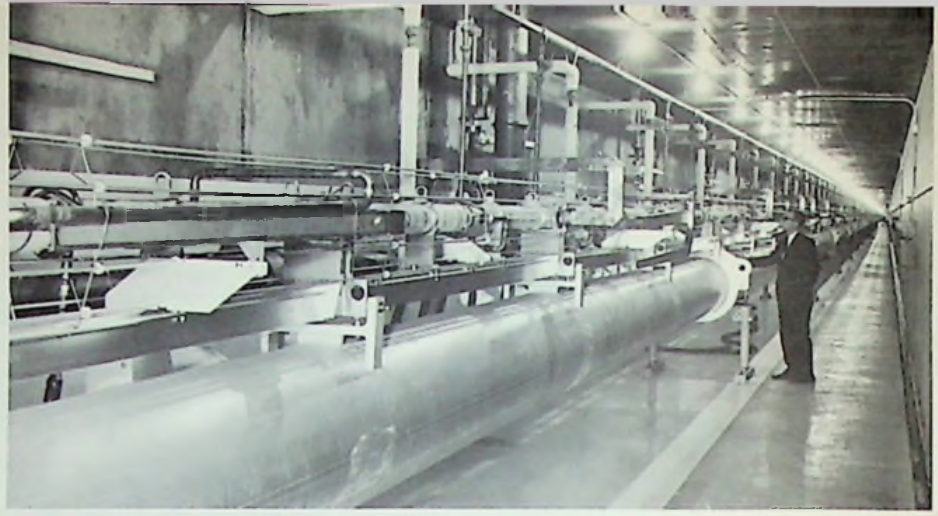
meeting ahead

POWER INDUSTRY COMMUNICATIONS

Robert J. Brown, general project administrator, PT & T, will discuss communications for the power industry at the February 23 meeting of the Communication Technology chapter.

The power industry has recently undergone revolutions of change in its art—changes in EHV, DC transmission and nuclear power. These changes have made it economical to move the electricity over many hundreds of miles instead of moving the coal over that distance. They have made it practical to tie together big distribution areas

(Continued on page 10)



Stanford Linear Accelerator Center has been toured or discussed at meetings of chapters and subsections in the past year, including Parts, Material & Packaging. A section of the underground tunnel, which is 10,000 ft. long, is shown here. Work on "the most sophisticated instrument for scientific research in the world" is nearing completion

MORE POWER COMMUNICATIONS

which before were independent, and so transmit electricity back and forth to match changing loads.

These far-flung systems, all tied together, require a high caliber of communications to keep them stable. Dispatchers, in addition to talking together, must have adequate telemetry in order to take immediate action to compensate for changes in the network. They need supervisory circuits to operate power equipment remotely, and administrative circuits for planning the scheduled transmission of power from one region to another.

The speaker will discuss the technical and administrative considerations in planning and operating a communications system used by a power net. Future needs for computerized power dispatching, fault locating and other advancing arts will be included.

Mr. Brown received the BSEE from the University of California and has been with PT & T since 1952.

Mero

Noton

meeting ahead

OCEANOGRAPHY & SEA LAB II

On February 28 Dr. John Mero, Ocean Resources, Inc., La Jolla, will review the modern history of oceanography from the classic H.M.S Challenger cruise to the recent Sea Lab II experiment. He will also discuss ocean resource development and forecast the need for exploiting the ocean storehouse, supplementing his talk with slides. The meeting will be jointly presented by the East Bay Subsection and the San Francisco Section.

Dr. Mero is one of the original pioneers in ocean resource development and specializes in methods of extracting raw materials from ocean sediment. He received his undergraduate degree from the University of North Dakota and his doctorate from the University of California, where he was first to receive the D. J. Jackling fellowship for his original work in ocean resource development. In 1958 he published the original paper dealing with the mining and processing of ocean-floor manganese nodules. In addition to many papers on the subjects of ocean mineral deposits and ocean mining, he is the author of the book, "The Mineral Resources of the Sea." He holds patents in the fields of gamma-ray spectrometry, process metallurgy, deep-sea hydraulic dredging, and has patents pending in the field of thermodynamics. Upon leaving the University of California, Dr. Mero began consulting in the field of ocean mining for such groups as the Stanford Research Institute, the National Academy of Sciences, Texas Instruments, International Nickel, Kennecott Copper, Richfield Oil, U.S. Steel, and many other industrial concerns.

meeting ahead

BART COMMUNICATIONS

David Noton, Bechtel Corp. engineer, will describe the engineering of communications systems for Bay Area Rapid Transit at the March 30 meeting of the Communication Technology chapter.

In 1962, Bay Area voters authorized the construction of a $1 billion rapid transit system, linking San Francisco with Alameda and Contra Costa coun-

(Continued on page 14)

MOST STANFORD EE ALUMS WIND UP RUNNING COMPANY

About three-fourths of Stanford engineers work for corporations and a big percentage end up running the company, according to a new survey of alumni who graduated from the Stanford School of Engineering 5, 15, and 25 years ago.

Over 60 percent of the classes of 1940, 1950, and 1960 replied to the survey questionnaire. The results, compiled by Associate Dean Lauress L. Wise, indicate steady progress toward top jobs and pay.

Better than half the 25-year men are presidents or vice presidents of their firms, and about three-fourths of the 15- and 25-year men make over $15,000 a year. The 5-year men appear likely to catch up soon, since more than half of them already make over $10,000.

The 5-year men are running well ahead of their seniors in one category —that of advanced degrees, from masters to doctorates. And although nearly a quarter of all who responded are not working in science or engineering, practically everyone said he needs his engineering training.

Full returns of the survey follow:

	Year Received Bachelor's Degree		
	1940	1950	1960
Corporation Employees	73%	73%	77%
% of Corp. Employees in position of highest authority	29%	7%	0%
% of Corp. Employees in position of second highest authority	26%	9%	5%
Self employed	10%	14%	4%
College or school employees	10%	0%	10%
No supervisory responsibility	4%	11%	52%
Employed in fields outside Engr. & Science	24%	23%	22%
Engr. background unnecessary	2%	2%	3%
Served in armed services	44%	90%	51%
Registered engineers	69%	28%	1%
Have graduate degrees	41%	39%	55%
Will eventually have graduate degrees	45%	49%	74%
Highest degree earned			
B.A. or B.S.	59%	61%	45%
M.S.	14%	18%	30%
M.B.A.	2%	10%	19%
Engr.	17%	4%	1%
Ph.D.	6%	6%	4%
Other	2%	1%	1%
Present Salary Range			
$20,000 or more	56%	34%	1%
15,000 or more	78%	71%	5%
10,000 or more	94%	99%	58%

Arizona cactus formed background for photo of Bay Area directors of WESCON during annual meeting of board in Phoenix. Left to right: Mike Leifer (Energy Systems), IEEE; Phil Gundy (Vega Electronics), WEMA; Jack Beckett (Hewlett-Packard), incoming IEEE; John McCullough (Litton), outgoing IEEE; and John Chartz (Dalmo Victor), outgoing WEMA.

Parts, Material & Packaging chapter, the result of a merger of Component Parts and Product Engineering & Production, is enjoying an active program year. Above, Robert L. Kleppe, field engineer for AMP Inc., participant at a recent meeting, demonstrates the making of a Termi-Twist connection with an air-operated hand gun.
Photo by Harmon R. Traver

MORE BART COMMUNICATIONS

ties. The system will be highly centralized and automated and will therefore be dependent on extensive communication of voice and data from outlying locations to the central control location. The overall communications system is probably one of the largest (non-military) installations to be engineered and installed at one time.

The various sub-systems include: an administrative PABX, a track-side emergency telephone system, a mobile telephone system to the moving trains, a system-wide maintenance telephone network, an integrated supervisory control and data transmission system, and various intercom and public address systems.

The talk will cover the operation and engineering of these subsystems and some of the interesting problems encountered and the solutions devised.

The speaker received a master's degree in engineering at the University of Cambridge, England, and moved to the U.S. in 1961. He was formerly on the staffs of Western Electric Co., New York and Sunnyvale, and Moore Associates, San Carlos.

BULLETIN BOARD NOTICES

Carrying the meeting calendar information that appears in *Grid*, but mailed in the preceding month, bulletin board notices are printed and distributed regularly by the section office to more than 400 members who have agreed to post them on the 860 bulletin boards of their firms or organizations. If you would like to be added to the mailing list, call or write to section office, indicating how many copies you would like to post each month in locations where they will attract the attention of member or non-member engineers.

MORE IEEE BOARD

Clarence H. Linder, IEEE's senior past president, will serve in the office of secretary for 1966. Dr. Seymour W. Herwald, vice-president, Westinghouse Electric Corporation, will continue in 1966 to hold the office of treasurer.

Dr. Shepherd, along with W. K. MacAdam, were elected president and vice-president, respectively, in the fall of 1965 and assumed office as of January 1, 1966.

The following directors, also elected in the fall of 1965, assumed office on January 1, 1966: Dr. W. Crawford Dunlap, assistant director, electronics

(Continued on page 16)

Donald E. Farina, General Micro-Electronics, Inc., Santa Clara, addressed more than 100 at the Computer chapter meeting. Prof. James Angell, Stanford University, served as moderator of the discussion following and wrote the review on page 17.
Photo by Howard Zeidler

ieee news

INSURANCE PROGRAM

Complete information kits on the IEEE insurance program, including the group life insurance plan for members and their eligible dependents (underwritten by New York Life Insurance Co.) and accidental death and dismemberment coverage for members and their spouses (underwritten by American Casualty Co.), may be obtained by writing to: Administrator, IEEE Insurance Program, 1707 L St., N.W., Suite 800, Washington, D.C. 20036.

MORE IEEE BOARD

research center, NASA, Cambridge; Dean Rufus G. Fellers, college of engineering, University of South Carolina; Dr. Edwin L. Harder, headquarters engineering staff, Westinghouse Electric, Pittsburgh; Allan G. Oxley, manager, inventions and patents, Canadair, Ltd., Montreal; Dr. John G. Truxal, dean of engineering, Polytechnic Institute of Brooklyn; and Prof. Carl R. Wischmeyer, professor of electrical engineering and master of Baker College, Rice University, Houston.

(Continued on page 20)

MOS TECHNOLOGY

Subsystem level MOS integrated devices were discussed by Donald E. Farina of General Micro-Electronics, Inc., at the September 28 meeting of the Computer chapter. There were more than 100 in attendance. The presentation forcefully emphasized the present state of feasibility in MOS technology, which is exemplified by a 1100-bit shift register, containing 615 MOS (metal-oxide semiconductor) transistors in a chip of silicon 0.100 x 0.065 inches.

After a brief discussion of the problems which existed with MOS technology two years ago, Farina compared advantages of the MOS structure with the more conventional double-diffused integrated circuits. Among the claimed advantages are: the need for fewer masks, thus implying simpler alignment procedures and greater precision; the need for fewer contacts between metalization and silicon, thus eliminating a major source of imperfection; the greater designability of MOS transistors; a larger, but controllable, voltage threshold for conduction in the MOS structure, with implicit greater noise immunity; and the ease with which resistors of the order of 10^5 ohms can be provided, using a transistor structure as the resistor.

The speaker also showed some unique structures taking advantage of the MOS transistor properties, such as a shift register which uses the capacitance of the gate (control) electrode for temporary storage, a JK flip flop on very small area, and code converters. The concluding part of the presentation provided some estimated cost comparisons, which showed the MOS technology being very useful now for moderate production levels, and especially compatible with digital-differential amplifier type of systems, in which the same type of chip may be used in many positions throughout a system.

During the question period, which was moderated by Professor James Angell of Stanford University, Farina predicted an improvement in speed capability for the MOS structure, which is now limited, largely by the capacitance of output lines, to roughly 1-mc rates. The question of testing large-scale integrated circuits was also discussed; the speaker likened the problems of testing these structures to those of testing a large digital printed wiring circuit, and proposed that a reasonable set of performance tests for the over-all structure will probably suffice.

—J. B. ANGELL

Smith

Stevenson

Foley

Kunz

grid swings

IT IS REPORTED:

Peter W. Smith has been elected executive vice-president of Western Gold and Platinum Co., Belmont, one of the world's largest producers of high purity ceramics and brazing alloys for the electronics and space industries.

John C. Stevenson has been appointed information services director for Dalmo Victor Co., Belmont, a Textron division, responsible for planning and administering the firm's publicity, public relations and advertising programs.

Sylvania Electric Products, Inc., Mountain View, has received a $3 million contract to produce components for electronic security systems for Minutemen sites.

William L. Foley has been appointed director of the customer requirements dept. of Applied Technology, Inc., Palo Alto, responsible for all customer liaison, contract administration, and applications engineering functions of the company.

William E. Kunz has been named head of the space communications section of Watkins-Johnson Company's systems division, Palo Alto, following a year of research and development on laser and traveling-wave tube programs.

Thomas E. Castanera has been named project manager at the Berkeley division of Beckman Instruments, Inc., responsible for product development programs concerned with electronic handling of data originating from a variety of transducers, including many of the corporation's analytical instruments.

Applied Technology, Inc., Palo Alto, has received a $6.6 million Air Force contract for electronic equipment.

Melabs, Palo Alto, has received a $64,866 contract from the Army Electronics Command to study the feasibility of developing high speed techniques for remotely tuning a 25-watt transmitter over the 100- to 400- Mc range.

Energy Systems, Inc., Palo Alto, has received a contract from Supreme Headquarters, Allied Powers, Europe for the design and manufacture of a $60,000 satellite communications transmitter in The Hague, Netherlands.

S. C. Chao has joined Applied Technology, Inc., Palo Alto, as a project engineer, to develop an all solid-state receiver for ATI's expanding reconnaissance and RFI monitoring product line.

Gordon L. Ness has been appointed executive vice-president of Data Technology Corp., Mountain View, formerly serving as director of marketing for Fairchild Instrumentation.

Earl Hickman, formerly an electronic engineer with Kaiser Aerospace & Electronics Corp., Palo Alto, has been named vice-president in charge of engineering and manufacturing, Kaiser-Cox CATV, Phoenix.

Gordon O. Sheppard has been elected treasurer of Memorex Corp., Santa Clara, formerly serving as assistant treasurer.

Leon A. Wortman, has been named manager of professional audio products for Ampex Corp., Redwood City.

Calvin K. Townsend has joined the board of directors of Granger Assoc., Palo Alto. He is president and chairman of the board of Jennings Radio, San Jose.

Harry J. Goett has been named director of advanced technologies plans and programs for the WDL division, Philco Corp., Palo Alto, formerly directing NASA's Goddard Space Flight Center.

Sol Zechter has been named director, ground instrumentation operation, Philco Corp. WDL, Palo Alto, was formerly director, commercial products and systems engineering, Philco communications and electronics division, Philadelphia.

Jack R. Yelverton has been elected vice president and a director of Wilkinson, Sedwick & Yelverton, Inc., San Francisco.

Laurence L. Spitters, president of Memorex Corp., Santa Clara, has been elected to the board of directors of United Control Corp., Redmond, Wash.

Jack O. Coffey has been named executive vice president and general manager of Stewart-Warner Microcircuits, Inc., Sunnyvale, previously serving as sales manager and manager of contracts administration.

Philco Corp., WDL, Palo Alto has received a $161,000 JPL contract to test the reliability of transformers and inductors that have been sterilized for use in deep space programs.

(Continued on page 20)

Thirty-three sections make up Region 6, largest in IEEE.

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Dynamic Associates
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Menlo Park; 322-8461

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968-1608, 253-5433

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3921 E. Bayshore,
Palo Alto; 326-1493

Rupp Co., V. T.
1182 Los Altos Avenue,
Los Altos; 948-1483

SMA/WEST
(Scientific Marketing Assoc.)
1094 West Evelyn Ave.,
Sunnyvale; 245-2500

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1020 Corporation Way,
Palo Alto; 968-8304

Stone & Assoc., Jay
140 Main Street,
Los Altos; 948-4563

The Thorson Company
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Palo Alto; 321-2414

Walter Associates
Box 790, Menlo Park;
323-4606

Wadsworth-Pacific Mfg. Assoc., Inc.
71 Parker Avenue, Atherton;
321-3619

Willard Nott & Co.
1485 Bayshore Blvd.
San Francisco; 587-2091

Richter

Fuller

MORE GRID SWINGS

William F. Richter has joined Granger Associates as program manager for communications, concerned mainly with the development of present and new markets for communications products.

W. Dale Fuller, program manager of the special systems organization, Lockheed Missiles & Space Co., Sunnyvale, has been named "Electronic Packaging Engineer of the Year" by the National Electronic Packaging and Production Conference.

You are IEEE's best membership salesman. Return the pledge card in the December issue and deliver the application form to one of your engineering colleagues, following up to see that he completes and mails it with his check.

MORE IEEE BOARD

The remaining members are: Junior past president, Dr. Bernard M. Oliver, vice-president for research and development, Hewlett-Packard Company, Palo Alto. Directors, Dr. George Sinclair, professor, department of electrical engineering, University of Toronto; Lynn C. Holmes, executive assistant for research and engineering operations, General Dynamics-Electronics Division, Rochester.

Directors-at-large, Dr. Gordon S. Brown, dean of engineering, Massachusetts Institute of Technology; Dr. Thomas F. Jones, president, University of South Carolina; Floyd H. Knapp, Cleveland Heights, Ohio; Dr. John B. Russell, dean of electrical engineering, Clarkson College of Technology, Potsdam, New York.

Regional dir., Charles D. Morrill, manager, electronics research and development, Goodyear Aerospace Corp., Akron; Fred W. Bush, engineering consultant, Allis Chalmers Manufacturing Company, Milwaukee; Jean D. Lebel, manager, C.L.E.S., Paris, France.

Directors emeritus, Dr. Alfred N. Goldsmith, consulting engineer, New York, and Elgin B. Robertson, president, Elgin B. Robertson, Inc., Dallas.

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Bistable Storage.

Automatic Erase — with selectable viewing times from 0.5 seconds to 5 seconds. Erase can be selected for re-current or after-sweep operation.

Erase-and-Reset — with push-button control for erasing display and rearming single sweep. Erase-and-Reset can be controlled remotely, if desired.

other features:

Precision Sweep Delay—from 1 microsecond to 10 seconds.

Wide Sweep Range — 5 s/cm to 0.1 μs/cm (Time Base A) and 1 s/cm to 2 μs/cm (Time Base B). 5X Magnifier extends fastest sweeps to 20 ns/cm (Time Base A) and to 0.4 μs/cm (Time Base B).

Single Sweep — manually, automatically, or remotely.

Full-Passband Triggering — with flexible, easy-to-use facilities.

Simplified Trigger Logic — with lever control of trigger functions.

Size and Weight — dimensions are 17″ high x 13″ wide x 24″ deep; net weight is ≈ 67 lbs.

Type 549 Oscilloscope $2375
(without plug-ins)

The plug-in units range in price from $145 (B high-gain unit, K fast-rise unit) to $1100 (1S1 sampling unit, illustrated).

U.S. Sales Prices f.o.b. Beaverton, Oregon

For more information call your Tektronix Field Engineer.

Tektronix, Inc.

Up in Seattle, we make basic tools for precision electronic measurement. We make them well. If you think you'd like to help us make them even better and live in the Great Northwest too, let's talk.

For almost a generation, we (The John Fluke Mfg. Co., Inc.) have been one of the world's leaders in metrology. Recently, the demand for our quality instrumentation has created a number of unusually fine professional employment opportunities.

So if you want to join a medium size, well-respected company where your contribution stands out and your identity means something to everyone from the president on down, this is a grand opportunity. Our engineers work in a sophisticated technical environment with great personal freedom to pursue design problems as they see fit. We pick up the total tab on a company-sponsored graduate program for eligible personnel at the University of Washington (now widely regarded as one of the 10 best universities in the Nation).

But, though the job is the main thing, living in the Pacific Northwest shouldn't be ignored either. About 85% of our employees live on wooded acres within 10 minutes of the plant. You can buy twice the house in Seattle for the same dollars you spend in San Francisco or Los Angeles. And the taxes aren't too steep either (there is no state income tax).

Schools are good. The State of Washington ranks among the first three in literacy and number one in terms of college graduates per thousand population. Art, theatre and music flourish in the great new Seattle Center, built for the World's Fair.

If the outdoors is your after hours bailiwick, Washington State offers great skiing (with short lift lines), the nation's best boating, outstanding hunting and fishing (sometimes, the other guy on the stream is five miles away), and fine hiking and climbing.

The company offers in addition to your salary (which is as good or better than anywhere else) profit sharing, medical insurance, and retirement benefits. So if all this excites you and you fit one of the job descriptions below, write our Engineering Manager, Mr. Ted Thomsen, in confidence. Interviews will be arranged in Los Angeles, San Francisco, or Seattle at your convenience. Please address Mr. Thomsen at P.O. Box 7428, Seattle, Washington.

Design or Senior Engineers with communication theory background and/or interest in digital circuits. Preferably an MSEE. Minimum experience, two years. Should be familiar with digital circuit design and frequency calibration techniques.

Design or Senior Engineer with minimum of one year's experience in feedback, digital and analog circuitry. Applicant should be familiar with differential amplifiers, amplifier and feedback design, AC-DC converters, and state of the art measurement instruments. MSEE desired.

Associate Engineer with good scholastic record and BSEE. No experience necessary. Applicant should have an interest in analog and/or digital circuit design and knowledge of solid state circuitry.

Electronic Package Design Engineer with either BSEE or BSME. Applicant should be familiar with packaging methods in the MHz to 10 GHz region. Two to six years' experience with good mechanical design aptitude required.

Industrial Engineer with three years' experience in electronics or associated industry. Should possess a BSIE. A BSEE or BSME is acceptable if applicant has industrial experience. Candidate must have knowledge of methods, value, and process analyses, and work simplification.

Senior Production Engineer with four years' experience. Should be a mechanical engineer familiar with electronics or an electronic engineer familiar with mechanical engineering. Applicant must possess a BSME or BSEE. Must be able to carry new product from design to production.

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