

# EDITOR'S PROFILE of this issue

*from a historical perspective ...*

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

May, 1960:

Cover: A photo shows two Boeing 707's flying near Mt. Rainier to highlight the Region 7 conference to be held in Seattle.

Page 10: The new constitution for the Section is ready for adoption. There is an Operating Committee that cares for administrative details, and a Program Committee that's concerned with the various Chapters and their operation. It provides a framework for the ongoing work of the SF Section.

Page 32: Bob Noyce and Gene Kleiner lead a tour of Fairchild's new plant on Whisman Road; both are members of the "traitorous eight" that left Shockley to form the new company. Noyce explains his management philosophy regarding commercial products, market understanding, and the advantages (and limitations) of being a small company. Kleiner, in charge of manufacturing engineering, discusses the furnaces and equipment, the seven assembly lines, and the three shifts of workers. Kleiner goes on to form our first large venture capital firm with Tom Perkins.

Page 36: The photo shows Lenkurt's automatic toroidal winding machine, used to make inductors for linesets (which needed filters with sharp cut-off frequencies). I have a story, from my time at Lenkurt: In 1969, several of these winders were sent to our factory in Guadalajara, Mexico, so we could reduce costs. Some months later, there were unexplained failures among our lineset filters, whose parameters had drifted from what was needed. Investigation found that the trifilar windings weren't done according to specification: The variously colored fine wires weren't in the right places. Turns out the Mexican women winding the toroids didn't feel that the way we'd designed them was pleasing to the eye, so they modified the placement of the windings to give a more artistic flavor!



Archive of available SF Bay Area GRID Magazines is at this location:

[https://ethw.org/IEEE\\_San\\_Francisco\\_Bay\\_Area\\_Council\\_History](https://ethw.org/IEEE_San_Francisco_Bay_Area_Council_History)

At time of scanning, the bound volumes are held by Paul Wesling.

July, 2021

Contact [p.wesling@ieee.org](mailto:p.wesling@ieee.org)

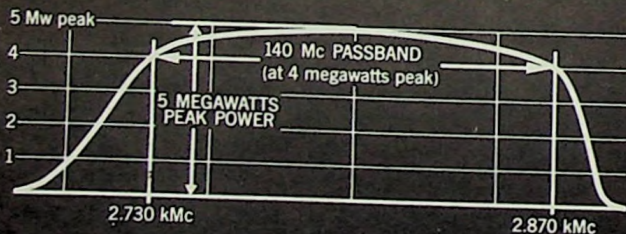
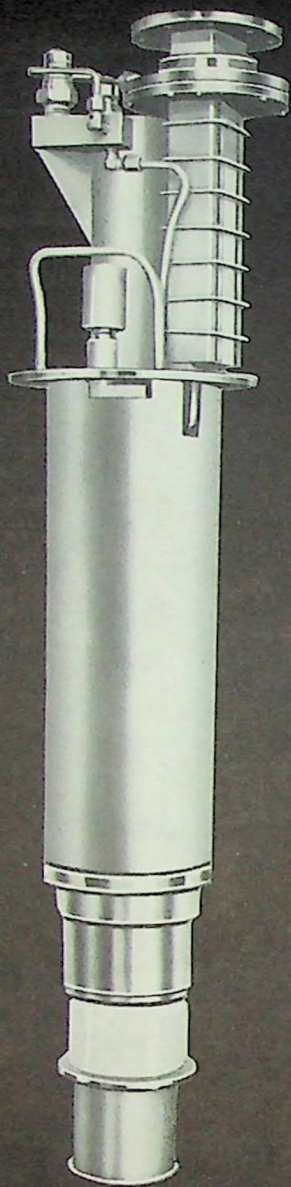
# *Grid* May 1960



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*7th Region Conference Seattle May 24 25 26*



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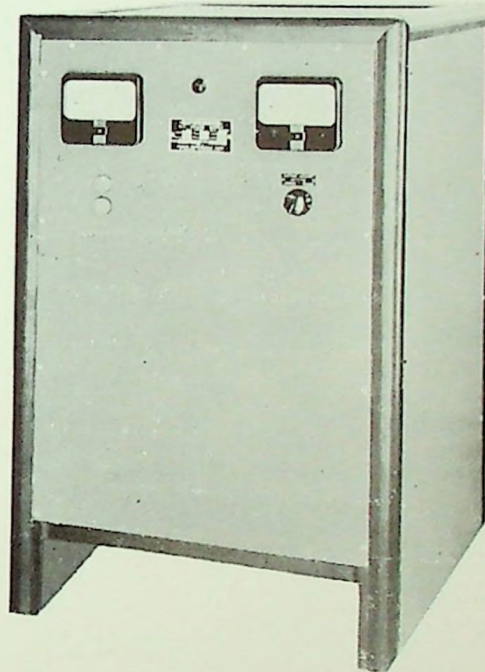
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(Continued on page 8)

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## IN THIS ISSUE

<b>From the Chairs</b> .....	6
<b>Meeting Calendar</b> .....	8
<b>Annual Dinner Meeting</b> .....	9
<b>Ballot for Section Election</b> .....	9
<b>Proposed Section Bylaws</b> .....	10
<b>7th Region Conference</b> .....	12
<b>Meetings Ahead (PGEWS, PGED, PGEC)</b> .....	16
<b>Membership Committee List</b> .....	22
<b>Meeting Reviews</b>	
<b>PGA</b> .....	23
<b>PGAP/SFS</b> .....	24
<b>PGRQC</b> .....	28
<b>PGEC</b> .....	28
<b>PGEM</b> .....	32
<b>PGMTT</b> .....	34
<b>Grid Swings</b> .....	36
<b>Events of Interest and Papers Calls</b> .....	44
<b>Manufacturers Index</b> .....	46
<b>Index to Advertisers</b> .....	46

## ABOUT THE COVER

### Northwest Passage

Two Boeing 707 jet airliners testing their wings over Mt. Rainier occupy our cover to remind Bay Areaans of the 7th Region Conference in Seattle on the three days of May 24, 25, and 26. Technical attractions are summarized beginning on page

12 and including the full program with abstracts. Those who attend the field trip to Boeing Airplane Co. will see the manufacturing and testing of these ships and their electronic systems.

The GRID is published by the San Francisco Section of the Institute of Radio Engineers monthly except for July and August.

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C. Bruce Clark

## FROM THE CHAIRS



### Goal: Lemons ← 0

To paraphrase a line from the car dealers' book: "This isn't a **bad** missile—the first three you got were just lemons!"

A "lemon" car has been described as one assembled from an unusually high percentage of out-of-tolerance parts. The troublesome computer, smoking power supply, inoperative radar, or oscillating servo, however, cannot always be accurately described as simply "out of tolerance." Someone made a mistake someplace, maybe in manufacture, maybe in design, maybe in procurement.

It is getting increasingly fashionable to obtain reliable products, and there are certainly many ways of producing reliable hardware and means of making machines that do their jobs in a commendable, trustworthy fashion.

What is all this reliability jazz?

We hear and see the word reliability used and misused more and more frequently. Some organizations even have activities which can best be described

as "Reliability Sales"! Genuine reliability efforts usually include specialists in various fields, including not only quality-control and statistical-analysis people, but many others.

Now the first concern of a design engineer is often with basic performance. A car is designed to go 80 miles per hour, and carry 5 people and their luggage, or a telephone should be capable of transmitting voice tones faithfully, not cost too much, and operate over specified distances.

The first customers were perhaps not too critical of failures. As industries developed, however, and the novelty of new inventions wore off, there were demands for better cars and better phone service. The job now called reliability engineering has been in many industries for a long time.

The telephone industry was one of the first to worry about the reliability of complex systems because of the development of automatic exchanges. As these systems developed, farsighted people saw the need for long-life equipment, and for component specifications that reflected **system** needs. Throughout the industry, at all levels, people became convinced that failures were bad. Designers, assemblers, parts suppliers, and field maintenance men contributed to system reliability. This sort of policy, that reliability is everybody's business, is what I like to call the "grass roots" approach to producing good equipment.

Let's look now at the history of reliability in the electronics business. It is not a very long story. We began hearing about reliability programs in electronics only about ten years ago.

As the radio industry was developed, it was not much concerned with large systems (except for transmitting installations). During and after the Second War, the complexity of radio and electronic equipment increased greatly, as 500-tube radars were designed and computers using tens of thousands of tubes were produced. These systems, however, were not the result of painstaking attention to the details of design and the slow evolutionary processes that characterized the development of dial telephone systems. Rather, their development was forced by the pressure of war needs. In contrast with telephone system development, the environment was rough and often unknown. Standardization, resulting in mass production of duplicate items, was lacking.

As a result, Electronics and Trouble became linked together because these marvelous boxes often failed after operating for only a short time. About 1950 various agencies concerned with equipment development and people operating electronic equipment began to demand more reliable gear. At the same time great effort was put into better maintenance methods so that

faulty parts could be located and the equipment restored to working order. In many cases the only thing that saved the equipment was the fact that it was possible to repair it frequently.

We are now coming face to face with a new type of problem as we enter the space age. The demand is for equipment which is characterized by "reliability without maintenance." A good example of this kind of system is a heavily instrumented satellite. It is not unusual these days to launch vehicles having tens of thousands of parts including items like tubes, transistors, resistors, diodes, and relays. This equipment must be lightweight, small, and operate on very little power, yet it is essential that it perform over periods of months or even years without **any** human intervention.

To reach our basic goal of having the number of lemons approach zero requires very careful attention to every design detail that may cause failure. There are no short cuts to success. The reliability engineer's job is to insure that reliability factors are considered at every decision point from block diagram through production and test. It is important to note that his best contributions are made early in design.

We now come to a very significant point. How does this reliability engineer get his job done without getting everybody mad at him? When improved design takes more time, people will be unhappy. If design improvements take more money, they probably just won't get done. Certainly there will be objections if size requirements are exceeded or if weight or power consumption is increased. The roof may blow off if a chemist or statistician is added to the payroll in reliability's name!

In many programs involving large systems the company policy or attitude towards reliability is getting increased attention. It is believed that if top management understands and supports the work needed to produce reliable equipment, much less friction will develop internally. Since various companies have various policies for obtaining reliable products, we chose the theme of our 2nd Annual Bay Area Reliability Seminar to be "Policies for Reliability." Representatives of many companies gave us their views on the best policy to follow in producing different kinds of products. We hope that this Seminar has helped to establish the need for firm company policies on reliability.

If the customer really wants it, we can minimize the lemons.

—C. Bruce Clark, chairman, PGRQC

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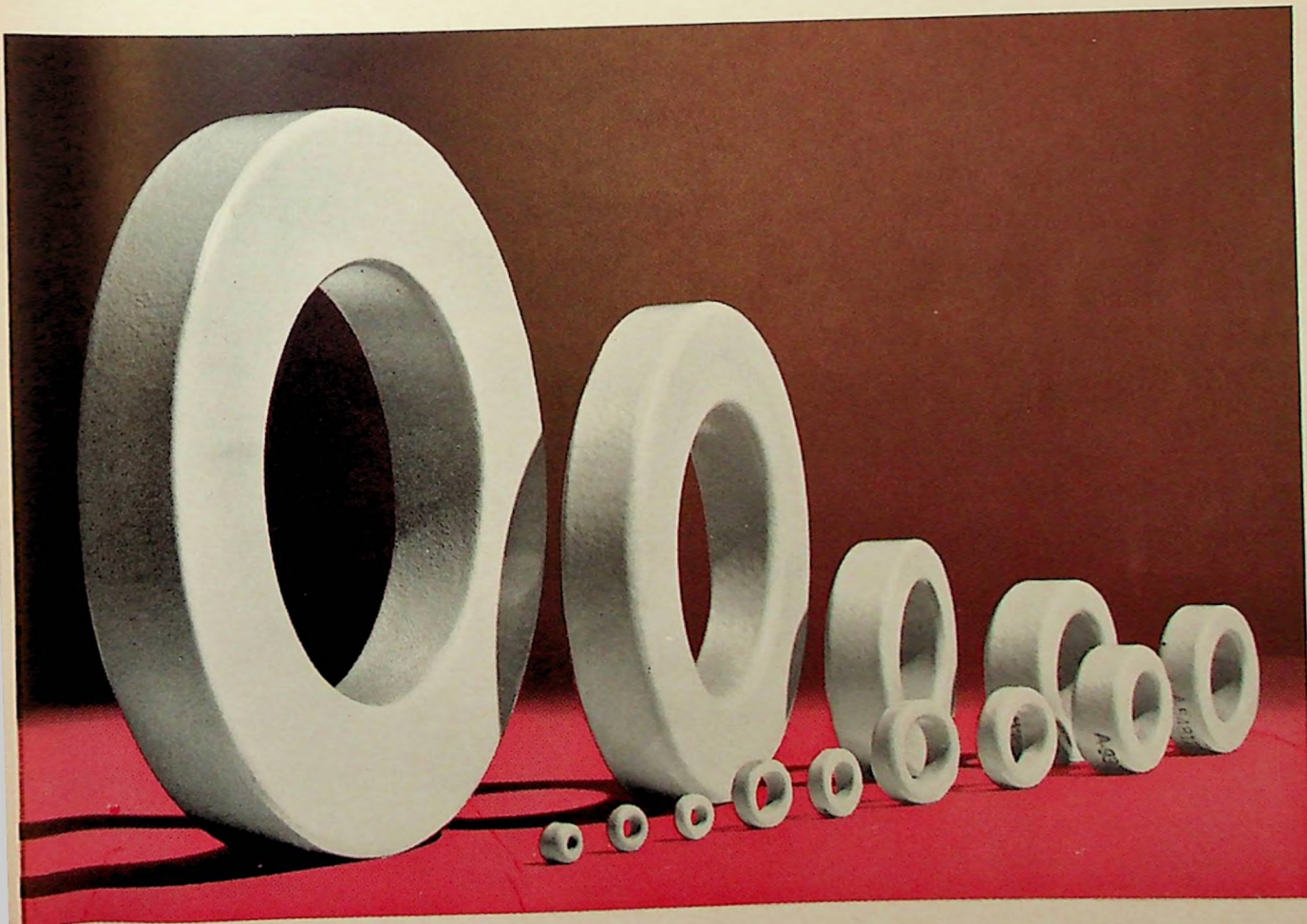
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## MEETING CALENDAR

### SAN FRANCISCO SECTION/EAST BAY SUBSECTION

(See page opposite)

### PROFESSIONAL GROUPS

#### Bio-Medical Electronics

8:00 P.M. • Tuesday, May 24

(Election of officers will be held at this meeting)

"Electrical Devices and Medical Quackery"

Speaker: Dr. Ralph Weilerstein, U. S. Food & Drug Administration  
Place: Room M-112, medical school building of Palo Alto-Stanford University Medical Center (Room M-112 is located in the courtyard of the wing in the center nearest Hoover Tower. Approach from Palm Drive on Stanford Campus, an extension of University Avenue, Palo Alto)  
Dinner: 6:00 P.M., Red Cottage, 1706 El Camino Real, Menlo Park  
Reservations: George Turner, Davenport 5-8332

#### Electron Devices

8:00 P.M. • Wednesday, May 25

"Localized Imperfections in P-N Junctions"

Speaker: Dr. Adolph Goetzberger

Place: Room 100, Physics Lecture Hall, Stanford University

#### Electronic Computers

8:00 P.M. • Tuesday, May 24

"The NEURISTOR, a Novel Device and System Concept for Digital Computer Applications"

Speaker: Dr. Hewitt D. Crane, senior research engineer, Stanford Research Institute, Menlo Park, Calif.

Place: Auditorium, Bldg. 202, Lockheed missiles and space division, 3251 Hanover Street, Palo Alto

Dinner: 6:00 P.M., Hal's Restaurant, 4085 El Camino Way, Palo Alto

#### Engineering Management

8:00 P.M. • Tuesday, June 7

(Joint meeting with Engineering Writing & Speech)

"Management Problems in Large-Scale Technical Writing Activities"

Panel: Douglas Dupen, Associated Techdata; William Patton, Sylvania Electric Products; and Peter Sherrill, Hewlett-Packard

Place: Hal's Restaurant, 4085 El Camino Way, Palo Alto

Dinner: 6:30 P.M.; Social Hour 5:45 P.M.; Hal's Restaurant, 4085 El Camino Way, Palo Alto

Reservations: Mrs. Iavicoli, LYtell 1-8461, Ext 461 or Mrs. Bolton, YOrkshire 8-6211, Ext. 2165

#### Engineering Writing & Speech

8:00 P.M. • Tuesday, May 17

"The Writing and Publishing of Technical Books"

Speakers: Dr. Karl Spangenberg, electrical engineering department, Stanford University; and Lloyd G. Lyman, University of California Press

Place: Building 4, Lenkurt Electric, Howard & Industrial Road, San Carlos

#### Engineering Writing & Speech

8:00 P.M. • Tuesday, June 7

(Joint meeting with PGEM—see above)

#### Production Techniques

8:00 P.M. • Tuesday, May 31

Plant tour of Hewlett-Packard facilities in Stanford Industrial Park, including new administration building and underground warehouse

Speaker: Noel Porter, vice president, Hewlett-Packard Co.

Place: On Page Mill Road, Palo Alto, go to crest of hill and turn left into parking lot. Proceed to back of the building closest to road

#### Space Electronics & Telemetry

8:15 P.M. • Tuesday, May 17

"A High-Accuracy Voltage-Controlled Oscillator for Airborne Telemetry"

Speaker: David Cureton, Wiancko Engineering Co., Los Angeles

Place: Auditorium, Bldg. 202, Lockheed missiles and space division, 3251 Hanover Street, Palo Alto

Dinner: "Meet-the-speaker" dinner, 6:30 P.M., Hal's Restaurant, 4085 El Camino Way, Palo Alto

Reservations: Lois Reed, REgent 9-4321, Ext. 28150, before noon, May 17

### CHRONOLOGICAL RECAP

May 17—Engineering Writing & Speech, Space Electronics & Telemetry  
May 24—Bio-Medical Electronics, Electronic Computers  
May 25—Electron Devices  
May 31—Production Techniques  
June 7—Engineering Management/Engineering Writing & Speech  
June 14—San Francisco Section/East Bay Subsection



*Andrija Puharich*

**THE SECTION MEETING**

**Anyone for ESP?**

This year for the Annual Section Meeting a topic and a speaker of more than unusual interest will form the main event of the evening.

Dr. Andrija Puharich, a neurophysiologist and a research consultant in the field of parapsychology, will presumably answer the question "Should Communication Theory Include Extrasensory Perception?"

Following custom, the program will also include the presentation of diplo-

mas to the Section's new Fellows, scrolls to the Section's Student Branch honor students, and the gavel to next year's Section chairman, whose identity is at present shrouded in mystery, particularly until you fill out **your** ballot and mail it to the address indicated. Results of the other elected officers will, of course, also be announced at the annual meeting.

As you can see from the program, the meeting has been planned to be interesting and worthwhile to a maximum variety of individuals. Since the social aspects of Institute membership regularly come to the front at the Annual Meeting, you are accordingly urged to bring family and friends. A suitable coupon for ordering tickets is near at hand.

Dr. Puharich initially prepared the material he will present for the Aldous Huxley Conference at Tecate, Mexico, June 27, 1960. Puharich is a resident of Carmel Meadows, Carmel, Calif., where he is currently preparing a book on the biophysical foundations of extrasensory perception to be published by Doubleday & Company late this year. He is performing research on hallucinogenic mushrooms and the physical phenomena of mediumship. For avocation, he goes hiking with his family and collects mushrooms—admirable hobbies in that they can be done at the same time.

Born in Chicago, Ill., he received primary and secondary education in the Chicago public schools and an MD from Northwestern University Medical School in 1946. He is licensed to practice in the states of Maine and California.

His postgraduate training was in physiology, medical research, and internal medicine. He is the author of numerous papers in medical and scientific journals and of "The Sacred Mushroom," Doubleday & Company, 1959. He served as director of research to the Round Table Foundation in Maine from

*(Continued on page 10)*

**Ticket Order**

Please reserve \_\_\_\_\_ tickets for me at \$5.00 per person for the San Francisco Section IRE Annual Meeting, June 14, 1960, Empire Room, Claremont Hotel, Berkeley, Calif.

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**SECTION ELECTION**

**Your Ballot**

Register your interest in Section affairs by completing the ballot below, detaching it at the perforation provided, folding it as indicated on the reverse side, securing the open end, and mailing it to the secretary. No additional nominations having been received, the slate is as announced in the April **Grid**.



For chairman,  
Donald A. Dunn



For vice chairman,  
Stanley F. Kaisel



For secretary,  
Peter D. Lacy

For treasurer,  
**(VOTE FOR ONE)**



Charles Susskind



W. Bruce Wholey



For section director,  
Albert J. Morris

Place  
1/4  
stamp  
here

Dr. Stanley F. Kaisel, Secretary  
San Francisco Section, IRE  
Suite 205, Whelan Bldg.  
701 Welch Road  
Palo Alto, California

fold here

## SECTION AFFAIRS

### Words to Live by

The proposed set of Bylaws for the San Francisco Section has just emerged from a series of committee discussions. It is published now for your perusal and voting action at the annual meeting on June 14.

These Bylaws cover the operation method that has been in effect on an interim basis for the past six months in the Section. It features a large Executive Committee with a wide representation of Section membership, about thirty-four members. This group meets regularly in August, January, and June and passes on all policy and fiscal matters. Then monthly meetings of the small Operating Committee take care of the details of Section management within the established policy framework.

The important area of planning technical, tutorial, and general meetings is the province of the Program Committee representing all of the Professional Groups and the East Bay Subsection. All section activities are implemented by the physical facilities of the **Grid** and the recently expanded Section Office.

Next, the Section is a sponsor in collaboration with outside organizations of WESCON, the San Francisco Engineer, and the San Francisco Engineering Council.

Thus, the Bylaws are directly concerned with activities peculiar to the San Francisco Bay Area. Matters pertaining to IRE objectives and restric-

tions are covered by a Section Constitution that is binding on all Sections unless specific changes are requested and approved by the Executive Committee of the Institute.

These Bylaws represent what is considered to be a workable framework for operation, written by the people currently concerned in each of the mentioned phases of Section affairs. We all know that the Bylaws could use more polish and will inevitably undergo change. This is your opportunity to examine them and where questions arise please feel free to telephone Miss Pacak at the Section Office.

In order that the June meeting not be doomed to be a legislative debate, it is hoped that one of three courses of action be taken: approved as written, approved with minor revisions that have been submitted in writing to Vic Corey, or deferred for committee revision.

—Pete Lacy

### Proposed Bylaws

#### THE INSTITUTE OF RADIO ENGINEERS, INC. SAN FRANCISCO SECTION

1. **Parliamentary Authority.** The rules contained in "Robert's Rules of Order Revised" shall govern the Section in all cases to which they are applicable, and in which they are not in-

*(Continued on page 12)*

### MORE ESP

1948 to 1958 where principal investigations were carried out on the nervous systems of men and animals and in the field of parapsychology. He has carried out researches in neurophysiology, on diseases, hearing and taste physiology, and electrical measurements on the organism.

Puharich is now working as research consultant in the field of parapsychology for a number of organizations such as: The Mind Science Foundation, San Antonio, Texas; Consciousness Research Foundation, San Pedro, Calif.; and Belk Research Foundation, New York.


He is a holder of several U.S. and foreign patents in the field of medical and sensory prosthetic devices.

Use reverse side of this coupon to order tickets for the  
San Francisco Section annual dinner meeting June 14.


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less than 1%, and gain is stabilized by substantial negative feedback to virtually eliminate effects of transistor characteristics and environment.

For a demonstration on your laboratory or field application, call your  representative or write direct.

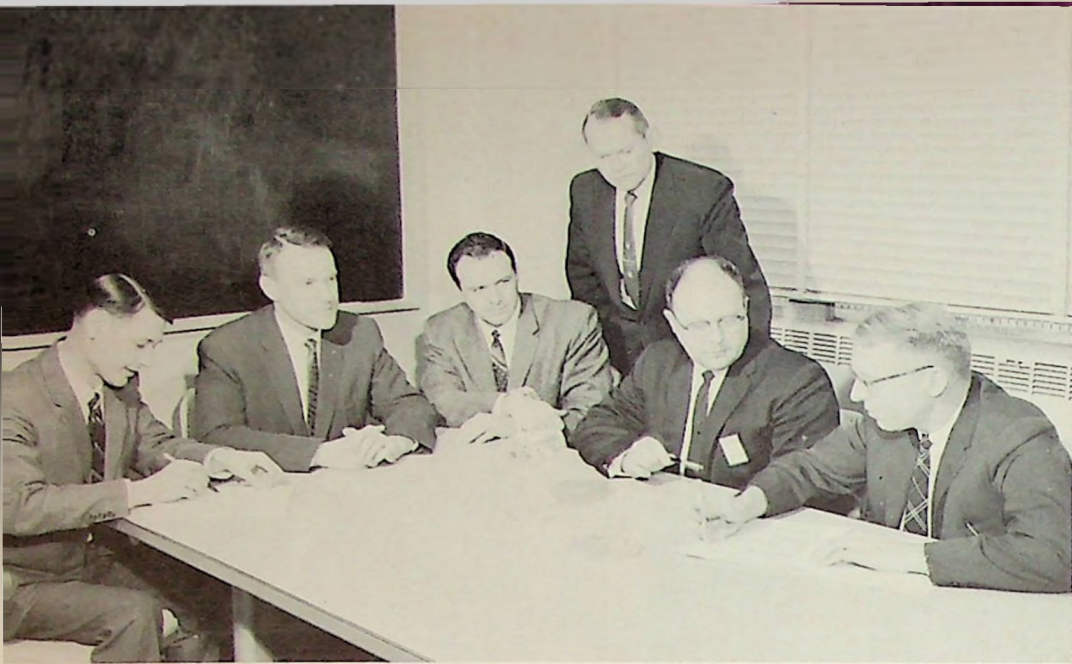
#### Specifications

Gain:	20 and 40 db, $\pm 0.2$ db at 1000 cps.	Output Impedance:	Approximately 50 ohms.
Frequency Response:	$\pm 0.5$ db 10 cps to 1 MC.	Distortion:	Less than 1%, 10 to 100,000 cps.
Output Voltage:	1.5 v rms across 1500 ohms.	Power:	12 radio type mercury cells; battery life about 160 hours; or ac line power.
Noise:	75 $\mu$ v rms referred to input, 100,000 ohm source.	Dimensions:	6 $\frac{1}{4}$ " wide, 4" high, 6 $\frac{1}{4}$ " deep. Weight: approx. 3 lbs.
Input Impedance:	1 megohm shunted by 25 $\mu$ f.	Price:	\$150.00 f.o.b. factory.

Data subject to change without notice.

### HEWLETT-PACKARD COMPANY

CONTACT OUR ENGINEERING REPRESENTATIVES, NEELY ENTERPRISES, FOR INFORMATION—Los Angeles, 3939 Lankershim Blvd., North H'wd., TR 7-0721; San Carlos, 501 Laurel St., LY 1-2626; Sacramento, 1317 Fifteenth St., GI 2-8901; San Diego, 1055 Shafter St., AC 3-8106; Phoenix, 641 E. Missouri Ave., CR 4-5431; Tucson, 232 So. Tucson Blvd., MA 3-2564; Albuquerque, 6501 Lomas Blvd., N.E., AL 5-5586; Las Cruces, 114 S. Water St., JA 6-2486.



*Scene in one of the planning sessions for the 7th Region Conference shows various chairmen: Bill Harrold, public relations; Rush Drake, exhibits; Frank Holman, conference chairman; Leroy Perkins, Seattle Section chairman; Frank Little, treasurer; and Professor D. K. Reynolds, technical program*

## 7TH REGION

### Three-Topic Conference

Control systems, solid-state electronics, and electromagnetics are to share the limelight in Seattle May 24, 25 and 26 when the 7th Region IRE conference and IRE/ISA joint technical exhibit take place. Frank S. Holman is conference chairman.

Details on the program, complete with abstracts, are provided on succeeding pages. Dr. Donald K. Reynolds is program chairman.

Among the other events calculated to attract visitors are an All-Industry Luncheon, a cocktail party, a field trip, and a roster of four special events for the ladies.

*(Continued on page 14)*



*Another 7th Region Conference grouping includes: John Tate, secretary; Professor Reynolds; Mel Paisley, arrangements; G. K. Prentiss, social activities; and Frank Little*

## MORE BYLAWS

sistent with the Constitution and Bylaws of the Institute or Section, or any special rules of order of the Section.

**II. Meetings.** The regular meetings of the Section may consist of separate meetings or joint meetings with Subsections, Professional Group Chapters, or other technical societies. These meetings shall be held at such times and places as determined by the Program Committee. The annual meeting of the Section shall be held during the month of June.

### III. Management.

**A.** The Executive Committee of the Section shall meet at the beginning of a meeting year, during the middle of the year, and at the end of a meeting year on a scheduled basis. A quorum of the Executive Committee for the transaction of business shall be at least a simple majority of the voting members thereof. An Executive Committee meeting may be called at any time on the written request, to the Chairman, from any three members of the Executive Committee. Other Executive Committee meetings may be called by the Section Chairman when and if needed. Attendance at Executive Committee meetings by persons who are not members of the Executive Committee can be arranged by the Section Chairman.

**1.** The Executive Committee shall consist of at least the following voting members or their duly authorized alternates:

**a.** The following Section Officers:

- (1) Chairman
- (2) Vice Chairman
- (3) Secretary
- (4) Treasurer

**b.** The Junior Post Chairman.

**c.** The chairmen of the following committees:

- (1) Program
- (2) Membership
- (3) Arrangements
- (4) Historical
- (5) Awards
- (6) Education and Student Relations

**d.** The Chairman of each Subsection.

**e.** The Chairman of each Professional Group Chapter.

**f.** The WESCON and Section Directors.

**g.** The Chairman of the Publications Board.

**h.** The Public Relations Coordinator.

**i.** The Senior Delegate to the San Francisco Engineering Council.

**j.** Any IRE National or Seventh Region Director residing within the Section boundary, *ex officio*.

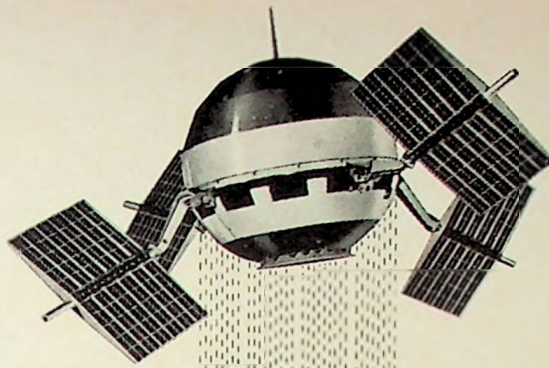
**2.** The following non-voting members:

- a.** The Editor of the *GRID*
- b.** IRE Section Office Manager

**B.** An Operating Committee shall be established to carry out the operations of the Section in accord with policies laid down by the Executive Committee. The agenda of Operating Committee meetings and the minutes will be circulated to the full Executive Committee. Attendance of persons who are not Operating Committee members shall be arranged through the Section Chairman. However, any Executive Committee member can request an invitation if he has a special interest in any matter on the agenda. The decisions of the Operating Committee are always subject to review by the Executive Committee. In matters of the budget, programming, publication policy, and awards, the approval by the Executive Committee of the plans for the year must be obtained. The results of this planning at the end of the year must also be reviewed by the Executive Committee.

**1.** The Operating Committee shall consist of at least:

*(Continued on page 14)*



**Pioneer V  
Paddlewheel Planetoid  
Is Vaulting  
Through Unexplored Space  
Toward The  
Orbital Path of Venus**

At this moment Pioneer V, one of the most advanced space probe vehicles ever launched, is on a course toward the path of Venus—26 million miles from earth. Blasted aloft March 11 by a Thor Able-4 rocket booster, this miniature space laboratory will reach its destination in about 130 days.

The project, carried out by Space Technology Laboratories for the National Aeronautics and Space Administration under the direction of the Air Force Ballistic Missile Division, may confirm or disprove long-standing theories of the fundamental nature of the solar system and space itself.

Energy from the sun—captured by almost 5,000 cells mounted in the four paddles—is used to supply all of the electrical power to operate the sophisticated array of instrumentation packed into the 94-pound spacecraft which measures only 26" in diameter.

By combining a phenomenal digital electronic brain (telebit) with a powerful radio transmitter inside the satellite, STL scientists and engineers expect to receive communications from Pioneer V at their command over interplanetary distances up to 50 million miles.

STL's technical staff brings to this space research the same talents which have provided over-all systems engineering and technical direction since 1954 to the Air Force missile programs including Atlas, Thor, Titan, Minuteman, and related space programs.

Important positions in connection with these activities are now available for scientists and engineers with outstanding capabilities. Inquiries and resumes are invited.

**SPACE TECHNOLOGY LABORATORIES, INC.**

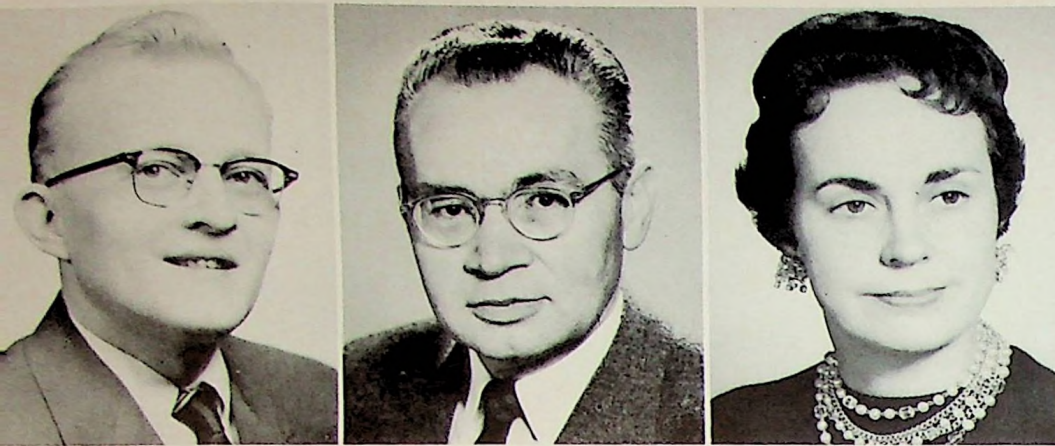


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Cape Canaveral • Manchester, England • Singapore • Hawaii

P. O. Box 95004, Los Angeles 45, California

MAY 1960

GRID-13



These 7th Region Conference chairmen had the following responsibilities: Roy Pearson, field trips; Arthur E. Harrison, vice chairman and advisor; and Mrs. Joanne Holman, women's activities

### MORE 7TH REGION

Over two hundred booths have been laid out in the National Guard Armory and plans have been made for attendance by over 5000 engineers and technicians. Rush Drake is IRE exhibit chairman.

A joint effort of IRE and the Northwest Section of the Instrument Society of America, these manufacturing displays will be made accessible by free shuttle-bus service from the conference in the Olympic Hotel to the Armory, provided by the Cascade Chapter of the Electronic Representative Association.

On Tuesday, the luncheon will be held in the Spanish Ballroom in the Olympic Hotel. It will feature two speakers and a master of ceremonies, two of the three individuals being members of the San Francisco Section.

O. G. Villard, Jr., Stanford University, will serve as master of ceremonies. C. W. Carnahan, Varian Associates, IRE 7th Region director, will speak on "The Role of the 7th Region Conference in IRE Affairs." Hugh A. Smith of Century 21 Exposition will speak on that international event being planned for Seattle, April to October 1962.

Also on Tuesday, the cocktail party will be held at the Olympic Hotel. It will feature the usual fluid substances presented in Northwestern hospitality.

Boeing Airplane Company's transport division at Renton, Washington, will provide the technical interest for the field trip on Wednesday, May 25. Participants will see the factory, radar test on the flight line, radar checkout in the electronic shop, electronic mock-up, evaluation of flight situations, and present and future airplane mock-up.

Women's activities will include a reception and coffee hour on Tuesday; a Puget Sound cruise and tour of Victoria on Wednesday—including dinner aboard ship; a Snoqualmie Falls and arboretum tour on Wednesday and a sunset cruise and barbecue on Thursday which will include husbands whose technical program has, by that time, been completed. All IRE members attending the convention may register on any of the three days at the Olympic Hotel or the National Guard Armory. There is no charge.

There will be a 100-page program directory distributed at the time of registration.

## 7th REGION CONFERENCE

### Program

#### SESSION I OPENING GENERAL SESSION

Tuesday, May 24  
9:00 A.M.

Chairman: Oswald G. Villard, Jr.  
Stanford University

#### SPEAKERS

WELCOME FROM THE CONFERENCE COMMITTEE  
Frank S. Holman, Boeing Airplane Co., Chairman, 7th Region Conference

#### "SEMICONDUCTOR DEVICES, PRESENT AND FUTURE"

Harper North, Pacific Semiconductor, Culver City, Calif.

#### "ELECTRONICS AND THE CHALLENGE OF SPACE"

Oswald G. Villard, Jr., Stanford University

#### IRE & ITS ROLE IN MEDICAL ELECTRONICS

Ronald L. McFarlan, president, IRE

#### CURRENT TRENDS IN CONTROL-SYSTEM RESEARCH

Robert N. Clark, University of Washington

### LUNCHEON

Master of Ceremonies: O. G. Villard, Jr.  
Stanford University, Stanford, California

#### SPEAKERS

#### "THE ROLE OF THE 7TH REGION CONFERENCE IN IRE AFFAIRS"

C. W. Carnahan, IRE 7th Region Director

(Continued on page 16)

## MORE BYLAWS

- a. The following Section Officers:
  - (1) Chairman (Voting Member)
  - (2) Vice Chairman (Voting Member)
  - (3) Secretary (Voting Member)
  - (4) Treasurer (Voting Member)
- b. The Junior Past Chairman (Non-Voting Member)

c. The Section-WESCON Directors (Non-Voting Members)

d. Any IRE National or Seventh Region Director residing within the Section boundary (Non-Voting Member)

2. A quorum of the Operating Committee shall consist of at least three voting members.

3. The following major activities of the Section shall be assigned to the designated members of the Operating Committee for representation and liaison:

- a. Chairman
  - (1) All Standing Committees except as listed below
  - (2) East Bay Subsection
  - (3) WESCON
  - (4) All External Relations
- b. Vice Chairman
  - (1) Professional Group Chapters
  - (2) Program Committee
- c. Secretary
  - (1) Publications Board
  - (2) Section Office
- d. Treasurer
  - (1) Financial

C. Section Office Management. The Section Chairman may obtain the services of full-time personnel to man an IRE Section Office with the approval of the Executive Committee. An IRE Office Manager will be appointed who will have the responsibility for handling any administrative functions which may be delegated by the Section Chairman. The Section Secretary will be operationally responsible for the activities of the IRE Section Office.

IV. Appointments. The Section Chairman shall, as soon as practicable after the beginning of his term of office, make the following appointments and obtain confirmation from the Section Executive Committee:

- A. Standing Committee:
  1. Program—Chairman
  2. Membership—Chairman
  3. Arrangements—Chairman
  4. Historical—Chairman
  5. Education and Student Relations—Chairman
  6. Awards—Chairman and all members

B. The Treasurer and three members to the Publications Board.

C. The Public Relations Coordinator.

D. Two San Francisco Engineering Council Delegates and one alternate in accordance with the Council Bylaws.

V. Committees and Representatives.

A. Program Committee.

1. Purpose. The Program Committee will coordinate the programs presented at the Section, Subsection, and Professional Group Chapter meetings; and the programs presented in conjunction with other organizations.

2. Organization. The Committee shall be composed of a Chairman, who is Vice Chairman of the Section, and the Subsection and Professional Group chairmen. The chairmen of these groups may designate alternates for attendance at Program Committee meetings.

3. Duties. The Program Committee will meet at the beginning of each year to prepare a program schedule. This meeting should take place during the month of August. At the meeting a program for the entire Section

(Continued on page 16)

# TEXAS INSTRUMENTS NEWS

from ...



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New for your high-temperature and high-speed computer applications . . .

### TI Gallium Arsenide Tunnel Diodes

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On our shelves now for immediate delivery, Texas Instruments 1N650-series gallium arsenide tunnel diodes offer you these *guaranteed* high-performance characteristics for your logic circuits, amplifiers, oscillators, and general computer applications:

1. Peak current ratings up to 10 ma  $\pm 2\%$
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5. High-temperature operation up to 150°C

*Economically priced*, these new TI gallium arsenide tunnel diodes are already in mass production and are less expensive than other semiconductor material types on the market today.

*For immediate delivery*, order today in 1-999 quantities at factory prices. And remember, you get fast local delivery on *any* of TI's complete line of semiconductors and components\*.

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Peter N. Sherrill

## MEETING AHEAD

### Among the Wordsmiths

Problems encountered in technical publications will be considered from a management point of view when, June 7, the Professional Groups on Engineering Management and Engineering Writing & Speech will meet jointly for this purpose. See Meeting Calendar for time, place, and other details.

The topic will be subjected to the panel approach, moderated by Hyman Olken of the Lawrence Radiation Laboratory, outgoing chairman of PGEWS. Panel members will be Peter Sherrill of Hewlett-Packard Co., William Patton of Sylvania EDL, and Douglas W. Dupen of Associated Techdata.

Sherrill will speak on the publication of internally produced instruction handbooks. Patton will cover the generation of engineering reports, proposals, etc. Dupen will speak on the special problems encountered by publication subcontractors with specific emphasis on the subcontracted preparation of military manuals for the government. He will cover liaison with the client; liaison

(Continued on page 18)



Douglas Dupen

## MORE 7TH REGION PROGRAM

### "THE CENTURY 21 EXPOSITION"

Hugh A. Smith, Public Relations Counsel, Century 21 Exposition

### SESSION II

### CONTROL SYSTEMS I: PERFORMANCE CRITERIA

Tuesday, May 24  
2:00 P.M.

Chairman: G. F. Franklin  
Stanford University  
Co-chairman: F. C. Fickeisen  
Boeing Airplane Co.

### PERFORMANCE MEASURES: PAST, PRESENT AND FUTURE

W. C. Schultz, Cornell Aeronautical Laboratory,  
and V. C. Rideout, University of Wisconsin

An increased amount of emphasis has been placed on the mathematical formulation of control-system performance. There are two areas of control-system theory in which the application of performance measures is of interest: (1) the evaluation of control system designs in general, and (2) the design of adaptive control systems.

In the former case, the performance measure is becoming an increasingly important aid to the control-system designer. In the latter case, the performance measure takes on even greater significance, since adaptive systems include, by definition, a performance measure as an essential function which permits correction of system dynamic response during actual operation. Furthermore, the overall evaluation of the adaptive loop itself presents new problems in the choice and use of performance criteria.

In the past, emphasis has been placed on various types of integrals, such as integral of error squared and ITAE (integral of the product of time and absolute error); present emphasis is being placed on forms of integrals of a more general type; the trend for future emphasis appears to be in applications of statistical concepts and in attacking the problem of choice of the error measure in the adaptive system.

### OPTIMUM PERFORMANCE CRITERIA WITH A MINIMUM LEAD SYSTEM

George S. Axelby, Westinghouse Corp., Baltimore, Md.

Although there is no universal definition of an optimum control system, several desirable features which would tend to make a linear system "optimum" are proposed. The paper illustrates that a system will possess most of the proposed features if it is designed to be a minimum-lead system.

Simple synthesis procedure for designing a minimum-lead system are reviewed, and the frequency and time characteristics of the resulting systems are shown to have consistent relationships. The normalized characteristic denominator of the system is compared with those of systems based on other "optimum" criteria.

Finally, there is a comparison between the corresponding frequency response, root locus, and transient responses for different deviations from the proposed "optimum" system. It is shown that the frequency response, which defines the minimum lead system, is quite sensitive in predicting that the transient response will change considerably as the system deviates from optimum whereas the root-locus variations, being very small, do not indicate that the transient response will change significantly.

Thus, it is shown by various means that a minimum-lead system possesses many desirable features of a general optimum criteria.

### OPTIMUM CONTROL SYSTEM WITH MINIMUM SPECTRAL BANDWIDTH OF PLANT INPUT

J. C. Hung, New York University

In servo system where the controlled plant has fixed or varying resonant modes at somewhat

(Continued on page 18)

## MORE BYLAWS

should be formulated and prepared for publication in the Grid. Deviations from and changes in the published program should be cleared with the Program Committee Chairman.

### B. Membership Committee.

1. Purpose. The Membership Committee shall solicit new members, encourage advancement of all members to higher grades, and encourage participation of the membership in Section activities.

2. Organization. The Committee shall be composed of a Chairman, Vice Chairman and members who are company representatives. The number of persons on the Committee should be as large as required to adequately cover the Section territory. At least one Committee man should be located among each concentration of members or potential members. The appointments shall be for a period of one year and should be made and acceptances secured within sixty (60) days after the annual meeting.

3. Duties. The Committee shall assist potential members to become members; assist those qualified for higher grades of membership to apply for higher grade; distribute and collect attendance cards of all Section and Sub-section meetings and special meetings series, and establish procedures for membership action developed at professional group meetings; and submit an annual detailed report on membership activities to the Section Chairman.

### C. Arrangements Committee.

1. The Arrangements Committee shall consist of a Chairman and such additional members as may be appointed by the Chairman of this Committee. It shall be the responsibility of the Committee to provide a meeting place, and all necessary and reasonable equipment to conduct Section meetings and social affairs and to provide assistance to Subsection and Professional Group Chapters as required.

### D. Historical Committee.

1. Purpose. The Historical Committee shall be responsible for the development of a continuing program aimed at preserving the historical artifacts and documents that originated in and have played an important part in the development of the San Francisco Bay Area.

2. Organization. There shall be a Working Committee composed of Chairman, Vice Chairman, and members who shall carry out the Committee's program. The Vice Chairman and additional members shall be appointed by the Committee Chairman. An Honorary Committee composed of the Senior Elder Statesmen of the Section shall serve as advisors to the Working Committee on matters relating to the early development of radio.

3. Duties. The Committee shall establish a program to create interest in and awareness of items of historical value. The Committee's activities shall include publicizing the area's radio-electronics history, arranging with those who have collections for exhibits at conventions, shows, and other special events, and providing help and assistance to those who have historical radio collections to the extent permitted by the Section and National IRE Constitution and Bylaws.

### E. Education and Student Relations Committee.

1. Purpose. The Education and Student Relations Committee shall aid in the development of student activities in schools within the area of the Section and be responsible

(Continued on page 18)

We promise you a reply  
within one week

The complexity of modern technology...the rapid increase in the number of specializations...and the frequent shifts in technological emphasis all have combined to require a staff of alert, aggressive, creative teams of engineering specialists. Their responsibility is to assist management in the formulation of plans for future efforts.

For our purposes the teams should be staffed by graduate Electronic Engineers and Physicists who have acquired several years of experience with radar, guided missiles, computers, infrared detection, nuclear radiation equipment, micro-electronics, underwater

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## Exploratory Studies • Advanced Planning • Systems Analysis

detection, space propulsion systems or related areas. Several of the positions require the ability to present contract proposals to both technical and non-technical officials. Other positions require the ability to do preliminary systems design. There are twenty-three openings in the above areas at the present time.

All of the positions involve close associations with senior engineers. All of the salaries reflect the unusual backgrounds required.

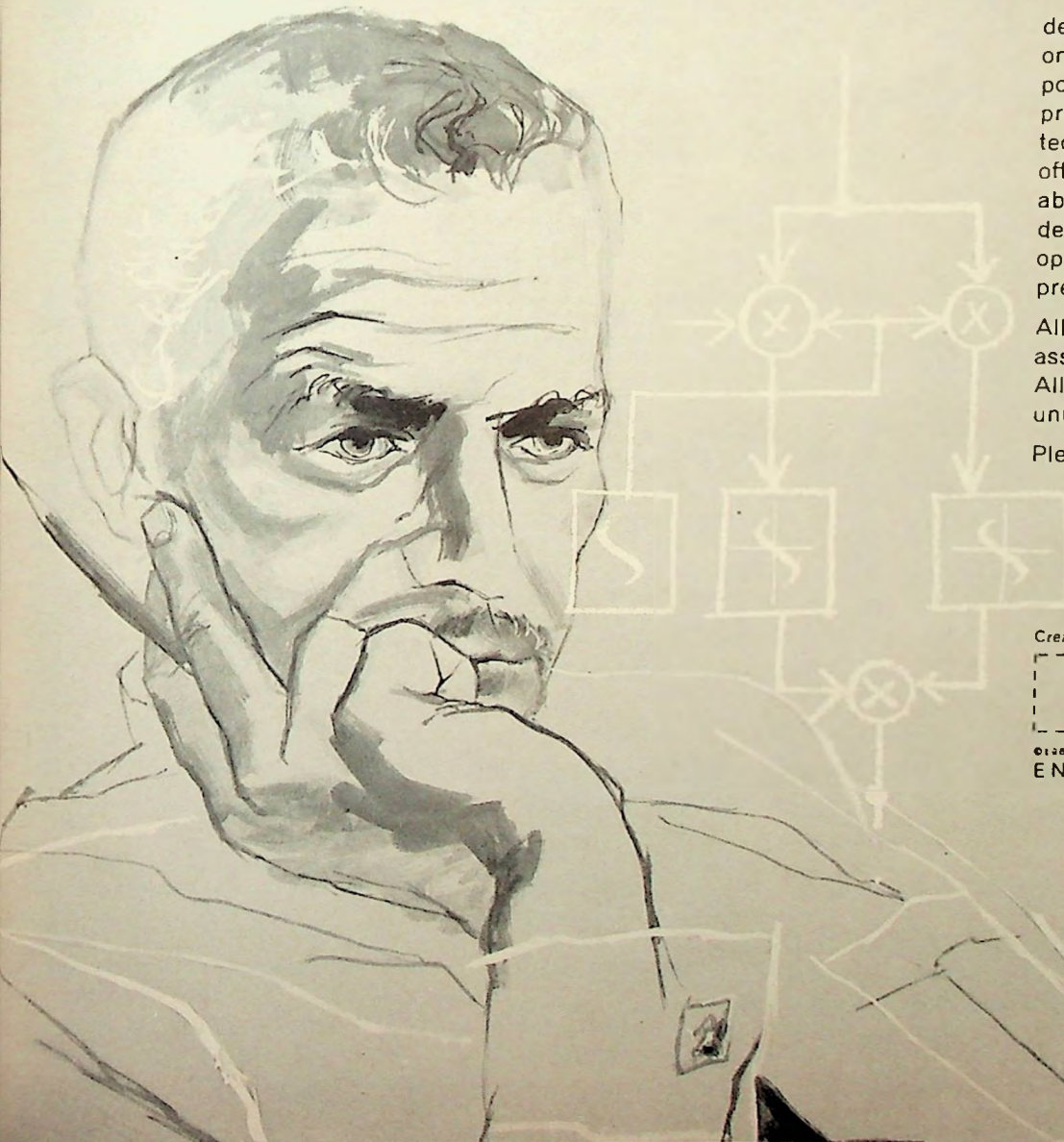
Please airmail your resume to

**Mr. Robert A. Martin**  
Supervisor, Scientific Employment  
Hughes Engineering Division  
Culver City, California

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**HUGHES**

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ENGINEERING DIVISION





William R. Patton

### MORE WORDSMITHS

with the military service; research on equipment; acquisition, accumulation, and interpretation of military specifications; and (deep sigh) the meeting of deadlines.

Sherrill was born in Washington, D. C., graduated from San Marino High School in Southern California, and received a Bachelor of Science degree from the U. S. Naval Academy in 1948. He joined Hewlett-Packard Co. in 1954 and is presently market promotion and technical publications manager.

A member of the Publications Board, he is also a public relations coordinator of the Section. In the American Astronautical Society he is a board director of the San Francisco Section and a former editorial consultant for *Astronautical Sciences Review*. In 1959 he was vice chairman of the public relations committee at WESCON and is a member of the present 1960 committee.

Patton also began the present phase of his career in 1954, joining the Sylvania Electronic Defense Laboratory as head of publications. A native of Portland, Oregon, he received his education there, graduating from Oregon State College in 1935 with the Bachelor of Science degree in Electrical Engineering.

Patton had fifteen years experience in the radio engineering field, designing and installing equipment for broadcast, air and ground communication, and public safety. During World War II he was with the Office of War Information, working on high-power radio facilities in North Africa, Italy, and Austria.

He has been in charge of engineering publication work continuously for the past ten years, at Sylvania and at Lenkurt Electric Co., San Carlos. Patton is a member of the IRE, and of the Armed Forces Communications-Electronics Association, of which he has been secre-

(Continued on page 20)

### MORE 7TH REGION PROGRAM

higher frequencies than that of the reference input signal, the usual practice is to restrict the system bandwidth so these resonant modes are not excited. Optimum design method which gives minimum root-mean-square error with limited bandwidth has already appeared in the literature.

However, with certain controlled plants, it is possible that limiting the system bandwidth does not limit the spectral bandwidth of the plant input function and these resonant modes are nevertheless excited.

This paper proposes a different approach to the problem. Instead of limiting the bandwidth of close-loop system function, the high-frequency power input to the plant is directly limited in the optimum design procedure. The selection of the asymptotic slope of plant input and the choice of the weighting function are discussed. The method proposed is applicable to both deterministic input and random input. Example is given to illustrate the method. The system thus obtained is certain not to excite the resonant modes of the plant.

### CONSIDERATION IN THE DESIGN OF FEEDBACK CONTROL SYSTEMS WITH OPTIMUM PERFORMANCE

R. L. Cosgriff and Major E. J. Hagin, Ohio State University

In the evaluation of any system it is necessary to determine (not define) a single function  $F$  which is evaluated in terms of such factors as downtime maintenance cost and dynamic characteristics as well as other considerations. (It is impossible to order a group of systems using multiple  $F$ 's which cannot be logically combined, nor can one determine optimum adjustment of a single system because of conflicting considerations introduced by the multiple  $F$ 's.) The function  $F$  when evaluated for a group of systems will properly order the systems in terms of their value for particular application under consideration.

In the synthesis of a control system, it is convenient to express  $F$  in the normalized form  $F_n = (F - F_1) / F_1$ , where  $F_1$  is the value of  $F$  resulting from the use of an ideal control system. The synthesis problem becomes that of making  $F_n$  as small as possible carrying out the evaluation of  $F_n$  for input signals whose characteristics are identical to those to be met in action operation.

At first glance it often appears impossible to use analytical techniques in system design because of the complexity of  $F_n$ . Yet the engineer is often able to base his design upon the rms error criterion and employ the optimum synthesis technique developed by Wiener or one of the variations of this technique. Two examples demonstrate the foregoing considerations.

A large number of "Figures of merit" and "rules of thumb" for control systems are often used as substitutes for performance criterion. The use of these formalizations, although convenient in the class room, are not only misleading but can be potentially dangerous particularly if they are used as a basis for the synthesis of non-linear systems. Examples of extremes that can result using such definitions of optimum response are illustrated. These considerations emphasize the importance of using legitimate criterion in the control field.

### SESSION III SOLID-STATE ELECTRONICS I: SEMICONDUCTORS

Tuesday, May 24  
2:00 P.M.

Chairman: Robert E. Connally  
General Electric Company, Hansford Laboratories Operation, Richland, Washington

### NEGATIVE RESISTANCE PROCESSES IN SEMICONDUCTORS

Ronald E. Burgess, Department of Physics, University of British Columbia

(Continued on page 20)

### MORE BYLAWS

for matters pertaining to the academic development of all students and members within the Section.

2. Organization. The Committee shall be composed of a Chairman, who shall be the Student Branch Coordinator, and members appointed by the Committee Chairman. The members shall be selected from each college or university within the Section having an IRE Student Chapter Branch, and they shall serve as Faculty Advisors to the Branches; and others interested in education and training activities. The terms of office shall be for one year or until the successors are appointed and take office.

3. Duties. The Committee shall take responsibility for and exercise its functions in three major areas, on each of which the Chairman shall report activities to the Section Executive Committee:

- a. Arranging programs, field trips, meetings, and industrial counseling opportunities for student groups. Joint meetings with the Section and other technical societies may be arranged. Assistance in obtaining speakers shall be provided. The Committee shall endeavor to further the interest in the IRE among the students in the Section.
- b. Generating interest and participation in and opportunity for further formal academic training of engineering and technical personnel employed in industry.
- c. Formation of a qualified panel of IRE judges who will evaluate student exhibits at the Annual Bay Area Science Fair; and formulating and carrying through detailed arrangements for IRE sponsorship of a selected number of winning exhibits at the following Future Engineers Show in connection with WESCON.

### F. Awards Committee.

1. Purpose. The Awards Committee shall be responsible for the solicitation and receipt from the members of the Section and evaluation of nominations for the honors and awards bestowed annually by IRE National. It shall be the duty of the Committee to prepare the Section's nominations for submission to the National Board of Directors in conformance with the time schedule established by the National Executive Committee.

2. Organization. The Awards Committee shall consist of three or more Fellows of the Section, one of them to be designated Committee Chairman. The terms of office shall be for three years for each member.

3. Duties. The Awards Committee shall receive the names of Section members and otherwise select candidates from the Section for the honor of Fellow and shall make recommendations to the Executive Committee for the Section Chairman's submission to the National Awards Committee for the following IRE National awards:

- a. Medal of Honor; Morris Liebmann Memorial Prize Award; Browder J. Thompson Memorial Prize Award; Harry Diamond Memorial Award; Vladimir K. Zworykin Television Prize Award; Founders' Award; and W. R. G. Baker Award.

The Awards Committee shall determine that each of the nominees is fully qualified to receive the honor for which he is recommended.

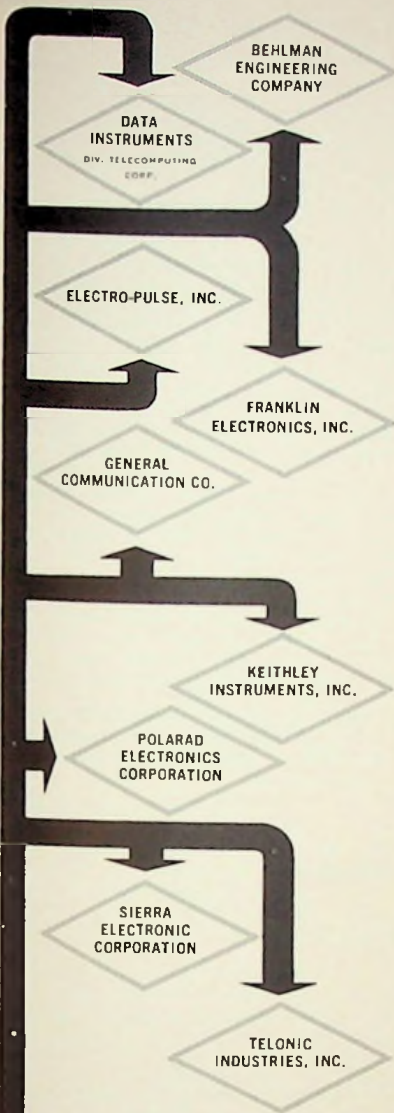
### G. Publications Board.

1. Purpose. The Publications Board shall be responsible for recommending and implementing publication policy for the Executive Committee. Operational matters of the Section publication, the *Grid*, and the *San Francisco Engineer*, shall be under the aegis of the Publications Board.

2. Organization.

- a. Officers of the Publications Board shall

(Continued on page 21)



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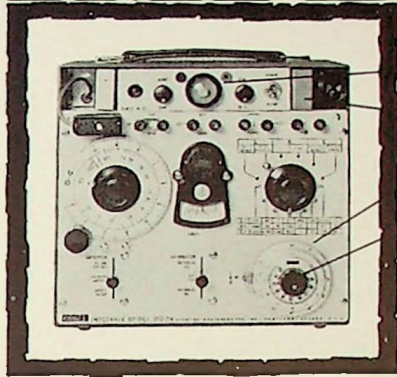
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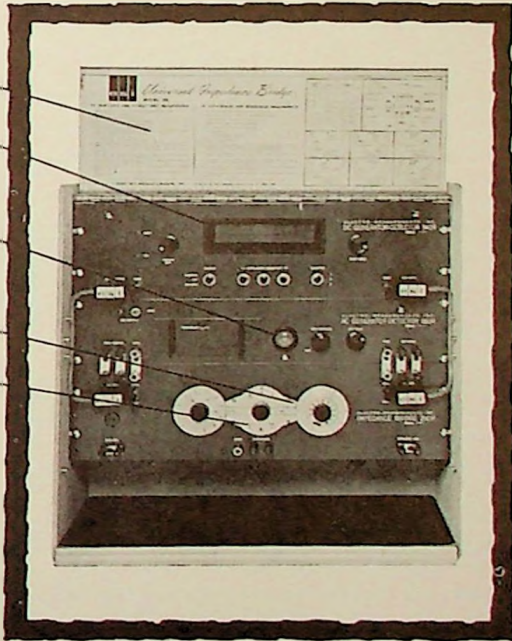
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## MORE WORDSMITHS

tary and vice chairman, San Francisco Chapter.

Dupen is chief writer at Associated Techdata where he has had experience in writing about electronics, microwave, and instrumentation equipment as well as research chemical analysis.

He holds an AB in physics from the University of California and an AB in English from Humboldt State College. He has been a Navy electronics maintenance officer and electronic countermeasures officer. During three years as an electronics design engineer, he developed devices for instrumentation and automation of control and switching systems which led to the granting of two U. S. patents. He has been with Sylvania's electronics defense laboratory as senior technical writer.

## MEETING AHEAD

### Imperfect Junctions

Late in May, PGED will offer a program on semiconductor imperfections, featuring as speaker Dr. Adolph Goetzberger of Shockley Transistor Corp. See the Meeting Calendar for other details.

Goetzberger received his PhD from the University of Munich in Munich, Germany in 1955, after which he was employed by the Siemens-Halske GMBH for a period of three and a half years. In 1959 he joined the Shockley Transistor Corporation where he is presently doing research which is directed toward an improved understanding of the phenomena occurring at a back-biased pn junction. Goetzberger has reported on his research at recent meetings of the American Physical Society in Detroit and Cleveland, and is a co-author (with Dr. W. Shockley) of an article (on the effects of metal precipitates in pn junctions) in the book "Properties and Structure of Thin Films."

Beginning with a short survey of the properties of the ideal junction, such as reverse current, avalanche breakdown, and Zener effect, Goetzberger will discuss junction imperfections and their effects on v-i characteristics. The effects to be discussed may be divided into two groups: Those arising from surface imperfections and those arising from volume imperfections.

Both types of imperfections can cause two deviations of characteristics from the ideal case, which are generally referred to as softness and double break. Experiments on one type of excess current which could be attributed to formation of metal precipitates in the space-charge region will be reported. The effects of dislocations and statistical fluctuations of donors and acceptors on avalanche breakdown will also be discussed.

## MEETING AHEAD

### Fibrous Computers

Homogeneous, distributed, active-passive structures in the form of one-dimensional fibers will be described by Dr. Hewitt D. Crane, Stanford Research Institute, and related to general application in the digital-computer field when PGEC meets in May. Consult the Meeting Calendar on page 8 for further particulars.

Called the neuristor, this novel device and system concept provides for fibers which perform the dual role of device and wire so that arbitrarily complex computer systems can be realized with nets of fibers properly related via appropriate fiber junctions. No other components are required. Crane will discuss the device and its system techniques.

## PROFESSIONAL GROUPS

### PGI Forming

Harold A. Kazanjian of Peninsula Associates has taken the lead in forming a San Francisco Section Chapter of the Professional Group on Instrumentation. A petition with fifty-four signatures was processed by the Executive Committee at the April 18 meeting and relayed to National Headquarters for approval.

Presented at Excom by the professional group coordinator, Frank Mansur, the document contains the names of fourteen present members of PGI, sixteen IRE members not members of PGI but willing to join, and twenty-four non-members of IRE willing to join both the Institute and the group.

## PROFESSIONAL GROUPS

### New Officers

#### Antennas & Propagation

Newly elected officers are: Dr. Richard C. Honey, Stanford Research Institute, chairman; Ray L. Leadabrand, Stanford Research Institute, vice chairman; and Dr. Tetsu Morita, Stanford Research Institute, secretary. It is pointed out that those who voted in this election will recall that there were candidates from other organizations, too.

#### Engineering Writing & Speech

Elections for the forthcoming year have been completed in this group with the following results: Art Walters, Hewlett-Packard Co., chairman; Jim Weldon, Sylvania, vice chairman; Douglas W. Dupen, Associated Techdata, secretary; and John P. Kern, Lenkurt Electric Co., treasurer.

#### Military Electronics

There will be a mail ballot for this group being distributed from the National Office. Nominees are as follows: Lou Gado, Wiancko Engineering, chair-

*(Continued on page 23)*

## MORE 7TH REGION PROGRAM

Negative resistance may appear in two-terminal semiconductor systems as a consequence of such processes as impact ionization, internal field emission, transit time, plasma modes or thermal feedback. Their exploitation in junction and non-junction systems and the ranges of useful operation are discussed.

A general analysis is given for the case where the current depends directly on the voltage (or field) and on some other control variable (e.g. temperature, current multiplication or recombination rate) which implicitly involves current and voltage. It is shown that the simultaneous presence of two of the processes can radically affect the character of the negative resistance. The inertia inherent in the physical process used determines the basic frequency range for amplification, oscillation and switching but this may be considerably restricted by parasitic impedances (e.g. conspicuously in the case of the tunnel diode).

Impact ionization can provide useful negative resistance in such devices as the pnp diode and the cryosar. However, the apparent negative resistance observed in avalanche diodes beyond the breakdown voltage is not similarly useful since it arises from the gross statistical nature of the breakdown process.

An interesting class of negative resistance involving specific frequency bands derives from transit time and plasma modes and the difficulties in realizing these systems are discussed.

### A SURVEY OF RECENT PROGRESS IN DEVELOPMENT OF HIGH-FREQUENCY TRANSISTORS

G. H. Hanson, Bell Telephone Laboratories, Inc., Allentown, Pa.

Theoretical and experimental work in the last few years has resulted in development of transistors which can operate at frequencies extending to 3000 mc. The relations which exist between frequency capability, gain, impedance levels, and power-handling capacity will be described in terms of the physical parameters of the transistor structures.

Such design approaches as diffusion of both junctions, and diffusion in combination with alloying will be discussed for devices intended for various types of applications. Comparisons will be given with other electron devices which might be used for similar purposes.

Some of the special problems which arise during preparation for manufacture will be described. These include the need for measurement techniques that are compatible with both large-scale production and with the requirements of circuit designers. Additional problems are associated with the miniaturization required for high-frequency devices.

Several examples of circuits which utilize the capability of high-frequency transistors will be given. These include wideband amplifiers with unique characteristics, several millimicrosecond switching circuits and high-power applications.

Throughout the paper, emphasis will be placed on the fundamental aspects of the developments rather than on specific devices or techniques.

### NOISE IN JUNCTION TRANSISTORS

A. van der Ziel, University of Minnesota

Noise in transistors can be split into a flicker noise part with a  $1/f$  noise spectrum and a shot noise part that is white at low frequencies.

Early work by Montgomery, Clark, and van der Ziel indicated that the noise could be represented by two uncorrelated noise sources: a noise  $e m f e$  in series with the emitter and representing the shot noise of the emitter junction, and a noise current generator  $i$  in parallel to the collector junction representing a partition noise term and a shot noise term due to the collector saturated current. Giacometto offered a similar representation. One recent theory attributes the noise to the random diffusion, recombination and generation of carriers in the base region whereas another theory ascribes the noise to the random passage of currents carriers across the two junctions.

*(Continued on page 22)*

## MORE BYLAWS

be the Chairman, Vice Chairman/Recording Secretary, and Treasurer.

b. The Board shall be composed of its three officers, the Secretary of the Section, the three members appointed annually by the Section Chairman, the Editor of the **Grid** (non-voting), the Public Relations Coordinator (non-voting), and such additional non-voting members as may be appointed by the Board Chairman.

c. Each year the Section Chairman will appoint a new Treasurer who will in successive years become Vice Chairman/Recording Secretary and then Chairman. Additionally, the Chairman shall appoint three members each year. The new term of office of all officers will start on 1 January each year.

d. The total term of service of the Publications Board officers shall be three years.

### 3. Duties.

#### a. Chairman

(1) Shall conduct meetings once a month or as the situation dictates.

(2) Shall be the Publications Board representative to the San Francisco Section Executive Committee.

#### b. Vice Chairman/Recording Secretary

(1) Shall assume the duties of the Chairman in his absence.

(2) Shall record minutes of Board meetings and distribute copies of the minutes to each Board member, the Section Operating Committee, the IRE Section Office, and the **Grid** Editor.

(3) Shall be responsible for distributing meeting notices.

(4) Shall serve as the official representative of the Section at the annual meeting of the **San Francisco Engineer** and shall carry the recommendations of the Chairman of the Section for the election of the succeeding Directors of the **San Francisco Engineer**.

#### c. Treasurer

(1) Shall monitor the financial matters of the San Francisco Section publications.

(2) Shall give an oral financial report at each Publications Board meeting.

(3) Shall distribute semi-annual financial reports to each Publications Board member, the Editor, the Advertising Manager, the members of the Section Operating Committee, and the IRE Section Office.

(4) Shall maintain liaison with the Publications Board bookkeeper.

(5) Shall have records audited annually.

(6) Shall prepare an annual budget for the succeeding year prior to the last day of May and submit it to the Section Treasurer.

4. Liaison. Liaison functions between the Publications Board and other professional agencies shall be the responsibility of the Chairman of the Board. He may, however, appoint such assistants as he requires to aid him in this responsibility; among these are:

- Bi-annual **Grid-Bulletin** representative
- Student activity representative

5. Quorum. A quorum shall consist of the simple majority of the voting members of the Publications Board.

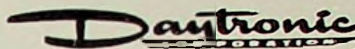
6. Operating Procedures. The Board shall establish such operating procedures as are necessary for the production of the Section publications.

a. The Publications Board shall hire an Editor to assume full responsibility for production of the **Grid** magazine. The Editor shall carry out the instructions of the Publications Board. His compensation shall be established by the Section Executive Committee based on recommendations received from the Publications Board.

(Continued on page 22)



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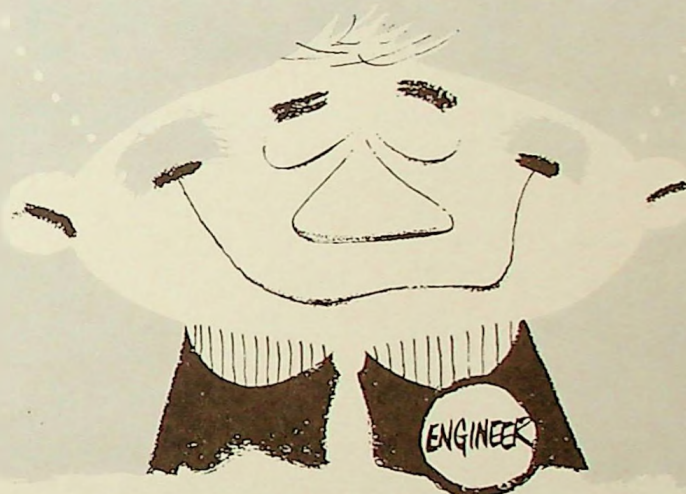


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## SECTION ACTIVITIES

### Membership

Among the little known facts about the San Francisco Section are those relating to the activities of the Membership Committee—that source of the life blood of the Institute, the recruitment of new members. These little-sung heroes of many tedious hours of service in IRE booths at WESCON and other conventions and symposia have in their possession all necessary information and application forms necessary for membership application as well as for change of grade for present members.

The Committee, under the chairmanship of Frank A. Brierly, has a vice chairman who is James P. Fitzpatrick and an East Bay Subsection chairman who is Frank K. Inami. Working with these gentlemen are individual members located at electronic companies throughout the area.

Knowledge of their identities will be useful to you if you are asked about membership by a prospect or if you should feel the need to rise to a higher grade yourself. They are as follows:

Admiral Corporation . . . . . William Milwitt  
American Standard . . . . . William Snyder  
Ames Research Center (NASA) . . . William Kerwin  
Ampex Corporation . . . . . Sol Cohen  
Beckman Instruments (Berkeley) . . . John Carl  
California Technical Industries . . . Cyril E. McClellan  
Dalmo Victor Company . . . . . John Damonte  
Danner Scientific Co. . . . . David Taskett  
Dymec, Inc. . . . . John Humphries  
Eitel McCullough, Inc. (Belmont) . . Dr. Bernard Arfin  
Eitel McCullough (San Bruno) . . . John Soderstrum  
Eitel McCullough (San Carlos) . . . M. E. Stangle  
Fairchild Semiconductor Corp. . . . R. J. Johnston  
G. E. Microwave Laboratory . . . . . Hans Mohr  
Hewlett-Packard Company . . . . . Norman B. Schrock  
International Business Machines . . . Harold Markey  
Jennings Radio Mfg. Co. . . . . Lewis B. Steward  
Kaiser Aircraft & Electronic Corp. . . . . Russ Aiken  
Lawrence Radiation Lab (Berkeley) . . . Ivan C. Lutz  
Lawrence Radiation Lab (Livermore) . . E. F. Laine  
Lenkurt Electric Company . . . . . Maurice Kebby  
Littlon Industries . . . . . Herman W. Smith  
Lockheed Missiles & Space Div. . . . Frank A. Brierly  
Marchant Research, Inc. . . . . Win Soule  
Mare Island Naval Shipyard . . . . . Chris Mingst  
Palo Alto Engineering Co. . . . . Lloyd M. Burkhart  
Philco Corporation . . . . . Edwin C. Gulick  
RS Electronics Corporation . . . . . Robert K-F Scal  
San Jose State College . . . . . Harry M. Engwicht  
Sandia Corporation . . . . . Eugene A. Aas  
Secode Corporation . . . . . Allan R. Ogilvie  
Shell Development Company . . . . . Carl Penhler  
Shockley Transistor Corp. . . . . Randall Christensen  
Sierra Electronic Corp. . . . . Gary Hirotsu  
Sperry Gyroscope Company . . . . . D. C. Fogard  
Stanford Research Institute . . . . . Dean F. Babcock  
Stanford University . . . . . Charles J. Shoens  
Stanford University . . . . . Dr. V. R. Eshleman  
Sylvania (Electronic Defense Lab) . . . Leonard Jeffers  
Sylvania (Microwave Tube Lab) . . . Dan V. Geppert  
Sylvania (Recon. Systems Labs) . . . Robert Van Hook  
U. S. Naval PG School . . . . . Prof. G. Robert Giet  
United Air Lines . . . . . Keith N. Cummings  
University of California . . . . . Prof. H. J. Scott  
University of Santa Clara . . . . . Prof. Danlan Jones  
Varian Associates . . . . . Eric Edberg  
Varian (Instrument Division) . . . . Paul Robbiano  
Varian (Tube R & D) . . . . . Robert G. Rockwell  
Watkins-Johnson Company . . . . . Dr. Boyd Israelten

## MORE 7TH REGION PROGRAM

tions. Both theories are equivalent.

The theory has been verified to a considerable extent by the work of Guggenbuhl and Strutt, Nielsen and Honson. Chenette carried out more refined experiments and discovered new effects that had escaped earlier notice. For germanium transistors he accurately verified the theoretical expressions for  $i^2$  and showed that the correlation between the emf  $e$  and the current generator  $i$  agreed with theory. A discrepancy between theory and experiment for silicon transistors could be attributed to recombination effects in the emitter transition region (Schneider and Strutt, van der Ziel, Chenette). By measuring the equivalent input noise resistance of the circuit as a function of the source impedance  $R_s$ , Chenette found further discrepancies between theory and experiment. These could be attributed to the fact that the measurement of the  $h_{12}$ -parameter gives only part of the base resistance. Strutt and his co-workers have demonstrated the presence of a high-level injection effect near the  $\alpha$ -cut-off frequency.

The theory of flicker noise is less well developed. Fonger has located the noise sources and has attributed the noise to slow fluctuations in the surface recombination velocity. Chenette has shown that the flicker noise emitter emf and the flicker noise collector current generator are fully correlated. Yajima has shown that the latter term shows considerable resemblance to the partition noise term of the earlier theory.

For references: A. van der Ziel, Fluctuation phenomena in semiconductors, Butterworths, London, 1959.

### THE TUNNEL DIODE

Jack Hilibrand, Radio Corporation of America, Princeton, New Jersey

The tunnel diode is a new two-terminal negative resistance device with remarkable high-frequency capabilities. The electrical properties of the tunnel diode will be described and explained. Particular attention will be devoted to those properties which are particularly attractive and to those which may limit the use of this device. In addition, some applications of tunnel diodes in communication circuits and in computer circuits will be indicated and the potential of the diodes for use in these areas will be discussed.

### SESSION IV

#### CONTROL SYSTEMS II: OPTIMAL DESIGN TECHNIQUES

Wednesday, May 25  
9:00 A.M.

Chairman\* A. H. Koschmann  
University of New Mexico  
Co-chairman: R. M. Hubbard  
Boeing Airplane Co.

#### PERFORMANCE CRITERIA IN ADAPTIVE CONTROL

C. W. Sarture and J. A. Aseltine, Space Technology Laboratories, Inc.

Adaptive systems have been defined as being characterized by:

1. A means for performance measurement
2. Translation of this measurement into a quantitative figure of merit
3. Closed-loop adjustment of the system parameters by means of the figure of merit

Since Item 2 will be realized through some performance criterion, the latter can be viewed as an essential element of adaptive control. This paper reviews a number of adaptive systems from the point of view of the performance criterion used.

Included in the adaptive system considered are those using the following performance criteria: 1. Operation at an extremum, 2. ITAE, 3. Impulse response area ratio, 4. Step response meeting specified requirements, 5. Maximum loop gain with a model, and 6. Mean squared error with a model.

(Continued on page 24)

## MORE BYLAWS

b. The Publications Board shall employ an Advertising Manager to handle all details of that phase of the Grid operation. His compensation shall be established by the Section Executive Committee based on recommendations received from the Publications Board.

c. Rates of advertising in the Grid shall be set by the Publications Board within the limits of the budget approved by the Executive Committee.

d. The Editor shall provide good publications management in accordance with current practices.

### H. San Francisco Engineering Council Delegates.

1. The two San Francisco Engineering Council Delegates and the alternate shall represent the San Francisco Section in all matters coming before the San Francisco Engineering Council.

### I. Public Relations Coordinator.

1. The Public Relations Coordinator shall be appointed to carry out Section public relations activities in media other than the Grid and the San Francisco Engineer as designated by the Section Chairman. He shall serve as a member of the Publications Board in order to effect coordination between Section public relations activities and those activities in this area accomplished through the Grid and the San Francisco Engineer.

### J. Nominating Committee.

1. Pursuant to Article VIII, Sec. 1 of the Section Constitution, the Nominating Committee will be appointed by the Chairman not later than the first of January. Nominations will be announced and solicitation of the membership at large for additional candidates will be published not later than the April issue of the Grid.

VI. Elections. The Section, Subsections, and Professional Groups will hold their elections in time for the results to be known by May 25 of each year. The Section election shall be by mail ballot.

VII. WESCON-Section Directors. The Section representatives to the Board of Directors of WESCON shall be two in number, their appointments to be confirmed by the Section Executive Committee. They shall serve in the dual offices of WESCON Board Members and Section Directors. As Section Directors they shall be nominated and elected by the Section membership in the same way as Section officers. This nomination and election of one new representative will take place in only the odd-numbered years to coincide with the current agreement between the San Francisco and Los Angeles Sections of the IRE. The term of service of the Section representatives on the WESCON Board will coincide with the aforementioned agreement and will be for a period of four years. Upon receipt of the official results of the election, the Section Secretary shall transmit to the WESCON Board the name of the newly-appointed Section representative prior to the opening date of WESCON. This newly-appointed representative will assume his duties as provided for in the current San Francisco-Los Angeles agreement. Such assumption of duties normally takes place in November and in the period from the time of the annual meeting until the November Board meeting of WESCON there will actually be three San Francisco Section representatives on the WESCON Board. All three representatives will sit on the Section Operating Committee and on the Executive Committee during this interim period. The Section representatives to the WESCON Board will be responsible for reporting to the Executive Committee and the Operating Committee on all matters pertaining to WESCON as they affect the operation of the San Francisco Section.

(Continued on page 24)



Walter Selsted with the new electrostatic headphones

## MEETING REVIEW

### Audio Gets a Push

Twenty members of the PGA and AES attended the Ramor Oaks dinner that preceded the April joint meeting at Hoover School in Redwood City. The audience at Hoover School was checked on the sign up sheet as follows:

Member of both PGA and AES	7
Member of AES only	10
Member of PGA only	4
Non-members	8
Counted but did not sign list	11

The audience listed addresses in the following cities:

Palo Alto	6	Mountain View	3
Menlo Park	2	New York City	1
San Jose	2	Cupertino	1
Redwood City	3	Son Carlos	1
Los Altos	5	Belmont	1
South San Fran.	1	Sunnyvale	2
Sacramento	1		

All but the New Yorker and the Sacramentan were satisfied with the geographical location of the meeting place as being convenient and centrally located.

The host, Walter Selsted; AES past chairman, Ward Widener, and Al Isberg, representing the PGA, discussed reorganization plans for the two groups. As indicated by a show of hands, the following was favored:

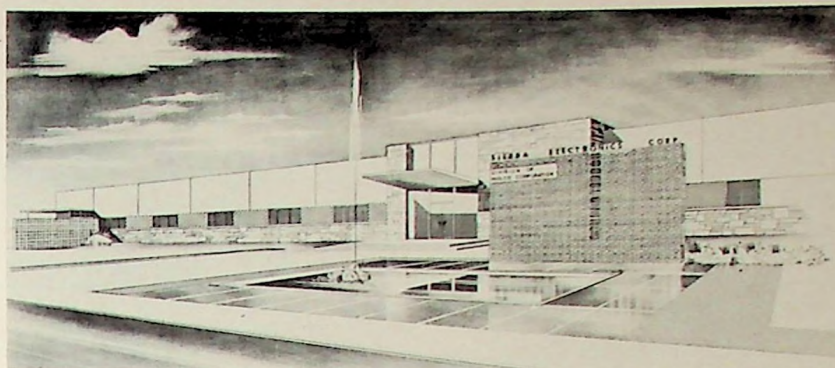
1. Both organizations will continue to function but with a newly elected slate of officers.
2. Both groups will have program committees and will coordinate

(Continued on page 24)

### MORE NEW OFFICERS

man; Walt Prize, Lockheed missiles & space division, vice chairman; Jerry Dover, Ampex Military Products, secretary; and Boyd Norris, Lockheed missiles & space division, treasurer. Ballots will contain write-in spaces for additional names for all offices.

Completed ballots are to be returned to O. R. Hill, 1176 Los Altos Ave., Los Altos, Calif., prior to May 27.



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## MORE AUDIO

program plans, possibly alternating in providing programs for joint meetings.

3. Joint meetings are desirable since the membership of each group is small and the interests are similar.

Of those present, audio in a broad sense was the common denominator. When queried about interest in a proposed new Professional Group on Tape Recording, only two persons showed interest.

A nominating committee for the AES was appointed including Ward Widener, Harold Lindsey, John Bennett, Rein Narma, and Al Isberg. This group will meet on May 12, 1960, at 8 P.M. at Al Isberg's residence, 200 Concord Drive, Menlo Park.

A nominating committee for the PGA was appointed and includes Walt Selsted, Vince Salmon, Lambert Dolphin, and Al Isberg. They will meet at the Key Club at 12:15 P.M. on May 10.

Future meetings probably will be scheduled in the Redwood City area unless plant tours or subjects of special interest will attract an audience and justify traveling a greater distance. Members were encouraged to communicate with the officers and to suggest suitable topics for future meetings.

The technical meeting was conducted by Walter Selsted, vice president for research, Ampex Corp., Redwood City. He described and demonstrated a new type of electrostatic stereo earphone.

The earphone is constructed with a thin conductive-plastic membrane stretched between two perforated metal plates which are at ground potential. The ear piece is made of polyurethane and is formed to make a snug closure with the wearer's ear. The outer perforated metal plate is covered by a thin layer of sound absorbing material to load the diaphragm. The wearer is not isolated from sounds in the room and can carry on a conversation while listening to the earphones.

Frequency response of the earphones can be comparable to that of professional microphones and the recreated sound is more natural than that produced by other types of earphones and loudspeakers.

This development is considered to be one of the best improvements in high-fidelity equipment in recent years.

—R. A. Isberg

## MEETING REVIEW

### Twinkle, Twinkle

Total attendance at last month's three-lecture tutorial series on radio astronomy was over four hundred, reflecting the wide interest among radio engineers in this new approach to astron-

(Continued on page 26)

## MORE 7TH REGION PROGRAM

### A SIMULATOR STUDY OF A TWO-PARAMETER ADAPTIVE SYSTEM

R. J. McGrath and V. C. Rideout, University of Wisconsin

A system using continuous parameter disturbance and correlator detection of an error function to effect self-adaptation and self-optimization is described and analyzed. Problems of adaptive loop design and optimum adaptive system response are discussed.

As an example, a third-order system with controllable feed-forward and feed-back parameters and two adaptive loops has been simulated on a high-speed analog computer. Mean-square error surfaces for the two controllable parameters were determined for square-wave and for various random input signals. Results of this computer study show that the system can approach the minimum error point on such error surfaces in an optimum fashion by simultaneous automatic adjustment of its parameters, to correct for either changes in the statistics of the input signal, or for random changes in any of the system parameters.

The system described should be applicable to more complex systems with more than two controllable parameters; other error criteria may be used, and it may be adapted to analog, digital, or hybrid control systems.

### LIMIT CYCLE EFFICIENCY OF ON-OFF REACTION CONTROL SYSTEMS

G. W. Freeman, presented by R. H. Hurlow, both of Boeing Airplane Co.

Because of the near absence of disturbances in space, the efficiency of the characteristic limit cycle of the on-off reaction control systems determines to a large extent the fuel required for attitude control of the satellite and space vehicle. Therefore it is desirable to investigate the parameters which most influence limit cycle efficiency.

In this paper, a figure of merit for limit cycle efficiency, based on the ratio of the jet "on" to "off" times, is derived. In addition, an expression is developed relating the characteristics of the control system to the figure of merit. Character-

istics considered are relay hysteresis, thrust "on" and "off" time lags, sensor and electronics dead-zone, and feed-back gains.

The directly controlled rocket and the controlled hot-gas types of reaction jet on-off control systems are numerically analyzed and their figures of merit compared. It is shown that sensor and electronics dead-zone and thrust "off" time lag are the principal deterrents to limit cycle efficiency.

### DESIGN ASPECTS OF ATTITUDE CONTROL SYSTEMS

M. F. Marx, General Electric Co.

Figures of merit in addition to those of performance are discussed relative to the attitude control system of a returnable vehicle capable of leaving the atmosphere. In addition to extreme changes in flight condition, these applications are subject to variations in configuration and performance requirements.

Traditionally, control optimization has been concerned with minimization or maximization of a function of a system variable such as error. Quite often these error criteria are replaced by other criteria such as invariance and the capacity for adaptability. In fact, during a complete mission including exit to re-entry, it is desirable to utilize variable figures of merit.

Examination of the control requirements of a modern returnable space vehicle illustrates how the various figures of merit dictate the design configuration. In those phases of the mission where self-adaptive control is employed, the figure of merit is usually determined by the particular technique selected. It is further demonstrated how the figure of merit varies with the mission phase as the control actuation configuration changes.

### SESSION V SOLID-STATE ELECTRONICS II: SOLID-STATE ENERGY CONVERSION

Wednesday, May 25  
9:00 A.M.

Chairman: Attie L. Betts  
Washington State University

(Continued on page 25)

## MORE BYLAWS

### VIII. Finance.

A. Fiscal Year: The fiscal year of the Section shall begin on the first day of July and end on the thirtieth day of June in the succeeding year.

B. Section Budget:

1. All operating bodies of the Section (Sub-section, Professional Group Chapter, Committee, etc.) shall submit a plan for a financial operation for the succeeding year on the last day of May to the Section Treasurer.

2. The Operating Committee shall be responsible for the preparation of the Annual Budget. The coordination of all Section financial affairs and policies for the Operating Committee is the responsibility of the Treasurer.

3. The Section budget shall be presented by the Treasurer to the last Executive Committee meeting of the fiscal year for approval. This budget shall cover the succeeding fiscal period commencing with the first day of July and ending with the thirtieth day of June. Approval of this budget shall constitute approval for expenditures not to exceed the budgeted items. This budget may be modified by the Executive Committee.

C. Financial Reporting: All operating bodies shall prepare and submit semi-annual financial reports. The reporting periods shall be the first day of July through the last day of December and the first day of January through the last day of June. The reports for the two periods

shall be delivered to the Section Treasurer by the tenth days of January and July respectively. D. Annual Report: The Treasurer shall cause to be prepared an annual audit of the affairs of the Section by certified public accountants and a report thereof submitted to the Executive Committee.

IX. Removal From Appointed Position. Any Section member appointed to any position may be removed from that position by a two-thirds majority vote of the entire voting membership of the Executive Committee. Prior to any vote being taken, the member in question shall be notified in writing of the pending action and requested to present himself before the Executive Committee at the time and place designated in the notice to show cause why he should not be removed from the position.

X. Amendment of Bylaws. These Bylaws shall be adopted in accordance with Article XII, Sec. 2 of the Section Constitution and may be amended. Any proposed amendments to these Bylaws shall require a two-thirds vote of the voting members present at any regular Section meeting for adoption thereof; provided that notice has been given to all voting members of the Section at least three weeks prior to such meeting. Amendments to these Bylaws may be proposed as follows: (a) by the Executive Committee, or (b) by presenting to the Executive Committee the proposed amendment, in writing, accompanied by a petition bearing the signatures of at least twenty-five voting members of the Section. Any amendment proposed in this manner must be presented to the membership for vote.

— END —

## MORE 7TH REGION PROGRAM

### THERMOELECTRIC GENERATORS

R. J. Tallent, Boeing Airplane Co.

A brief review of the theory will be presented. The present status of materials and fabrication technology will be discussed. Generator application and design problems will be outlined.

### NEW DEVELOPMENTS IN SILICON SOLAR CONVERTERS

Ieland D. Swanson, Hoffman Electronics Corp., El Monte, Calif.

A new technique for gridding solar energy converters will be discussed showing the effects on conversion efficiency and on practical cell size. In addition, new techniques under development for making larger area solar converters will be presented.

"RECENT ADVANCES IN THE THEORY OF THE CESIUM PLASMA THERMOCOUPLE"

Howard Steele, Boeing Airplane Company

"MODES OF OPERATION OF THE VAPOR FILLED THERMIONIC CONVERTER"

Thomas C. Robinson, Thermo Electron Engineering Corporation, Cambridge, Massachusetts

Co-Chairman: J. C. Noyes  
Boeing Airplane Company

### RADIO EMISSION FROM THE SUN AT DECA-METRIC WAVELENGTHS

James W. Warwick, High Altitude Observatory, University of Colorado, Boulder, Colorado

A program for study of ionospheric effects on radio stars has resulted in considerable additional data on solar radio emission in the relatively unexplored low-frequency range from 15 to 40 mc. The emission consists generally of three types: bursts, occurring almost simultaneously (within 5 seconds) at all frequencies within this range, and lasting for 10 to 30 seconds; bursts, drifting slowly from high to low frequencies at about 1 mc per minute; and continua, lasting for periods ranging from minutes to hours. Noise storms with their

(Continued on page 26)

### SESSION VI

### ELECTROMAGNETICS I: RADIO ASTRONOMY

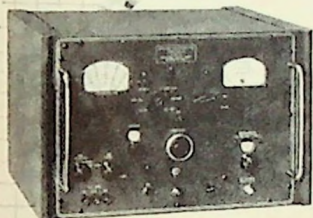
Wednesday, May 25  
9:00 A.M.

Chairman: M. T. Lebenbaum  
Airborne Instruments Laboratory,  
Melville, Long Island, New York

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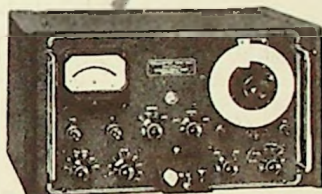
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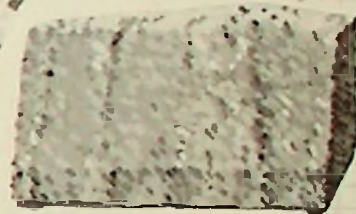
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Ronald N. Bracewell at the blackboard during the first of the PGAP/SFS series on radio astronomy  
—Lloyd Provan photos

## MORE TWINKLE

omy. The meetings, which were sponsored jointly by the Professional Group on Antennas & Propagation and the San Francisco Section, were originally scheduled for each of the four Wednesday nights in April, but a sudden cancellation by one of the speakers necessitated a change for the third meeting and a cancellation of the last scheduled meeting.



Morton Roberts

On April 6, Professor Ronald Bracewell of Stanford University spoke on an "Introduction to Radio Astronomy." He traced the early beginnings of this science as far back as 1895 when it was suggested, on the basis of theory, that the sun should be emitting radio waves. But with the equipment of that day it was not possible to check this prediction.

In 1932, when Karl Jansky noticed unusual directional noise picked up by a system he had built for atmospheric noise studies, he at first thought that the sun was the source. However, he later noticed that the direction of the source moved about a degree a day relative to the position of the sun, and

he correctly deduced that the source must be outside our solar system, in a direction toward the center of our galaxy.

From these relatively recent beginnings, radio astronomy has advanced to the point where it has greatly augmented our understanding of the solar system, the galaxy, and the external galaxies beyond. Highlights of the results obtained by radio astronomy include: the size and shape of our galaxy; the shape of the spiral arms determined by the radio spectral line of hydrogen at 21 cm wavelength; synchrotron or other non-thermal origins of both radio and light energy; colliding galaxies as a source of radio energy; the discovery of a gas corona around galaxies; and some clues as to the nature of evolution of the universe.

Dr. Morton Roberts of the University of California spoke on April 13 about "The Structure of Our Galaxy." He likened the problem of studying our galaxy by optical astronomy to the problem of determining from Westwood the features of the Los Angeles Civic Center and the flow of traffic on the downtown freeways, in a heavy smog. With radio astronomy we can penetrate the smog (of tiny dust particles) and see for the first time the center and other distant regions of the galaxy. Roberts outlined how it is now possible to chart  
(Continued on page 28)

Allen M. Peterson



## MORE 7TH REGION PROGRAM

characteristic bursts, seem relatively unimportant in this range.

Special measures are required to make synoptic observations of these phenomena in the face of severe interference from telecommunications. R. H. Lee of the staff of the High Altitude Observatory developed, over the last four years, techniques to cope with these problems as they appear in total-power receivers, and in fixed and swept-frequency interferometers. This report outlines some of his procedures.

Finally, strong ionospheric effects severely distort many of our solar observations. Examples are given of both intensity and angle-of-arrival variations appearing in otherwise steady solar signals.

### RADIO ASTRONOMY AT NRL

B. S. Yaplee and A. Shapiro, U. S. Naval Research Laboratory, Washington, D. C.

The NRL Radio Astronomy program has pioneered in observations of radio waves from celestial objects at centimeter and millimeter wavelengths. The principal instruments employed are a 10-foot precision paraboloid, and the 50-foot and 84-foot reflectors. In addition several smaller radio telescopes are used to study solar disturbances. Recent observations have investigated in detail the radiation from the solar system and bright radio stars. The minimum distance to Cassiopeia A has been estimated from 21-cm absorption line profiles. A lunar radar program has provided independent measurements of the lunar orbit, and improved values of geodetic and astronomical constants have been derived.

### RADIO STUDIES OF THE MOON

Dave D. Cudaback, Stanford University

Physical properties of the surface of the moon have been determined by studies of black-body emission at microwave frequencies and reflection of radar signals. This work by many observatories is summarized, and values of thermal conductivity, heat capacity, electrical conductivity, and electric constant discussed.

Most of these studies have been performed with little angular resolution across the moon. The Stanford Microwave Interferometer can resolve about one-tenth of the moon's diameter at 9-cm wavelength. It is being used for studies of both emission and radar reflection, which will hopefully lead to values of the above physical constants for different parts of the moon's surface. Research supported by the Air Force Office of Scientific Research under contract AF 18 (603)-53.

### RADAR ECHOES FROM THE SUN

P. B. Gallagher, Stanford University

On April 7, 10, and 12, 1959, radar echoes were obtained from the sun at Stanford University. Coded sequences of pulses were transmitted for a fifteen minute period at a frequency of 25.6 megacycles from a 40 kilowatt transmitter and a broadside array of four rhombics. The antenna array was then connected to a receiver, and the input signal was recorded on magnetic tape for subsequent reduction on an electronic digital computer.

After several months of computation and trial analyses, the data indicated a presence of radar echoes from the sun at a level of 40 to 50 db below noise after detection. Tests for probability of an echo being present indicate a chance for error of less than  $10^{-5}$ .

These first instances of radar contact with the sun provide little more scientific knowledge about the sun than the fact that it can reflect radio energy in detectable amounts. However, continuing radar studies of the sun should provide important new information on certain processes occurring in the solar corona, and their effect upon the earth. Work supported by Electronics Research Directorate of the Air Force Cambridge Research Center, under Contract AF 19(604)-2193.

(Continued on page 28)



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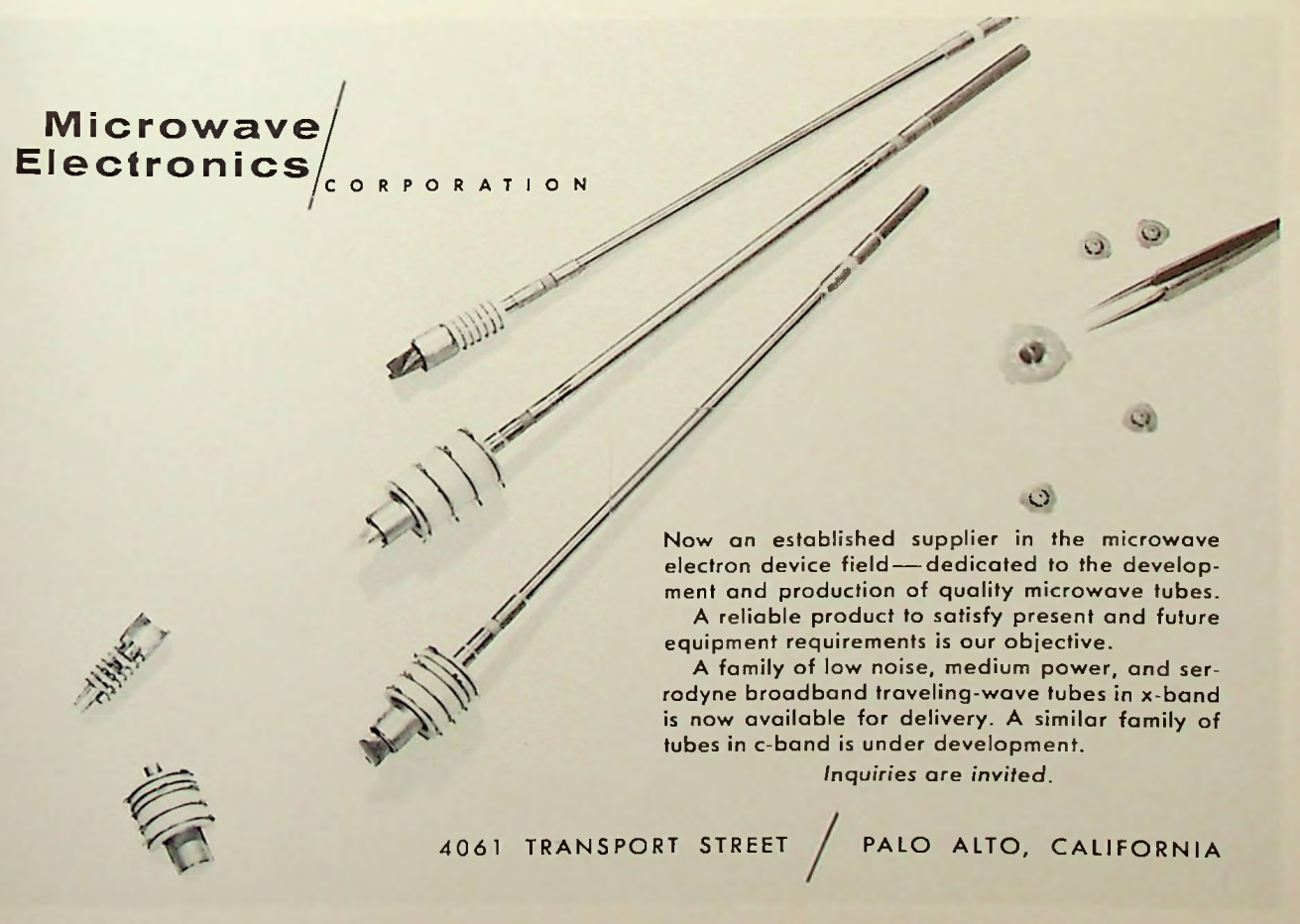
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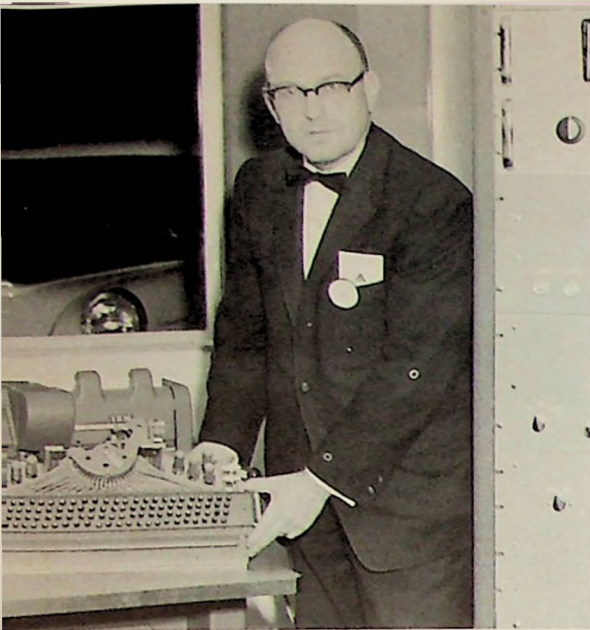
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At the April PGRQC meeting, Julian Hilman shows some of the equipment used in the automatic testing and recording of electrical parameters of transistors —John Hall photo

## MEETING REVIEW

### 100,000 Guinea Pigs

In April, Julian Hilman, manager of the reliability-evaluation division of Fairchild Semiconductor Corp., spoke to 70 members and guests of PGRQC on "Transistor Reliability" at the newest

### MORE TWINKLE

the position of the spiral arms, one of which includes our sun, making use of the doppler shift in the radio spectral line of hydrogen.

On April 20, Dr. Allen M. Peterson of Stanford University and the Stanford Research Center concluded the series with a talk on "Radar Astronomy." This new branch of radio astronomy makes use of man-made signals instead of depending on the radiation that nature has chosen to broadcast. With this added versatility and contro, it is hoped that we will be able to probe into previously inaccessible regions to make measurements that complement and extend those of passive optical and radio astronomy. Peterson outlined the recent successful radar detections of Venus and the sun to point out the requirements for future scientific investigations throughout the solar system. Very large transmitter power and large antennas will be required, since the echo strength varies inversely as the fourth power of range. Peterson, looking to future possibilities, suggests that the proposed two-mile linear acceleca-tor be connected to antennas so that radar astronomers can make use of the tens of megawatts of peak power produced by a thousand high-powered klystrons.

—Von R. Esleman

location of the company in Mountain View. The talk was preceded by a dinner at Hal's Restaurant, attended by 23 persons.

Mr. Hilman pointed out that in discussing transistor reliability we must consider four major factors:

A. Design—The design of a device inherently sets the ultimate reliability that can be achieved.

B. Fabrication—The procedures used in fabrication will determine, to a very large extent, how close the actual reliability of the device will come to the theoretical limit. Fabrication concerns itself with the materials, tools, and procedures of assembly, and the training programs for the personnel who perform these operations.

C. Screening Procedures—In man-made devices, and more particularly transistors, it is not expected that one will meet the theoretical reliability that has been designed into the device. It is desirable to have means of detecting those devices that are more likely to become unreliable.

D. Evaluation—We have now done all we can to make the device as reliable as possible. The question now is "How Reliable is it?"

The design and fabrication factors were reviewed with a step-by-step description of the production line, illustrated with slides. A brief discussion covered the screening procedures used. Most of the talk was concerned with the evaluation-program goals, procedures, and hardware.

Fairchild Semiconductor Corporation expects to have over 100,000 devices on life test simultaneously within 18 months at various conditions of temperature, voltage, power, and combinations thereof. The basic sample size for each test condition will be 100 units and selected conditions will contain larger quantities up to 22,000 units. The range of aging temperatures will be 25 to 300 C. The information obtained on this program will determine (a) if failure rates follow a random pattern (for the first 10,000 hours), (b) whether a correlation exists between accelerated aging and conservative aging (and what this factor is), (c) what are the mean life figures under various conditions of use and several end point limits, and (d) how successful the attempt has been to eliminate failure modes.

## MEETING REVIEW

### Simplicity Wins

The monthly meeting of the Professional Group on Electronic Computers was held in the LMSD auditorium at Palo Alto on April 26. Dr. Arthur W. Lo of IBM, Poughkeepsie, New York, spoke on "Parametric Phase-Locked Oscillators & Esaki Diodes as Switching Elements."

(Continued on page 30)

## MORE 7TH REGION PROGRAM

"GALACTIC AND EXTRAGALACTIC RESEARCH"  
A. E. Lilley, Harvard College Observatory

### SESSION VII

### CONTROL SYSTEMS III: NON-LINEAR & SAMPLED-DATA SYSTEMS

Wednesday, May 25  
1:30 P.M.

Chairman: R. E. Hanna  
Douglas Aircraft Co., Santa Monica, Calif.  
Co-chairman: E. Noges  
University of Washington

### NON-LINEAR EFFECTS IN SERVO CONTROL SYSTEMS

Richard B. Higly, North American Aviation, Inc.

This report covers a specific type of non-linear effect often the cause of much trouble in control systems. Backlash and stiction non-linearities are carefully examined in a multiple loop servo system with a servomotor and gear train as the trouble source. The linear analysis yielding a flat band about 100 cps wide is derived. The non-linearities are analyzed by the describing function method to show a low-frequency unstable point. A new simple but effective technique is used to show the existence of two other high-frequency unstable points, one that is extremely annoying.

This technique involves analyzing the combined stiction and backlash effects on a torque-versus-displacement-angle plot. Next, determine the minimum and maximum slope of the resulting hysteresis curve within the range of the torque input. These two slopes are "effective springs" in the load drive shaft. The open-loop transfer function is then re-examined, including this new "non-linear spring." The inclusion of these terms introduces the two or more unstable points. A linear compensation network is shown to relieve the trouble and yield a satisfactory solution to the problem. The output-motion boundary limits are derived; a simple technique is shown which will allow prediction of the closed-loop output performance at any output-signal level, and it includes the non-linearities.

### CONTROL OF HIGHER-ORDER SYSTEMS BASED ON TIME OPTIMAL REGULATION

Fred B. Smith, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

A general method for obtaining time-optimal regulation is presented. It is applicable in principle to systems of arbitrary order and is limited in practice by computer speed. On line solution of a set of transcendental algebraic equations is required. These equations are derived and a method for solution described. Measurements necessary for practical use of time optimal regulation are discussed and results of computer simulations of fourth and sixth order systems are presented. Computer requirements for real-time operation are discussed.

### AN ERROR MINIMIZATION TECHNIQUE FOR SAMPLED-DATA SYSTEMS

A. F. Engelbrecht and C. W. Steeg, Jr., RCA, Burlington, Mass.

The increased significance of sampled data in control systems has emphasized the desirability of transferring well known techniques for continuous systems into methods applicable to discrete systems, even though, historically, the opposite situation has been common. However, because one factor dominating the choice of error criterion is mathematical simplicity, the error criteria most frequently involved for continuous systems are not necessarily the most pertinent for discrete systems.

The general control problem, whether for systems describable by differential equations or for those describable by difference equations, in-

(Continued on page 30)

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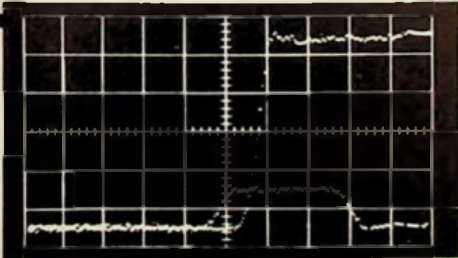
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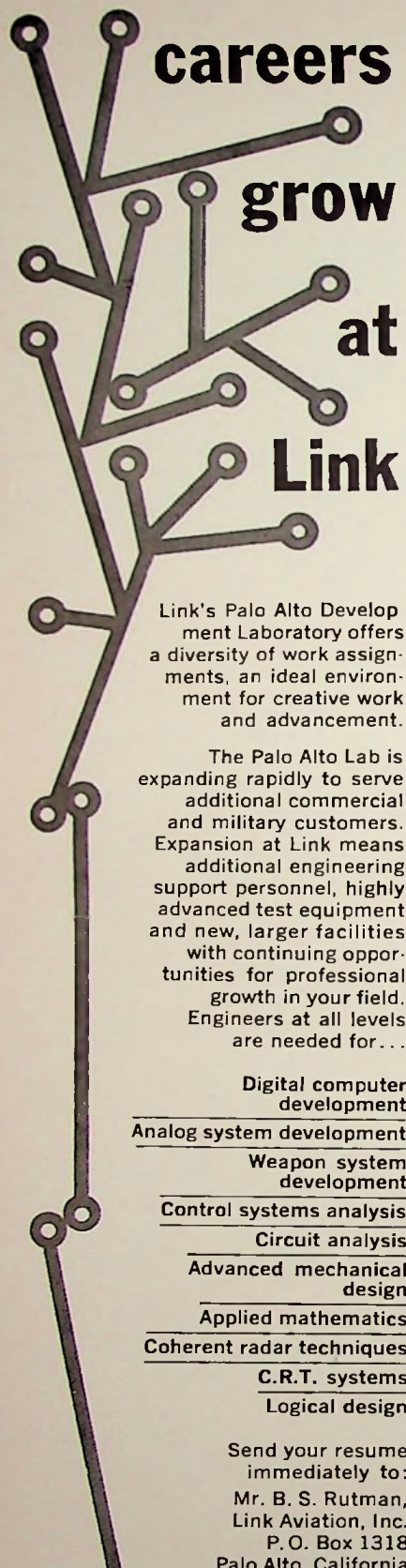
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## MORE PGEC

Lo gave an excellent review of the state of the art of phase-locked oscillators. Phase-locked oscillators are circuits that will oscillate at a frequency one-half the energizing or pump frequency and at a phase determined by the phase of the input signal. These circuits have been used in digital-computer applications where the phase of oscillations determines the digital state. The Parametron invented by Goto is an example of the phase-locked oscillator and used in several computers built in Japan. A three-phase pump-frequency source determines the directivity of the signals in these circuits. Some work is being done in this country using thin magnetic films as the non-linear inductive element of the oscillator. It is hoped that higher information rates can be achieved with thin films but the efficiency is very low.

Many more people are working with non-linear capacitors (voltage-controlled diodes) in the oscillators. Pump frequencies of 1 to 10 kmc are used to achieve high information rates. Lo stated that in principle this approach is beautiful but at these frequencies the microwave techniques are a big problem. To date there have been insufficient technical developments to determine if this is a good approach for computers.

The Esaki diode as a logic element has been very much in the limelight of recent. Lo gave a summary of the developments in the application of this diode to the computer field. There are three basic modes of operation: (1) bistable with a conditional reset or constant current, (2) self-resetting or constant voltage, and (3) twin diode.

The first mode requires the matching of all diodes in a system and some method of providing unidirectional coupling. The second mode also requires matching of all diodes. The third mode requires matching of diodes only in pairs. This circuit scheme seems to have the most promise. The twin-diode circuit was discussed at an earlier PGEC meeting this year by Goto. There is a direct similarity between the twin-diode circuit and the phase-locked oscillators. The digital information is represented not by the phase of oscillations but by the polarity of the voltage. There are circuits presently working with available diodes at speeds of 50 to 100 kmc.

Lo concluded the meeting on a philosophical discussion on what he called "his half-cooked ideas." He classified the available devices used for computers and listed three requirements that the devices should have: (1) provide signal standardization and gain, (2) provide directivity, and (3) perform logic. His closing remarks were on the selection of a device: do not pick the best device but rather the easiest to make.

—J. A. Boysen

## MORE 7TH REGION PROGRAM

valves change of the energy state of the system from an existing energy state to a desired final energy state. Commands must be so provided to the system to change the initial energy state to the desired terminal energy state in some optimal fashion. When the desired energy state is specified at a particular sampling time, the system described here reaches the terminal values with the minimum terminal error and with minimum energy expenditure. Details of the applicable error criterion and features of the resultant system are discussed in this paper.

### SESSION VIII

#### ELECTROMAGNETICS II: VERY-LARGE-APERTURE ANTENNAS

Wednesday, May 25  
 1:30 P.M.

Chairman: Allen S. Dunbar  
 Lockheed Missiles and Space Division

#### RADAR ASTRONOMY: A NEW TECHNIQUE FOR THE STUDY OF THE SOLAR SYSTEM

Ray L. Leadabrand and Rolf B. Dye, Stanford Research Institute, Menlo Park, California

Until recently man has studied the solar system by passive astronomy (optical and radio). The relatively recent advent of the rocket space probe has generated considerable public interest in the study of space. However, at the same time, another new method has been developing which is capable of studying space, but which is only now receiving some attention.

This new method of space exploration is called Radar Astronomy. Unlike passive astronomy it uses man-made transmissions of radio energy which are reflected, scattered, refracted, dispersed, rotated and absorbed by the interplanetary medium and the sun and planets. By receiving some of this energy, it is possible to conduct studies of interplanetary space and of the sun and the planets.

Based upon experience obtained in the study of echoes from the moon, Stanford Research Institute is currently constructing a 150-foot diameter parabolic reflector which is steerable in elevation and azimuth. Stanford University is simultaneously installing a transmitter which can be operated at any frequency in the 20-60 mc range at an average power level of 300 kw. A 400-mc transmitter with a peak power of 10 megawatts and an average power of 600 kw is also planned for use with the 150-foot radar telescope.

For future radar astronomy studies Stanford Research Institute and Stanford University are proposing the construction of an 800-foot diameter steerable Radar Telescope. This large step forward in antenna design is necessary for the study of distant solar system bodies.

It is interesting to note that since the first moon reflection—obtained in 1945—radar sensitivity has increased by a factor of  $2 \times 10^3$ —an amount sufficient to permit the detection of Venus in 1959.

#### THE DESIGN AND OPERATION OF A TWO-MILE- APERTURE ANTENNA

W. C. Erickson, Convair Scientific Research Laboratory

An antenna of two mile aperture has recently been placed in operation at a frequency of 26.3 Mc/sec (11.4m) at the Clark Lake radio astronomy station of the Convair Scientific Research Laboratory. This antenna possesses a total of 416 elements. The antenna combines the patterns of two arrays. One is a Christiansen type array of 256 half-wave folded dipoles. These are arranged in eight parallel, equally spaced, N-S lines. Each line of dipoles is 20 wavelengths long N-S, and the lines are separated at intervals of 40 wavelengths E-W. This array has a multiple beam pattern, and ambiguities arise in the analysis of records from it alone. Therefore, the interval between the central lines of dipole is filled by an E-W array 40 wavelengths long. This array can-

## MORE 7TH REGION PROGRAM

sists of 160 full-wave dipoles. It responds only to sources near the local meridian. By phase switching between these two arrays, one obtains a pattern consisting of a single beam  $\frac{1}{4}^\circ$  E-W and by  $15^\circ$  N-S.

Fabrication and testing techniques employed in the construction of this array will be discussed.

### ENVIRONMENTAL ANTENNA PATTERNS

James F. Carpenter, Dalmo Victor Company, Belmont, Calif.

Since the surrounding environment has an effect on the radiation characteristics of an antenna, it follows that an operational antenna may have noticeably different radiation characteristics than its free-space counterpart. This is due primarily to the scattering and propagation anomalies that cause a point source to appear as a time-varying extended source.

Using these concepts, an environmental pattern for an antenna is defined. The differences between the free-space pattern and the environmental pattern of an antenna are discussed in conjunction with environmental pattern prediction possibilities.

### THE OHIO UNIVERSITY 360-FOOT RADIO TELESCOPE

Robert T. Nash, Ohio State University

The radio telescope consists of a fixed standing parabola 360 ft. long by 70 ft. high with tiltable flat reflector of approximately the same dimensions. Celestial radio waves are deflected by the flat reflector into the parabola and thence to the prime focus point which is at ground level.

The antenna is a meridian transit instrument that was designed for use in radio astronomy. Observations may be made from within  $15^\circ$  deg. of the southern horizon to a direction  $25^\circ$  deg. north of the zenith. The antenna is vertically polarized, the two reflectors consisting of parallel wires with a 1 in. spacing which results in an upper frequency limit of about 2000 mc. According to model measurements at 420 mc the beam area will be one square degree.

### SPECIAL SESSION CONTROL SYSTEMS OPEN HOURS— UNIVERSITY OF WASHINGTON

Wednesday, May 25  
4:00 P.M.

University of Washington Campus  
Room 321, Electrical Engineering Hall

Chairman: R. N. Clark  
University of Washington

Faculty members of the Electrical Engineering Department will be on hand to discuss the undergraduate and graduate course offerings in automatic control subjects. Faculty and graduate student research projects and laboratory facilities will also be open for inspection. All conference attendees are cordially invited to attend.

### SESSION IX STUDENT PRIZE PAPER CONTEST IRE 7TH REGION FINALS

Wednesday, May 25  
8:00 P.M.

Chairman Floyd D. Robbins  
University of Washington

### SESSION X ENGINEERING MANAGEMENT SYM- POSIUM—TECHNICAL MANAGE- MENT OF LARGE SYSTEMS

(Continued on page 33)

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Part of the group that toured the new Fairchild plant during the April PGEM meeting

### MEETING REVIEW

#### Eat Later

The April 12 meeting of the San Francisco Chapter of the Professional Group on Engineering Management drew one hundred members and visitors to tour the facilities of the Fairchild Semiconductor Corporation's Mountain View plant and to hear about "Planning for an Expanding Operation" from the vice president and general manager, Dr. Robert Noyce, and from the manager of manufacturing engineering, Eugene Kleiner. The two are members of the original group of eight who founded the operation just two and a half years ago. Fairchild Semiconductor now has 1,390 employees and 98,000 sq ft of space, and has completed the layout of an additional 78,000 sq ft.

Noyce expressed his diffidence in addressing a group of managers about planning for expansion when the group, seated in the cafeteria, could observe a temporary partition that separates a portion of the cafeteria for the use of some overflow drafting boards. The PGEM group was impressed by Fairchild's ability to develop and market silicon transistors in such large numbers as to require the temporary sacrifice of some cafeteria space to keep up with demand, and listened with close attention to Noyce's explanation of the approach which has been so successful.

All research and development has been company-sponsored, because the company's objective is to develop prod-

ucts for sale at a profit rather than to sell development as such. This has the advantage, according Noyce, of flexibility in dropping unpromising lines of endeavor so that the basic resources of technical manpower are not wasted. Further, R&D people need not waste time in non-productive tasks such as writing reports, but can concentrate on achieving a high yield on the production lines.

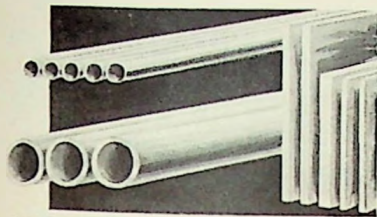
Silicon transistors were chosen as the semiconductor device to be produced initially because the market prospects for this device appeared bright in 1957; use of silicon transistors has been growing faster than that of any other semiconductor device, proving the accuracy of the early market research carried out by Tom Boy, marketing manager, and of the application and research people who worked with him in discovering the needs of potential customers before the first silicon transistor design was undertaken. The importance of the correct choice was pointed up by Noyce with the observation that, even though the market for transistors is doubling every year, there are enough existing and semiconductor facilities to satisfy substantially more than the market demand.

Noyce feels that a small concern of limited means may compete successfully with large and established concerns principally by better concentration of effort in a desired direction. Smallness and limitations of resources does im-

(Continued on page 34)

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## MORE 7TH REGION PROGRAM

Wednesday, May 25  
8:00 P.M.

Olympic Hotel, Georgian Room

Chairman: R. R. Kearton  
Assistant General Manager,  
Lockheed Missiles and Space Division  
Co-Chairman: L. C. Perkins, Chairman  
Seattle Section of the IRE

### Panelists:

Robert Bennett, Space Technology Laboratories,  
Los Angeles, California  
C. S. Perry, Douglas Aircraft Company, Santa  
Monica, California  
Oscar Simpson, Philco Western Development  
Laboratory, Palo Alto, California  
H. W. Withington, Boeing Airplane Company,  
Seattle, Washington

## SESSION XI CONTROL SYSTEMS IV: BIOLOGICAL CONTROL SYSTEMS

Thursday, May 26  
9:00 A.M.

Chairman: J. A. Stern  
Boeing Airplane Company  
Co-Chairman: P. E. Dittman  
Boeing Airplane Company

THE DESIGN OF MAN-MACHINE SYSTEMS BY  
MEANS OF QUANTITATIVE ANALYSIS TECH-  
NIQUES OF HUMAN FACTORS ENGINEERING  
O Herbert Lindquist, Minneapolis-Honeywell  
Aeronautical Division

Several recent systems studies have included human factors engineering analyses. This has resulted in the development of quantitative criteria that can be used to design and specify equipment related to man and to specify automatic requirements. Honeywell has conducted such studies on the Mercury, Dynasoar, Astra and X-15 programs. The analysis technique includes study of both the normal and emergency modes. Reliability data is integrated into the analysis. Pilot work load and performance are predicted using experimental techniques. Use has been made of the human transfer function, information theory and computer simulations.

## RELAXATION AND TRANSIT-TIME OSCILLATIONS IN THE HEART

J. W. Woodbury, University of Washington

Rhythmic contractions of the heart are initiated and terminated by simultaneous periodic variations in the electric potential difference across the boundary (membrane) of each heart cell. Contraction is initiated by a rapid change (depolarization) of the transmembrane potential from about -80 mv (inside negative) to 20 mv.

Relaxation begins 0.4 sec later following repolarization. Depolarization spreads over the heart as a wave with constant amplitude and speed. The fixed size of the depolarization wave results from the properties of the cell membrane, a non-linear resistor shunted by a fixed capacitor.

This is because the ease with which sodium ions penetrate the membrane depends on the voltage across it. For certain voltages, membrane resistance is negative and the voltage switches to a new level in much the same manner as a monostable multivibrator. However, in the sino-atrial nodal region, there are no stable states and sustained oscillations occur. The beat originates here and spreads over the heart.

In contrast to these normal relaxation oscillations, abnormal oscillations called fibrillation may occur. Fibrillation consists of waves of depolarization-repolarization circulating around the ventricular cavity. The requirement for such oscillations is that the length of the wave be less than the effective circumference of the heart.

(Continued on page 35)

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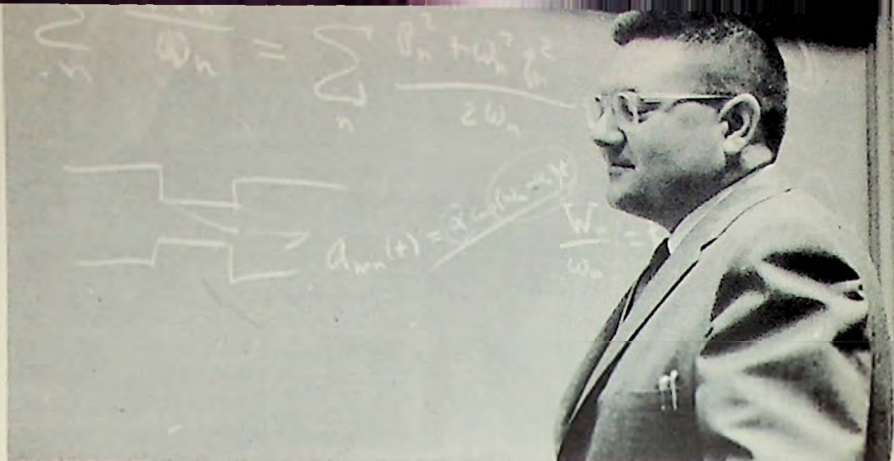
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pose a limitation in the amount of research which the company can carry out on its own funds. Long-range research must be deferred until the profit from production can support research. A company can look forward in time about as far as it can look back upon successful operations, according to Noyce. He drew an analogy between investing dollars in blue chip versus speculative stocks and investing research in blue chip versus speculative ventures. The importance of direct contact between research people and customers is that the research people become alert to the customers' needs. At least two major developments of Fairchild would have been overlooked, according to Noyce, had the research people not been so alerted.

Eugene Kleiner discussed the problems of providing the multitude of gases and liquids required at every point of a semiconductor plant, along with the 375 tons of air conditioning for the present 68,000 sq ft of floor space and the 1200 kva of power required to operate the furnaces and production machinery and provide 70 foot-candles of light for three shifts of workers. The seven assembly lines are independent of the furnaces, with all lines being fed



In April, PGMTT heard Professor E. T. Jaynes on maser theory

—David Haylock photo

dice from a central point. Additional stages of diffusion or other furnace changes can be made without altering the assembly lines. When the assembly lines are changed, it usually is not due to changes in the design of the semiconductor device but rather to improvements in machines which result in increasing the production rate.

—C. F. Meyer

## MEETING REVIEW

### Masers in Classical and Quantum Theory

The April 19 meeting of the PGMTT was held in the Physics Lecture Hall at

Stanford University. Professor E. T. Jaynes discussed the significance of a profound theoretical connection which exists between masers and classical parametric amplifiers. This connection suggests a more general approach to problems in quantum electro-magnetic theory by way of classical analogies.

The wave function of an atom can be expanded in terms of the energy eigenfunctions of the atom. Each coefficient of this expansion is related to the probability of finding the atom in the corresponding energy state. These coefficients obey differential equations derivable from Schrodinger's equation, and these equations may include terms due to perturbing external forces, such as time-varying electric fields. By a simple transformation of variables these differential equations can be shown to be formally identical with the classical equations of motion of a system of mutually coupled harmonic oscillators. The quantity corresponding to the Hamiltonian function of the classical system is the expected value of the energy of the atom. The terms representing time-varying perturbations of the atom by external fields correspond to time-varying force constants and coupling coefficients in the classical analogy.

For example, consider the transition of the atom from one energy state to another induced by an external field varying at the frequency corresponding to the difference between the two energy levels. This corresponds in the classical analogy to the conversion of energy from one to another of two harmonic oscillators by varying a parameter coupling the two oscillators at a frequency equal to the difference of their natural frequencies. Thus any scheme for making a maser involving induced transitions between the energy levels of a system of atoms or molecules is formally equivalent to a type of parametric amplifier. The converse, incidentally, is not true—not all parametric

(Continued on page 36)

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### THE NON-UNIFORM TWO-DIMENSIONAL SPREAD OF LOCAL CIRCUIT CURRENTS IN THE RAT ATRIUM

W. E. Grill and J. W. Woodbury, University of Washington

Rat auricular appendages were simultaneously impaled with two microelectrodes. Constant currents (1<sub>0</sub>) were applied through one electrode and, at various radial distances and angles, changes in potential (ΔV) across the membrane were measured with the other electrode. Equivalency ΔV/I<sub>0</sub> contours are irregular ellipses with the major axis in the same direction as the muscle fibers. ΔV/I<sub>0</sub> falls to 1/e in 100 microns in the fiber direction and in 70 microns perpendicular to the fibers. Based on electron micrographic measurements of fiber and interspace sizes, the 1/e distance parallel to the fibers should be about 100 micra assuming that membrane resistance and capacitance are the same as in other tissues. These results indicate that current flow from an active cell is sufficient to initiate activity in adjacent cells and thus spread the wave of depolarization over the atrium.

### SESSION XII ELECTROMAGNETICS III: ARCTIC IONOSPHERE PHENOMENA

Thursday, May 26  
9:00 A.M.

Chairman: H. Myron Swarm  
University of Washington

DISTRIBUTION OF AURORAL RADAR  
DISTURBANCES IN ALASKA DURING THE IGY  
Robert S. Leonard, Geophysical Institute, College, Alaska

A preliminary analysis of IGY Auroral Radar records taken by the Alaskan chain of radars which span the auroral zone, shows the distribution of echoing activity as a function of time of day, season, and latitude. By comparing the range distributions of each station with the angle the radar ray makes with the magnetic field at the aurora, we can verify the aspect sensitivity of the auroral echoes. The distribution of echoing activity as a function of latitude considering all the Alaskan stations shows a very striking auroral zone that is in good agreement with the one determined from visual observations. Utilizing these distributions of echo occurrences one can determine the possibility of utilizing this type of ionization for communication purposes. This work was sponsored by the National Science Foundation.

### SWEEP-FREQUENCY BACKSCATTER STUDIES IN THE AURORAL ZONE

Howard F. Bates, Geophysical Institute, College, Alaska

Oblique sweep-frequency backscatter soundings of the auroral zone ionosphere show a prevalence of direct scatter echoes from field-aligned irregularities in the F region. The two most common echoes have been identified respectively as weak backscatter from random collections or irregularities distributed over a large region of the ionosphere and strong backscatter from isolated patches of irregularities.

The first type of backscatter echo shows the range-frequency variation expected for a least-time focused mode. It is primarily a nighttime phenomenon, although it is occasionally observed during the day in disturbed periods. Using this echo, we have estimated that the heights of the irregularities are between 250 and 400 km.

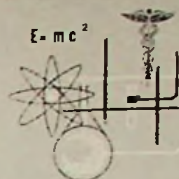
The second type of echo has essentially a constant range over the observed frequency interval. It has been recorded mainly during winter days. The strong scatter echo apparently arises from that portion of the F region that is illuminated by solar radiation but is north of ground sunrise. This research was supported by the Elec-

(Continued on page 37)

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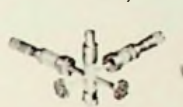
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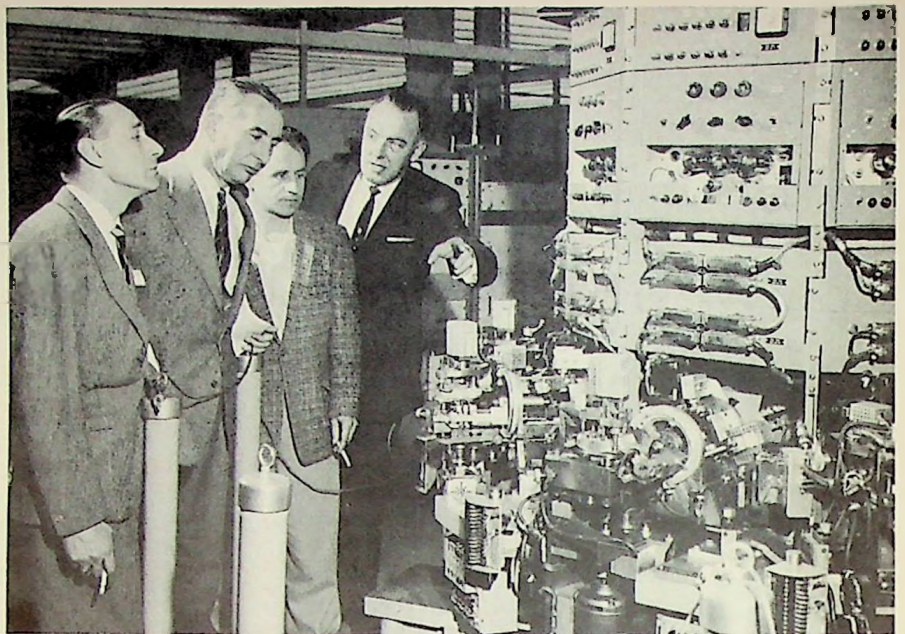
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*Touring the San Carlos, Calif., plant of Lenkurt Electric Company recently were chief engineer Alberto Turco (second from left) and engineer Alberto Bruno (left) of Societa Esercizi Telefonici, the telephone operating company serving southern Italy. Among processes viewed was Lenkurt's "Carousel" automatic toroidal winding system, here being explained by manufacturing manager George Ewing (right) with the linguistic aid of assistant engineer Igino Vellandi of Lenkurt's military engineering group.*

## GRID SWINGS

### It Is Reported:

Confirmation of exhibit space contracts for 987 booths at the 1960 WESCON went into the mail this week, Don Larson, manager, announced. The Western Electronic Show and Conven-

tion, to be held August 23-26 in Los Angeles' new Memorial Sports Arena, was again an advance sellout nearly five months before the event.

At a recent quarterly meeting of the board of directors of Microwave Electronics Corp., Palo Alto, Robert O. Deh-

*(Continued on page 38)*

## MORE MASERS

amplifier schemes have maser analogues.

From our present perspective it appears that the history of quantum mechanics might have been different had the early workers in this field been clearly aware of the principles governing the parametric excitation of oscillators. The Ritz Combination Principle of spectroscopy, according to which the frequencies of spectral lines can be expressed as differences between a relatively small number of terms, remained a mystery for many years because it seemed impossible to account for it in terms of the picture of oscillating electrons coupled directly to the electromagnetic field. Once it is understood that the coupling is parametric rather than direct, the Ritz Principle is easily accounted for.

As another example of the way in which seemingly diverse concepts are unified by this approach, the Manley-Rowe relations among the energies associated with various frequencies in a parametrically excited system of oscil-

lators can be shown to be closely related on the one hand to some classical theorems on the conservation of action in mechanical systems, and, on the other hand, to the principle in quantum mechanics that the sum of the probabilities of all possible energy values of a system must equal unity.

A more complete and rigorous treatment of the interaction between an atom and an electromagnetic field includes the effect of the atom on the field as well as that of the field on the atom described above. This problem can also be discussed by the method of classical analogy. The result shows clearly why only the ground state of an atom is stable, the higher energy states being metastable in the sense that any small perturbation causes a transition to a lower energy state with emission of radiation at the difference frequency. Details of the analysis of this example and those discussed earlier will be found in Professor Jaynes' recently published paper on this topic in Proceedings of the Symposium on Quantum Electronics.

—E. F. Barnett

## MORE 7TH REGION PROGRAM

ronics Research Directorate, Air Force Cambridge Research Center.

### HIGH-FREQUENCY STUDIES OF THE ARCTIC IONOSPHERE

R. D. Hunsucker and Leif Owren, Geophysical Institute, College, Alaska

High-frequency radars are used to study the regular and irregular features of the high latitude ionosphere as well as radio aurora. Continuous groundscatter observations on 12, 18, 24, and 30 mc show the ability of the ionospheric layers to sustain propagation as a function of time of day, season, frequency, and geomagnetic activity. Transpolar hf-transmission conditions and propagation modes are inferred from combined backscatter soundings at College, Alaska, and reception of the same pulse signals at Scandinavian stations. The observations indicate that a high

reliability may be expected for properly designed transpolar h-f communication circuits.

The high-latitude ionosphere characteristically has much irregular structure as evidenced by frequently observed direct backscatter from the E and F layers.

Backscatter from auroral E layer ionization has been studied in detail on 12 mc. The radar echoes depend on the aspect angle even at this frequency and there exists a circular cone of no-echo return with axis parallel to the magnetic field lines and an average half-angle of 65 degrees. Thus the auroral ionization seen by the h-f radars appears to be field-aligned. Determination of the actual aspect angle requires that E layer refraction be estimated from the simultaneous vertical incidence soundings. Under favorable circumstances the size of the scattering irregularities can also be deduced. This research was supported by the Electronics Research Directorate, Air Force Cambridge Research Center.

### A HIGH-ALTITUDE STUDY OF SPREAD F ECHOES

Z. A. Ansari and Leif Owren, Geophysical Institute, College, Alaska

The nature of spread F echoes was investigated from ionograms obtained at College, Alaska, during a 14-month period. The data have been compared with radio-star scintillation observations and oblique backscatter soundings. The usual practice of indexing the spread F by visual inspection was abandoned in favor of a quantitative measure based on the actual amount of spread in mc observed on the ionograms.

Marked diurnal and seasonal trends are apparent in the spread F Index. The diurnal curve has a minimum near noon and peaks near midnight. Sudden daytime increases in geomagnetic activity are accompanied by an increase in spread F. The seasonal trend is characterized by a gradual transition from a minimum of spread F activity in July to a maximum in December.

No consistent correlation could be established between radio star scintillations and spread F activity. A marked correlation was found between spread F and the frequency of occurrence of retardation type sporadic E but not for any other type of Es. Spread F also correlates well with the frequency of occurrence of oblique direct backscatter from F region irregularities.

These results indicate one of three possible mechanisms as being the most likely cause of spread F in high latitudes. This research was supported by the Electronics Research Directorate, Air Force Cambridge Research Center.

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


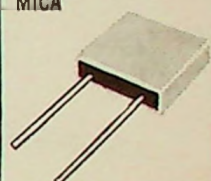


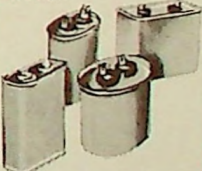
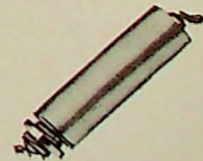
### SESSION XIII SOLID-STATE ELECTRONICS III: MAGNETICS & DIELECTRICS

Thursday, May 26  
1:30 P.M.

Chairman: John L. Bjorkstam  
University of Washington

FERROELECTRIC POWER CONVERTERS  
S. R. Hoh, ITT Laboratories, Nutley, N. J.

(Continued on page 38)

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HERMAN E. HELD  
District Manager

## MORE SWINGS

lendorf II was elected treasurer of the corporation. Dehlendorf is business manager of the firm, an operational position he will retain. Microwave Electronics currently employs 40 persons.

**Dave Young**, who has his BS in electrical engineering from Michigan State University, has been appointed staff engineer in charge of the **Neely Enterprises** mobile laboratory.

A new electronics firm known as **Wiltron Company** has been organized in Palo Alto, for the engineering, development, and production of new instruments for video-pulse testing and microwave-test applications. Founders of the company are **William Jarvis, Dr. Peter Lacy**, and **Duane Dunwoodie**, all graduate engineers from Stanford University and all former employees of the Hewlett-Packard Co. laboratory.

Jarvis is president, Lacy vice president and director of engineering, and Dunwoodie director of new product development. Jarvis received his BS degree from the U. S. Naval Academy at Annapolis and an MBA from Stanford Graduate School of Business. He did other college work at the University of Oklahoma, the University of California, and for the last 6 months engaged in graduate studies in electronics engineering at Stanford. Lacy received his BSEE degree from Florida University and following graduation served for a short time as instructor there; his MS and PhD degrees are from Stanford University where he did research in microwave noise in electron beams. He served for a year as consultant to Varian Associates. Dunwoodie received

*(Continued on page 40)*



*Dr. Peter Lacy, William Jarvis,  
and Duane Dunwoodie*

## MORE 7TH REGION PROGRAM

Ferroelectric converters are new solid-state devices which are capable of converting thermal energy directly into electrical energy. The converters are based on the phenomenon that the high field permittivity  $k$  of certain ferroelectrics decreases rapidly above the Curie point. A ferroelectric capacitor charged near its Curie temperature accepts a charge  $Q = V_1 C_1$ . Heating of this charged capacitor results in a voltage ratio which is inversely proportional to the capacitance or permittivity ratio:  $V_2/V_1 = C_1/C_2 = k_1/k_2$ , as long as  $Q = V_1 C_1 = V_2 C_2 = \text{constant}$ . Thus, heating the capacitor, causes its charge  $Q$  to rise to a higher potential. This means that the electrical energy  $W$  of the capacitor is increased in proportion to its voltage because  $W = \frac{1}{2} QV$ . The electrical energy gained is converted from thermal energy.

Practical converter circuits use several capacitors which feed into a load through diodes. Since temperature cycling is required, alternating currents can easily be obtained. Also, output voltages of thousands of volts can be generated conveniently. Cascading of converter stages should result in output voltages of several hundred thousand volts. These unique characteristics make the new energy converter particularly useful for certain applications. Conversion efficiency and output per unit weight which appear competitive will be discussed in some detail. Also, experimental results will be presented.

### NEW MAGNETIC DEVICES FOR DIGITAL COMPUTERS

Duncan H. Looney, Bell Telephone Laboratories, Murray Hill, New Jersey

Several new structures have been developed to extend the use of magnetic storage elements. Ferrite sheets, twistors, and three-hole cores have been evaluated in all solid state systems with capacities of over 50,000 bits. The ferrite sheet and the twistor are comparable to memory cores in speed of operation but are significantly lower in cost. The twistor and the three-hole core are less sensitive to temperature variations and hence offer improved reliability. The three-hole core can be operated in memory stores at much faster switching speeds than the simple toroid. In addition to the above structures, thin evaporated films of magnetic metals have been tested in small stores at very short cycle times. The film may be switched in times of a few millimicroseconds.

Several devices have been suggested for the storage of semipermanent information such as the program of the computer. The transfluxor and the biax are complex ferrite elements which can be used in electrically changeable memories. The twistor is used to sense patterns of small permanent magnets on plastic cards. The semipermanent memory elements do not utilize the magnetic material simultaneously for storage and selection. Consequently, the elements can operate over an extended temperature range and can be interrogated in a time of the order of one microsecond.

Several magnetic components have been proposed for logic devices. Computers using the parametric principle have been made with ferrite components for both the memory and logic elements. Parametrons with increased speed capability have been tested using evaporated thin films. In addition, the biax, laddic, and transfluxor have been suggested as logic elements.

### EXCHANGE EFFECTS IN ELECTRON PARAMAGNETIC RESONANCE

Lajos Rimai, Raytheon Co., Waltham, Mass.

Usually the strongest coupling mechanism between transition element ions in insulating crystals is the exchange interaction. In materials where the magnetic ion concentration is high this interaction commonly causes magnetic ordering, and, at sufficiently low temperatures, the crystal becomes antiferromagnetic. Above the ordering

*(Continued on page 39)*

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## MORE 7TH REGION PROGRAM

temperature, or in magnetically dilute crystals one has a paramagnetic whose resonance spectrum will show the effects of the exchange coupling.

In the concentrated samples, due to the dipolar interaction, one expects broad paramagnetic resonance lines. The exchange coupling may cause a marked reduction in the width of these lines and thus by a careful study of the shapes information on the exchange forces may be obtained. Such information is, however, quite crude, yielding only a value for an average exchange constant.

By investigating the dilute crystals one may do much better. When we deal with magnetic ion concentrations in the range of a few per cent, there is a small but finite probability of having ions paired in neighboring lattice sites. The EPR spectrum of such a pair will usually be very different from the spectrum of an isolated ion and its study will give information on the exchange interaction for this well-defined pair. In addition, one may observe the spectrum of many inequivalent pairs of ions.

### MASER OPERATION AT INFRARED AND OPTICAL FREQUENCIES

L. C. Levitt, Hughes Research Laboratories, Culver City, Calif.

Search for means of extending the upper frequency limits of production and amplification of "monochromatic" electromagnetic waves has been one of the continuing efforts of electronic research and development. It appears that the principle of the maser, utilizing now optical pumping or electron bombardment as excitation means, should permit production of coherent oscillation at wavelengths extending into the region of visible light, or perhaps even the near ultraviolet. Within the past two years, efforts aimed at achieving this have been commenced at several laboratories. It is the purpose of this exposition to point out the principles underlying these efforts, to examine some of the difficulties to be overcome, and to indicate some interesting areas of potential applications for such devices.

The basic principles of maser operation will be reviewed, and discussed from the standpoint of operation at optical frequencies, using a convenient three-level model. The necessary pumping power for maser action will be expressed in terms of the characteristics of the maser material. Means of minimizing the required light flux by use of sensitized fluorescence, the "optical funnel" effect, electron bombardment, and pulsed excitation, will be pointed out. The design of a suitable multi-mode resonant cavity will be illustrated by the Fabry-Perot interferometer proposed by Schawlow and Townes. Possible means of detection of this radiation will be mentioned, and an effort to achieve an "optical mixer" will be motivated.

Finally, some likely scientific and systems applications will be enumerated and discussed.

### SESSION XIV

#### ELECTROMAGNETICS IV: TERRESTRIAL ELECTROMAGNETIC EFFECTS

Thursday, May 26  
1:30 P.M.

Chairman: *Fredrick W. Brown*  
National Bureau of Standards,  
Boulder Laboratories  
Co-Chairman: *Lloyd B. Craine*  
Washington State University

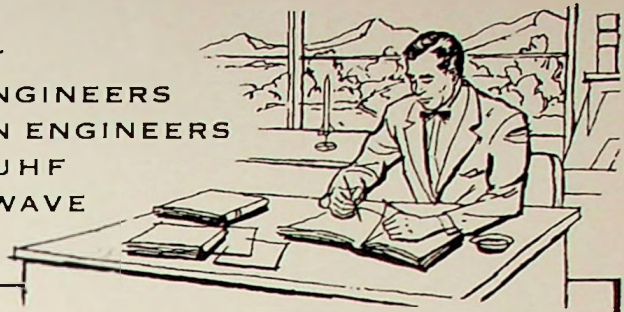
#### TERRESTRIAL PROPAGATION OF VLF AND ELF RADIO WAVES

James R. Wait, National Bureau of Standards,  
Boulder, Colorado

The concept that radio waves are guided between the earth and the ionosphere as in a waveguide has proved very useful for very low frequencies (3 to 30 kc) and extremely low fre-

(Continued on page 41)

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## MAN-MACHINE SYSTEMS



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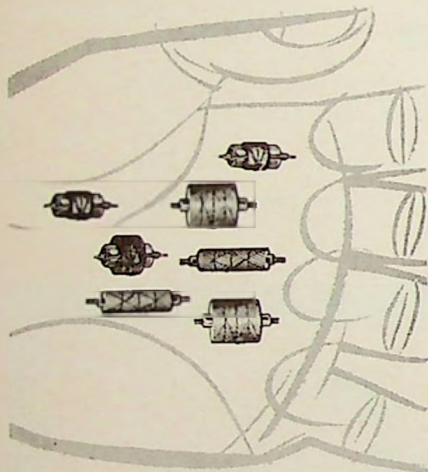
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### MORE SWINGS

his BSEE degree at Kansas University and his MS degree at Stanford. He is now completing work at Stanford for an advanced degree.

In the instrument division at Beckman & Whitley, Inc., San Carlos, Robert D. Shoberg becomes manager of camera products, having formerly been manager of the Fastax division of Wollensak Optical Company and sales manager of the Fairchild Data Devices Company.



Shoberg

Hunter

Three new vice presidents have been appointed at Varian Associates: Paul B. Hunter, Dr. Theodore Moreno, and Dr. Emery H. Rogers.



Moreno

Rogers

Hunter, who has been patent director, assumes a newly created post. Moreno, who was formerly manager of research and development in the tube division, succeeds Howard R. Patterson who is now group vice president for instruments and equipment. Rogers, who formerly served as manager of field engineering for the instrument division, now fills the post formerly held by Ralph Kane who is now vice president and manager of foreign operations.

Other appointments at Varian include the following: Donald Griffin becomes supervisor of engineering design in the instrument division; Henry Kaider is manager of quality control in the radiation division; Jerry McNeal becomes manager of manufacturing engineering in the radiation division; Dr. Richard B. Nelson is named manager of tube division research and development; James Pruett has been made factory engineering supervisor for process control in the Palo Alto tube division;

(Continued on page 42)

## Designer for Meteorological Electronics

Current expansion in our meteorological systems group has created an unlimited opportunity in this expanding field.

Within the next month we shall add to the staff an ambitious individual with a BSEE or equivalent. His activities will include the design of special amplifiers, power supplies, and transistor circuitry for pulse and digital applications.

His experience will include two to four years of electronic circuit design with transistors, servos, digital systems, and/or telemetry.

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Gordon Wheeling, personnel mgr.,

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### OPINION

#### Education

Speaking at the opening of the Hawaii Space and Jet Age Week back in March, Herschel J. Brown, Lockheed vice president and missiles and space division general manager, touched on the technological revolution being brought about by developments in the missile/space age. He suggested that there would be a tremendous expansion of knowledge and skills and that these would be fundamentally the fruits of improved educational systems.

To illustrate this trend he told a story about Cape Canaveral. The second graders of a school near the launching area were watching a missile countdown from the school yard at recess.

"They're opening the theodolite tracking dome," one said. "That's five minutes 'til launch."

"Yes, and they're using a stroboscopic beacon this time, so it must be a gyro test," the other said.

"Look, the lox has stopped venting," the first one said, "so they're at T minus 30 seconds." And then, using his Mickey Mouse watch, ". . . 15 . . . 10 . . . 5-4-3-2-1," and sure enough, the missile took off with a roar.

Just then the bell rang and one of them said, "Well, let's go back into the classroom and string some more of those damned beads."

## MORE 7TH REGION PROGRAM

quencies (3 kc down to 1.0 cps). The connection between this mode theory and the more conventional ray or hop theory is derived using only elementary reasoning. The mode approach is particularly convenient at the lower end of the vlf band and the whole of the elf band since only a few modes are required to represent the field.

However, towards the upper end of the vlf range the mode sum becomes cumbersome and a ray representation is desirable. In this latter case, however, wave corrections must be made in the vicinity of caustics of the ray systems. The influence of the earth's magnetic field and stratification in the ionosphere is also discussed.

Finally, experimental data at vlf and elf both in the form of C-W signal vs. distance curves and waveforms of atmospheric are reviewed briefly. It is indicated that while many observed characteristics of the experimental results are consistent with the theoretical models proposed, many factors are not yet understood.

### WHISTLERS AND RELATED PHENOMENA

R. A. Helliwell, Stanford University

Whistlers and vlf emissions recorded by the Denstation IGY whistler-west network are described and classified. Whistlers are interpreted in terms of a theory of propagation based on columns or shells of enhanced ionization aligned with the earth's magnetic field. Electron distribution out to five earth radii is determined. The traveling-wave theory of the origin of vlf emissions is extended to explain the association of whistlers and vlf emissions, known as "interactions." A new ground-based experiment is proposed in which a sweep-frequency vlf transmitter would be used to accelerate electrons or ions and modify their distributions in the outer ionosphere. Work is supported in part by the Air Force Office of Scientific Research under Contract AF18(603)-126 and the National Science Foundation under Contract NSF G-8839.

### EFFECTS OF TERRESTRIAL ELECTROMAGNETIC DISTURBANCES ON WIRELINE COMMUNICATIONS

R. Sanders, Hughes Aircraft Co.

Effects of natural electromagnetic phenomena on wireline circuits are discussed. An important factor causing degradation of system operation or damage to equipment is the occurrence of earth currents associated with electromagnetic storms. Three to six earth-current storms occur yearly, during and after the maximum of the sunspot cycle.

Peak disturbances last 10 to 30 minutes and return to normal within 6 to 48 hours. Typical disturbances are 3 to 20 volts/km in the auroral zones; 0.5 to 5.0 volts/km in middle latitudes, and less than 100 mv/km near the equator. Current flow is generally N-S, except near the geomagnetic equator where it is E-W.

Undisturbed diurnal variations exhibit the same general characteristics, but attain values in the range of 5 to 200 mv/km. Cases are cited of adverse effects on commercial circuits; open wire, buried cable, and submarine cable systems are compared.

### FADING OF RADIO WAVES VERTICALLY INCIDENT UPON THE IONOSPHERE

D. H. Schrader and H. M. Swarm, University of Washington

This paper describes a study of the variation of the amplitude of radio waves that were reflected from the ionospheric E-layer at vertical incidence. One-minute-long records of the detected amplitude of these waves were statistically and harmonically analyzed to determine the characteristics of the scattering process that causes fading.

The radio waves studied were generated by a National Bureau of Standards C-2 ionospheric recorder and were received by specially constructed auxiliary equipment. Frequency functions for the

(Continued on page 43)

# NEW

## RADIO INTERFERENCE — FIELD INTENSITY MEASURING EQUIPMENT, 375 mc to 1000 mc



The NEW NM-52A RI-FI instrument developed by STODDART to government specifications is now ready for immediate delivery.

Its purpose is to investigate, analyze, monitor and measure to the highest practical degree conducted or radiated electromagnetic energy to military specifications within the frequency range of 375 mc to 1000 mc. In addition, the NM-52A is valuable as a highly sensitive frequency-selective voltmeter and receiver for numerous laboratory and field applications.

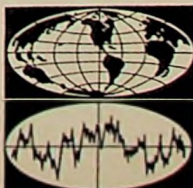
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Electronic Systems Division



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Nelson



Rivera

**MORE SWINGS**

Michael Rivera becomes manager of systems design and development in the vacuum-products division; Renn Zaphiropoulos has been made manager of



Zaphiropoulos



Zitelli

components design and development in the vacuum-products division; and Dr. Louis Zitelli has been named manager of klystron development in the Palo Alto tube division.

Varian and Semicon Associates, Inc. have jointly announced that Varian will acquire 100 per cent ownership of Semicon through an exchange of common stock. Semicon was founded in 1953 by Dr. Otto G. Koppius. It consists of two operations, Semicon of Kentucky, located at Lexington, Ky., and Semicon of California, located at Watsonville. It will become a part of Varian's recently formed microwave tube group. Koppius will continue as head of Semicon Associates.



Dr. Koppius and Mr. Patterson during preliminary negotiations

The Weston Instruments Division of Daystrom, Incorporated has moved from its San Francisco location to larger quarters at 1125 Marshall Street, Red-

wood City, Calif. Herman E. Held, long active in local IRE circles and a former member of the Section Publications Board, is district manager.

Levinthal Electronic Products, Inc., a subsidiary of Radiation Incorporated, Melbourne, Florida, has received an \$800,000 contract from Page Communications Engineers for design and production of four tropospheric scatter radio power amplifiers.

The amplifiers are to be installed in England and Spain on a radio communications link covering over 500 miles—the longest link of this type. Page will install this equipment as part of a communications complex extending from Morocco to the United Kingdom, under contract to the U. S. Air Force.

Harold Cooperman has been named manager of customer service; Walter R. Lamb, developmental physicist; and Robert E. Lorenzini, research engineer at Rheem Semiconductor Corporation, Mountain View.



Hopner

Emil Hopner has been promoted to the rank of senior engineer at the IBM Corporation plant at San Jose. Hopner heads the data-transmission project whose primary objective is to evolve economic and reliable communications links between computers and from remote input stations to computers.

Charles Elkind has joined the corporation as technical information manager for the technical center at San Jose. In this assignment, Elkind is serving as information liaison between the research, advanced systems development division and general products division development laboratories and the technical and daily press. He also will be engaged in the public relations phases of technical symposium and professional-society activities.

Richard A. Strassner Co. announces the moving of their branch office to expanded facilities at 126 Third Street, Los Altos. Merrill (Tod) Holt, branch manager, and Philip Halinger, sales-engineer, are now both working out of the new facilities.



New Cerruti building

Cerruti and Associates, electronic engineering representatives, announced that they have moved to larger quarters at 116 Cypress Street, Redwood City. The new building, which is owned by Cerruti and Associates, is on a 5,000-sq-ft site.

### NEIGHBORING SECTION News of Hawaii

Radio communications with submarines was the scheduled topic for the April Hawaii Section meeting. Concerned primarily with vlf transmitting equipment and submarine receivers, the presentation was by Harold A. Wheeler, president of Wheeler Laboratories, Great Neck, Long Island, N. Y., whose organization has been doing extensive development work in this field, primarily for the U. S. Navy.

Also, the Hawaii Section has announced the selection of the Science Fair student winner and alternate who will represent them at WESCON this year. They are Steve Walther and Ed Morgan of Punahou. Walther's exhibit is entitled "Seeing with Sound" and utilizes audio pulses instead of r-f to display surrounding objects in a ppi presentation.

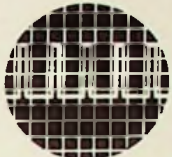
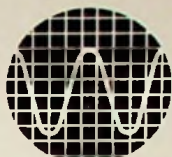
In the event that he cannot make the trip, the alternate, Morgan, will show an experiment titled "Theory, Design, and Construction of a 300,000-Volt Accelerator and Experiments with Cells."

### MORE 7TH REGION PROGRAM

detected amplitude of the signal were constructed and compared with the probability density curves predicted by the generally accepted theory describing the scattering process. Power spectral density curves were computed from the data to determine the frequency distribution of the power in the fading process. A statistical test of the maximum value of the power spectral density curve for each record was performed. Under the hypothesis of many scattering centers in the ionosphere, a value of power spectral density was computed such that the maximum value of the curve would exceed this value with low probability.

On the basis of this test it is concluded that the ionosphere did not contain many scattering centers during the test periods. The frequency functions did not show a striking disagreement with theoretical probability density curves.

— END —



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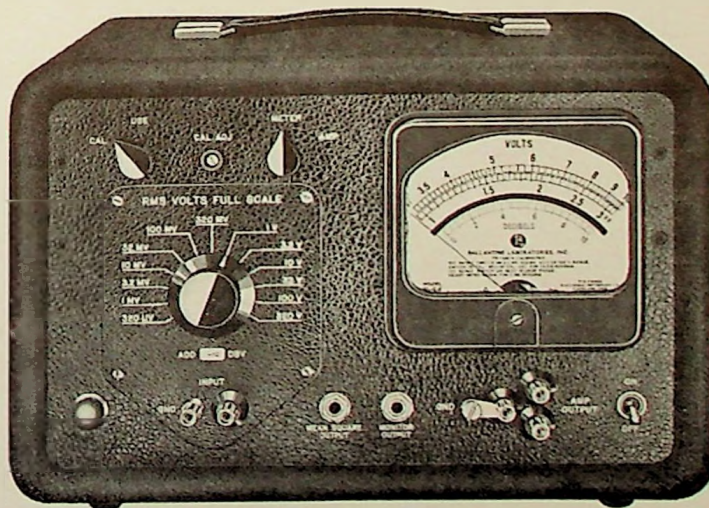
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## EVENTS OF INTEREST

### Meetings Summary

May 17—**Women's Association of the Electronic Industry**, Philco Western Development Laboratory, Palo Alto. (Dinner meeting, followed by plant tour.)

May 23-25 — **National Telemetering Conference**, Miramar Hotel, Santa Monica, Calif.

May 24-26—**14th Annual Convention and Exhibition of the American Society for Quality Control**, Sheraton-Palace Hotel, San Francisco, Calif.

June 8-11—**National Society of Professional Engineers Annual Meeting**, Statler Hotel, Boston, Massachusetts.

June 12-14—**American Nuclear Society Annual Meeting**, Palmer House, Chicago, Ill.

June 14-17—**Annual Industrial Engineering Seminars**, Cornell University, Ithaca, New York.

June 20-21 — **First Chicago Spring Conference on Broadcast and TV Receivers** by PGBTR and Chicago Section of IRE. Graemere Hotel, Chicago, Illinois. Jack E. Bridges, Warwick Mfg. Co., 7300 North Lehigh, Chicago, Ill.

### Papers Calls

May 16—Abstracts for Fourth Global Communications Symposium — Professional Group on Communications Systems and the U.S.A. Signal Corps (Washington, D.C., August 1-3). Send to: Ralph L. Clark, c/o Office of Director of Defense Research and Engineering, Washington 25, D. C.

June 1—Summaries in triplicate of papers for the Fourth Annual Conference of the Professional Group on Production Techniques (Boston, Mass., November 15-16) in conjunction with 1960 NEREM Meeting, under general headings of "Design Techniques That Insure a Better Product" and "Materials and the Product Today." Send to: C. W. Watt, program chairman, Fourth Annual Conference PGPT, c/o Raytheon Company, Waltham 54, Mass.

June 6—500-word abstract for unclassified sessions of the Seventh East Coast Conference on Aeronautical and Navigational Electronics (October 24-26; Baltimore, Md.). Send to: Sanford Hershfield, Mail No. G-3143, the Martin Company, Baltimore 3, Md.

June 15—Abstracts for the Twelfth Annual MAECON Conference (November 15-16; Kansas City, Mo.). James Austin, General Papers Chairman, Bendix Aviation Corp., 95th and Troost, Kansas City, Mo.

## THE SECTION

### Membership Status

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

Eustaquio C. Agbulos	Daniel Luchter
William A. Alfano	John M. Malovich
George L. Bailey	Robert P. Marcellini
Beverly C. Barr	J. Bruce Martin
Christian G. Bechtle	Crowell H. Mays
Joseph B. Berkley	Carl E. Minich
Raymond E. Brown	Dennis B. Nelson
Charles Buananno	George K. Ozaki
Joseph M. Burt	Winton B. Pafford
Thomas J. Copeland	Howard N. Ponttaja
John B. Day	Charles F. Parker
Roger W. Esh	Peter J. Paulos
William T. Fitch	Cleaborn C. Riggins
Robert D. Frost	Jerry W. Robinson
James T. Hall	Ronald M. Rule
C. Frank Harris	Forrest L. Rutledge
Daniel B. Harris	Henry L. Scarborough
Robert L. Hickerson	Curt D. Schulze
Frank A. Horak	Richard T. Schumacher
Jack S. Jacob	Ralph N. Seymour
James O. Jacques	Earl J. Shelton, Jr.
Floyd O. Johnson	Saul Sherman
Brian L. Jones	John B. Skewis
James S. Koford	Glenn E. Strahl
Joseph P. Lally	Warren L. Vaitch
	Conrad Woo

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

Richard W. Ahrens	Birchard L. Kortegaard
John Baker	William F. Krajewski
Peter M. Banks	Franklin F. Lee
Raymond R. Bourret	Robert W. McGinnis
George G. Burke	Jordan C. J. Mah
Jack F. Butler	Charles T. Markee
Jack A. Byers	Syed A. Nasar
George A. Center	Walter R. Peterson
John L. Cole	Val Prescop
Elisha J. Daly	Edward W. Pullen
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Richard L. English	Harry L. Ramsey, Jr.
Gildo L. Epis	John L. Ravera
Wallace Evans	Seymour N. Rubin
Francis R. Gagen	John R. Swanson
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Ferdo Ivonek	Barry H. Whalen
Ronald E. Jachowski	Willis M. Whelchel
Gerald P. Kaoyers	Stuart D. Winter
	Richard T. Wort

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

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Richard C. Singleton

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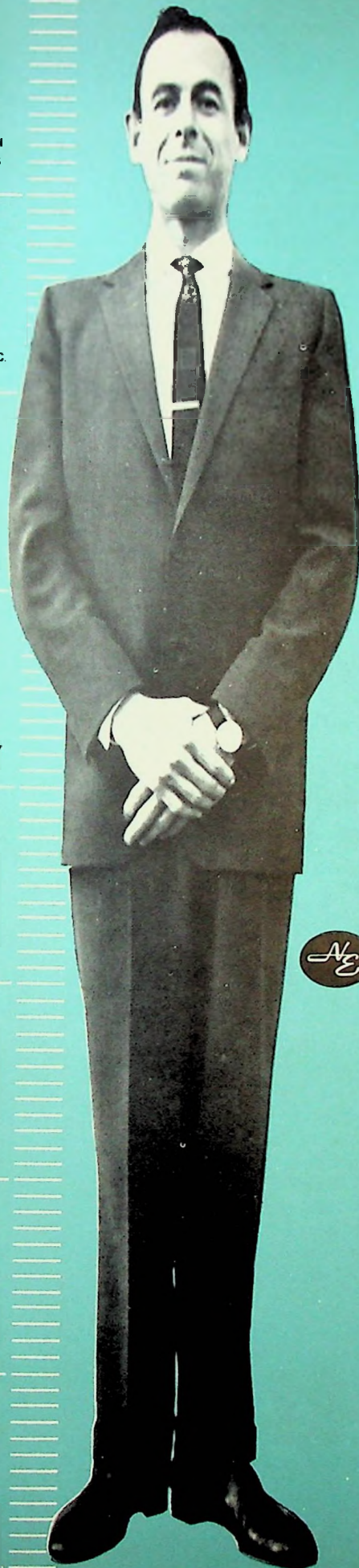
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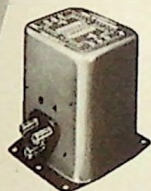
Applied Technology, Inc.	31
Arnold Engineering Co.	7
Ballantine Laboratories	43
Beckman & Whitley, Inc.	40
Columbia Technical Corp.	38
Cornell-Dubilier Electric Corp.	37
Daystrom, Inc., Weston Instruments Div.	37
DeMornay-Bonardi	35
Electro-Scientific Industries, Inc.	19
Elmar Electronics, Inc.	15
Fluke Mfg. Co., John	4
Food Machinery & Chemical Corp. Central Engineering	36
General Radio Co.	48
Gertsch Products, Inc.	47
Gray Co., Hugh	29
Hewlett-Packard Co.	11
Hill Company, J. T., 420 S. Pine St., San Gabriel, Calif.; ATLantic 7-9633; CUMberland 3-6555	46
Hughes Aircraft Co.	17
Hughes Co., Inc., R. S.	33
Jerrald Electronics Corp.	33
Jet Propulsion Laboratory	39
Kaufman, Jack; 126 - 25th Avenue, San Mateo; Flreside 1-4942	37, 46
Kay Electric Co.	32
Kittleson Co.	31
Link Division—General Precision, Inc.	30
Litton Industries, Electronic Equipments Div.	39
Litton Industries, Electron Tube Div.	29
Luscombe Engineering Co.	33
McCarthy Assoc.; 635 Oak Grove, Menlo Park; DAvenport 6-7937	21, 46
Measurements Corp.	35
Microwave Electronics Corp.	27
Miller Co., J. W.	40
Neely Enterprises, 501 Laurel, San Carlos; LYtell 1-2626; 1317 - 15th St., Sacramento; GL 2-8901	45, 46
O'Halloran, John Francis & Associates, 825 San Antonio, Palo Alto; DAvenport 6-1493	46
Perkin Engineering Corp.	3
Permanent Employment Agency	38
Premmco, Inc., P.O. Box 412, Alameda; LANDscape 3-9495	46
Rupp Co., V. T.; 1182 Los Altos Ave., Los Altos; WHitecliff 8-1483	46
Sierra Electronic Corp.	23
Snitzer Co., T. L., 510 So. Mathilda Ave., Sunnyvale; REgent 6-6733	19, 46
Space Technology Laboratories	13
Stoddart Aircraft Radio Co., Inc.	41
Stone & Associates, Jay; Box 583, Sunnyvale; YORkshire 8-2770	46
Sylvania Mountain View Operations	42
Tech-Ser, Inc.	34
Tektronix, Inc.	29
Van Groos Co.	25
Varian Associates	2
Western Gold & Platinum Co.	27
White & Company, 788 Mayview, Palo Alto; DAvenport 1-3350	46
Zippertubing Co., The	44

Radiation Counter Labs	White and Company
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Scientific-Atlanta, Inc.	J. T. Hill Co.
Sensitive Research Instrument	McCarthy Assoc.
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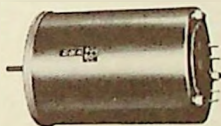
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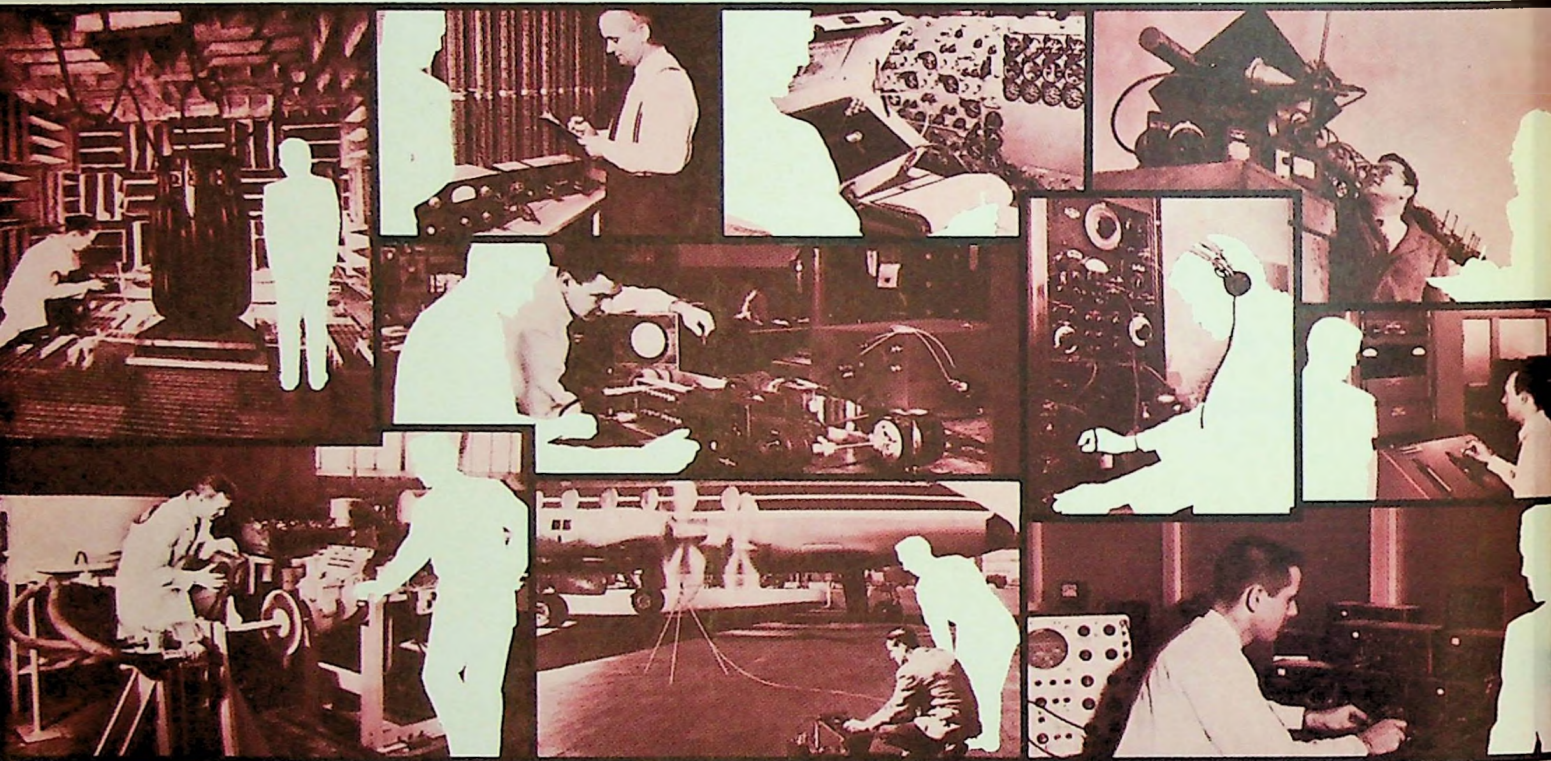
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