DECEMBER 1963, Vol. 12, No. 4

The Reflector

PUBLISHED BY THE BOSTON SECTION OF THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

WINTER LECTURE SERIES ON PERT

(SEE PAGES 8 & 9)

Season's Greetings

The **Reflector**

DECEMBER 1963

Volume XII, No. 4

Published monthly except June, July, and August by the Boston Section of the IEEE.

Subscription rate: Boston Section Members, 50c per year; non-members, $2.00 per year.

Second-class postage paid at Boston, Mass.

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INDEX TO ADVERTISERS

Cover Story

Merry Christmas

THE ELECTRIC UTILITIES

RONALD E. SCOTT
Chairman — Boston Section

MANY of the readers of THE REFLECTOR are relatively unfamiliar with the modern electric utility industry. Yet America has the most advanced electric power system in the world, and we can be justly proud of it. We have more electric power capacity than the next five nations combined and three times that of Russia, the second ranking nation. More than 80 per cent of this capacity is privately owned by some 300 companies, large and small, which, however, are interconnected into large operating groups. One of these, covering the whole eastern United States, has alone almost double the power capability of the Soviet Union.

The growth curve for the industry is exponential with a doubling of plant capacity every ten years. The current rate of capital expenditure is $3.4 billion per year and is expected to rise to $12 billion by 1980. This investment represents 10 per cent of all new plant capacity added by American industry. It also represents a tremendous challenge for engineering since new concepts and new devices can be rapidly put into large scale operation.

The average investment per worker in the United States is about $10 000. In the utility industry it is about $125 000. It is this investment which has enabled the utilities to produce electric power at a steadily decreasing cost while every other item in our economy has been increasing. Each worker and, in particular, each engineer in the utilities has a large leverage to increase his economic value to the country. It is no accident that two-thirds of the executives in the utilities are engineers, and it is no accident either that these men are highly paid.

The engineers in the utilities are systems engineers. They do not design the generators and transformers which they use as components, any more than the engineer designs his own resistors. They make extensive use of computers for designing new systems, for making studies of the economics of proposed projects, for reliability studies, for the analysis of the optimum operation of their systems, and often for the direct computer control of turbines and generators.

A key word in all utility work is economics. New projects are justified on the basis of their economic value. However, the broadest possible interpretation is given to the term economic value. Reliability has an economic value. Thus the utilities have developed atomic power at a time when it was still not economically competitive with conventional power generation, and they are currently turning their thoughts to various forms of direct energy conversion which may not be operational until the 1970s.

Research in the power industry is not as spectacular as in the aerospace industry or in the telephone industry because it has been financed internally and because the industry has no equivalent of the Bell Telephone Laboratories. Significant work is going on, however, in the areas of improvement of conventional equipment, nuclear power generation, and direct energy conversion. The Edison Electric Institute, the power industry trade organization, made a survey which showed 856 research projects under way in the utility companies, and EEI itself is sponsoring about eight million dollars worth of research in university and private laboratories each year.

New opportunities such as integrated methods for the electric heating, lighting, and air-conditioning of homes and commercial buildings are being developed. The future of the electric power industry looks very bright. We welcome the utility engineers among us.

To the Former AIEE Members of Our Boston Section, IEEE:

SHERMAN B. FARNHAM
Past Chairman, Boston Section AIEE

ONE of the traditions of our old AIEE Section was the "Chairman's Letter." Mailed to all our members several times each year, this was generally a state-of-the-Section message, and served to keep our membership posted on how the affairs of the Section were progressing. While it usually included reminders of forthcoming Section activities, its primary aim was to give the membership some insight into our plans, our problems, and occasionally some of the Chairman's philosophies. Thus, whether or not a member regularly attended our meetings, he was able to maintain a sense of knowing what was going on in the Section. Since the merger, we have had indications that some of our former AIEE members now feel out of touch. Perhaps a few comments in the form of this letter from a Past Chairman may therefore be in order.

In THE REFLECTOR we have, potentially, a far better medium than ever before for keeping our members informed. THE REFLECTOR is published monthly throughout our active season, and is mailed to all members of the Boston Section. It was highly successful as the principal medium for news and publicity in the former IRE Section. Now it fills a similar, though expanded, role under IEEE.

It is perhaps inevitable, however, that those of us whose backgrounds were in AIEE now find things "different." While the Boston Section of the IEEE is in the process of becoming affiliated with ESNE, thereby permitting us to continue participation in matters of broad interest to the engineering profession, we no longer receive the *ESNE Journal,* which formerly carried all our meeting notices.* Nor do we see our distinctive bulletin board notices, or the colorful flyers regarding important events, which formerly accompanied mailings of the Chairman's Letter. Some of us may be sensitive to the void left by the discontinuation of our "Yearbook" wherein the entire year's program and our complete committee organization were available at a glance. In THE REFLECTOR even the words are different. Our "Technical Meetings" have become "PTG Meetings." The old "Educational Courses" are now "Lecture Series."

But now, enough of the past and its differences! We have come together as one organization; and those of us who were privileged to participate in forming the new Boston Section of the IEEE are most enthusiastic about the opportunities and challenges which lie ahead. In this vein, there are several topics which I would like to outline for your information and for such thoughtful action as you may care to take.

1. Last spring, representatives of the Boston Sections of IRE and AIEE hammered out a set of bylaws which served most effectively as the basis for launching the new Boston Section, IEEE. Those bylaws were purposely of skeletal proportions, so as to minimize the possibility of misunderstanding and delay over points which were non-essential to the merger. Now, however, with several months' operating experience behind us, we recognize the need for refinement and for adding some flesh to the framework. Our new bylaws, now well along in preparation, will incorporate what we believe to be the best features found in the bylaws of both predecessor organizations, as well as the constructive suggestions of some very dedicated individuals. You will shortly see them in print in THE REFLECTOR, and will have an opportunity to vote on their adoption. I am sure you will agree that they are a strong, complete, and clear-cut directive for the organization and continual successful operation of our Boston Section.

2. As was announced in the November REFLECTOR, a new Professional Technical Group has been organized within IEEE by transfer of the old AIEE Power Division to PTG status. Thus, the new Professional Technical Group on Power (PTG-P) will become the "home" for many former AIEE members whose interests are in the power field. A chapter of PTG-P will certainly be established within the Boston Section. In fact, we are already operating very much as if such a chapter actually existed, through our Utility System Discussion Group.

It appears not unlikely that a similar transition may also occur in the former AIEE Industry Division; and, again, the Boston Section has already organized an Industrial Systems Discussion Group, which can easily become a PTG chapter in this field. Other technical fields that may be of interest to our former AIEE members, such as nucleonics, engineering management, and instrumentation, are already well covered by PTG chapters which had previously been established and which are being continued and expanded. Former AIEE members are now active in the administration of some of these chapters. You have only to refer to the center page spread which appears each month in THE REFLECTOR to determine the time and place of any of the technical group meetings within your own fields of interest.

3. The costs of publishing and mailing THE REFLECTOR are supported very largely by income from advertising. With its newly expanded coverage (now nearly 7000 copies for each regular issue) and with the increased volume of meeting notices and text material, we must now seek a broader base for our advertising income. Plans are now being formulated for contacting an expanded list of potential advertisers, particularly those offering products or services in the power field. Should you be requested to lend a hand in this endeavor, I hope you will do so.

4. Finally, to those who have expressed the feeling that THE REFLECTOR is too "electronics oriented," may I say that this is in your power to change. THE REFLECTOR is as it is only because electronics-oriented people do the work and supply most of the text material. Let's stop thinking about it as "their" magazine, and let those of us whose backgrounds are in fields related to electric power now do our share in a balanced endeavor, so that "we" and "they" together can all be justifiably proud of "our" magazine.

* For information on how to subscribe to the *ESNE Journal* see pages 10-11 (the center spread).

In the January Issue
A Photo Report of NEREM-63

LYNN SUBSECTION

Space Age Home Lighting

DR. Domina Eberle Spencer, nationally prominent lighting authority, will present the most recent lighting innovations as applied to the modern home. She is a Professor of Mathematics at the University of Connecticut, and received her S.B., S.M., and Ph.D. from Massachusetts Institute of Technology. She has taught at American University, Tufts College, and Brown University before joining the University of Connecticut in 1950.

D. E. SPENCER
Univ. of Conn.

Dr. Spencer is an accomplished theorist in the field of lighting, mathematics, and physics, who pioneered (with her husband, Professor Parry Moon) in the development and introduction of the interflectance method of calculating interior illumination. From her theoretical work on interflections and vision resulted the first designs for luminous ceilings. She has defined lighting terms mathematically to make illumination calculations using tensors, which are the basic language for scientific research.

More than two hundred scientific papers on lighting, photometry, mathematics, engineering, color, and vision are part of Doctor Spencer's contribution to the scientific world. Her book *Lighting Design* (co-authored with Professor Parry Moon) is a fundamental textbook of illuminating engineering which has also appeared in Japanese. Other books co-authored with her husband are *Foundations of Electrodynamics, Field Theory for Engineers,* and *Field Theory Handbook.*

Many of the new generation of projectors and photographic equipment use reflectorized and prefocused lamps which resulted from basic reflector designs by Dr. Spencer. These lamps eliminate the focusing lenses. She advocated and pioneered controlled reflectors for fluorescent lamps currently used in industry. She also suggested and designed the aperture fluorescent lamp which will be demonstrated in the lecture.

Dr. Spencer is a fellow of the Illuminating Engineering Society, and the Optical Society of America. She is a member of the American Mathematical Society and the Franklin Institute.

TUESDAY, DECEMBER 3
Dinner — 7:00pm — Hotel Hawthorne — Salem
Meeting — 8:00pm — Hotel Hawthorne
Dinner Reservations must be made with
Hagop Garavanian, by phoning 774-1640, ext. 276

INDUSTRIAL POWER SYSTEMS

New Insights in the Protection of Commercial and Industrial Power Systems

J. C. CRANOS — G.E.

THERE is an increasing number of serious burndowns in industrial and commercial low-voltage power systems, especially on 460-volt systems. These are usually associated with single-phase interrupters such as fuses. The problem is chronic and widespread. The electrical section of National Fire Protection Association (National Electrical Code) found the problem sufficiently serious to create a special technical committee to deal with overcurrent protection problems in high-capacity low-voltage systems.

Mr. Cranos will present an understanding of the technical circuit problems associated with single-phase overcurrent protection in polyphase systems. Case histories and preventive measures will be included. Arcing grounds are often associated with the single-phasing problem and will be discussed from a practical standpoint. Suggested overcurrent protective methods for low-level fault currents will be included. The presentation will include a short movie showing the destructive effects of short circuits on low and medium voltage systems.

Mr. Cranos is an electrical engineering graduate of the Pennsylvania State University. He has been associated with the General Electric Company and is currently an Industrial Power Systems Application Engineer concerned with the design of industrial and commercial power systems and the proper application of the associated electrical equipment. Mr. Cranos is a member of the IEEE and a registered professional engineer in the State of New York.

WEDNESDAY, DECEMBER 4
Meeting — 8:00pm — MIT Room 5-234

Human Engineering Aspects of Highway Safety

DR. MCFARLAND — *Harvard School of Public Health*

THE field of human engineering is concerned with the design of equipment in terms of human capabilities and limitations. This implies that vehicular designs must be intimately related to the biological and psychological characteristics of the drivers. It seems reasonable to assume that engineers should be familiar with the basic facts about human perception if satisfactory information is to be supplied from signals and lights. In addition, the designer must not place unreasonable demands upon the driver in requiring him to reach and operate controls and levers. These same general principles apply to all aspects of the design of highway transport equipment.

Dr. McFarland and his associates will present a summary of the results which have been obtained in an extensive investigation in the field of highway transport safety at the Harvard School of Public Health. The primary purpose of this study was to determine (1) whether an effective integration had been achieved between drivers and their equipment, (2) whether limitations had been imposed in operational efficiency giving rise to fatigue, and (3) whether some accidents may have resulted from design defects.

The data, which will be presented in diagrams, frequency distributions, and tables, are concerned not only with human body size and capabilities but also with the selection, health, and operating practices of drivers.

Dr. McFarland is internationally known for his studies in the field of aviation and aerospace safety and for his research into the effects of high altitudes on man. In bringing this experience to bear on the problems of highway safety, he has headed a team with specialized training in engineering, experimental psychology, physical anthropology, and medicine with the objective of achieving a more effective integration of drivers and the equipment they operate.

THURSDAY, DECEMBER 5
Dinner — 5:45pm — MIT Faculty Club — Sloan Building, Cambridge
Meeting — 8:00pm — Harvard School of Public Health,
Room 102, 665 Huntington Avenue, Boston

Education in Western Germany

EDUCATIONAL opportunities open to students in Western Germany will be discussed briefly from elementary school to entrance into a profession.

A fairly detailed discussion will be given of education in universities and institutes of technology, with greater emphasis on specialized training in the institutes of technology, in the fields of electrical engineering and telecommunication engineering.

T. A. ABELE
Bell Labs

Dr. Thomas A. Abele is a native of Duisburg in West Germany where he received his elementary education. His undergraduate work in Telecommunication Engineering was completed at the Institute of Technology in Aachen, where he was appointed Assistant Professor for the period from 1958 to 1962. His Doctorate was completed at the Institute for Microwaves of the Institute of Technology at Aachen in 1960. He joined the Bell Telephone Laboratories in North Andover, Massachusetts, early in 1963 and is engaged in the design and development of Microwave Networks.

MONDAY, DECEMBER 9
Meeting — 7:30pm — Lowell Technological Institute
Lowell, Mass., Room NB210

Prolonging the "Half-Life" of Technical Personnel

The Role of Universities, Professional Societies, and Industrial Management

F. K. WILLENBROCK — *Harvard University*

IN the October 1963 REFLECTOR, Boston Section Chairman R. E. Scott wrote, "It is a widely recognized fact that the 'half-life' of an engineer in the technical field is about ten years." He concluded that engineering deserves more than the contributions from the prelude of a man's serious career.

Our speaker, Dr. F. Karl Willenbrock, Associate Dean of Engineering and Applied Physics, Harvard University, will explore the role of the university, of professional societies, and of industrial managers in encouraging prolonged contributions from technical personnel. He will also comment on the individual's role in preventing his own technical obsolescence.

Dr. Willenbrock is well equipped to speak on this topic because of the breadth of his background. In his present position at Harvard he is intimately concerned with both the instruction and research programs in Engineering and Physics.

MONDAY, DECEMBER 9
Dinner — 6:00pm — Charterhouse — Rte. 128, Waltham
Meeting — 8:00pm — Sylvania Electronic Systems, 100 First Ave., Waltham
(Please make dinner reservations with Shirley Whitcher
IEEE Office, LA 7-5151)

CORRESPONDENCE

Dear Mr. Scott:

I have read your editorial in the November issue of THE REFLECTOR, and I must say it was shocking to see such a politically-oriented discussion in a publication which should have nothing whatever to do with politics.

Regardless of whether one agrees or disagrees with your point of view—conservative or liberal—such a discussion is completely out of place in a publication representing a professional organization.

I believe that the editor of THE REFLECTOR is guilty of an even greater discretion *[sic]*, and a copy of these remarks is being addressed to him also.

Roy F. Allison Cambridge, Mass.

Dear Mr. Scott:

Sincere congratulations on your splendid article on "Ayn Rand and The Engineers" in THE REFLECTOR.

It is a distinct pleasure to realize that there are a few thinking persons who believe in individual accomplishments and conservatism, and are not afraid to speak out.

Norman E. Kidwell Windsor Locks, Conn.

Dear Mr. Scott:

Your sympathetic treatment of Ayn Rand's philosophy is quite disappointing to me and, I am sure, others in IEEE.

The genius who can create significantly new advances without help from contemporaries or a previously built body of knowledge and experience is extremely rare. Most engineering achievement is based on the work of predecessors or on joint contemporary effort or, more often, on both. As a consequence, Ayn Rand's basic positions are invalid and impractical in the real world. The Ayn Rand type of society would stagnate technically and degenerate sociologically into chaos.

Taxation is criticized. Without it, mass education leading to higher engineering education opportunities would be inferior or nonexistent. Engineering education would be limited to a fortunate few who would probably not be the best qualified. Furthermore, without the capital concentration possible through taxation and appropriation, imagine the lack of progress and opportunity we would see in aircraft, ship-building, construction, electronics, and nuclear engineering, to mention only a few disciplines. Private corporations and individuals would not and could not promote the great programs which have been carried out in the above fields.

Robert M. Shepard Hingham, Mass.

December IEEE Meetings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

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WINTER LECTURE SERIES
PERT and PERT/COST
For Program Planning and Control

CONSECUTIVE THURSDAYS — JANUARY 9, 16, 23 & 30
7:30 - 10:30pm

AT KNIGHT AUDITORIUM — BABSON INSTITUTE — WELLESLEY

The advances in the military electronics field have opened vast new markets for the industry. The contracts subsequently awarded have demanded not only technological achievements but also the achievement of schedule and budgetary goals as well. To accomplish these goals, planning must be carefully performed and control of the plans must be dynamic. PERT and PERT/COST represent two advances in the "state of the art" of planning and control of research and development programs. These systems need not only be applied to defense contracts but can be used wherever the need exists for planning and controlling "one-time-through" tasks. The key to successful use of these important management tools is a thorough knowledge of them as well as an appreciation of their place in the total spectrum of planning and control tools.

The Winter Lecture Series will address itself to PERT and PERT/COST as part of the total engineering and management planning and control process. Thus, PERT and PERT/COST will be treated in perspective with the other tools of program management. The spectrum of tools which will be discussed by authorities in the field includes, in addition to PERT and PERT/COST, Program Definition, Multiple Incentive Contracting, Configuration Management, Line of Balance and Line-of-Balance Cost.

PERT SESSION — JANUARY 9 — 7:30pm

BRUCE H. FRANK, *Sylvania* — NORMAN B. SOLOMON, *Sylvania*

This session will form the foundation for the other three sessions of the lecture series. The presentation will first center on the role of PERT in the total management planning and control process and the terminology and methodology of the network and its use as a control tool will be covered as well as nuances of the system. The final portion of the lecture will be a discussion of the types of computers and the different computer program characteristics available for PERT processing.

PERT/COST SESSION — JANUARY 16 — 7:30pm

WALTER H. PHOENIX, *Itek Corp.* — JACK McCARTHY, *Management Systems Corp.*

The PERT/COST system will be defined in depth and the philosophy and objectives of the system will be explored. PERT/COST will be discussed in perspective with PERT/TIME and other management tools. The planning, reporting and trade-off considerations of PERT/COST will be explored and the hows and whys of the system discussed. The advantages and disadvantages of using the system in preference to other systems will also be explored. The status of development of computer programs and the present availablility and characteristics of these programs will also be discussed.

IMPLEMENTATION ROUNDTABLE — JANUARY 23 — 7:30pm

Discussion Leader
P. A. FITTER, *Lt. Col., U.S.A.F.*

Panel
WILLIAM ASHLEY, *Mauchly Assoc.* — L. L. GOBER, *U. S. Army* — R. H. KASSEL, *I.T.T.* — W. T. SHEA, *AVCO*

The problems of implementation of PERT and PERT/COST from the viewpoints of government program management, industrial program management and subcontractors will be discussed by the panelists. Such questions as how to implement, level of detail, types of contracts and standardization of systems will be answered. The problems encountered on different programs and the lessons that can be learned from this experience will be explored. Ample time will be allowed for questions from the attendees to be answered.

ROUNDTABLE ON ADVANCED ASPECTS OF PERT/COST
JANUARY 30 — 7:30pm

Discussion Leader
R. W. MILLER, *Raytheon Co.*

Panel
J. J. BENNETT, *Lt. Col., U.S.A.F.* — A. C. GEHRINGER, *ONM* — R. L. HAMILTON, *MITRE*
JORDAN KADET, *Sylvania* — R. E. MATTHEWS, *Management Systems Corp.*

This roundtable will discuss the impact on PERT and PERT/COST by other program management tools. The topics which will be discussed include: Technical Systems Definition — the Basis for PERT and PERT/COST; Segmentation of the Research, Development, Test and Engineering Budget; Program Definition; Configuration Management; Multiple Incentive Contracting; Contractor Performance Evaluating System; PERT/Line of Balance and Line-of-Balance/Cost-extension into the Production Area. Questions from the attendees will also be answered at this session.

DECEMBER 3
Tuesday, 8:00pm
Hotel Hawthorne
Salem, Mass.

LYNN SUBSECTION - See page 4
SPACE AGE HOME LIGHTING
Domina E. Spencer, University of Connecticut
Dinner - Hotel Hawthorne - 6:30pm
Reservations must be made by phoning
Hagop Garavanian, 774-1640, ext. 276

DECEMBER 4
Wednesday, 8:00pm
MIT, Room 5-234

INDUSTRIAL SYSTEMS - See page 4
NEW INSIGHTS IN PROTECTION OF COMMERCIAL AND INDUSTRIAL POWER SYSTEMS
John C. Cranos, General Electric Company

DECEMBER 5
Thursday, 8:00pm
Harard School of Public Health Room 102
665 Huntington Ave.,
Boston

BIOMEDICAL ELECTRONICS - See page 6
HUMAN ENGINEERING ASPECTS OF HIGHWAY SAFETY
Ross A. McFarland, Harvard School of Public Health
Dinner - MIT Faculty Club - 5:45pm

DECEMBER 9
Monday, 8:00pm
MIT, Room 4-231

INFORMATION THEORY - See page 11
NYQUIST'S PROBLEM IN PULSE TRANSMISSION THEORY
D. W. Tufts, Harvard University
Dinner - MIT Faculty Club - 6:15pm

DECEMBER 9
Monday, 7:30pm
Officers' Club
L. G. Hanscom Field

RELIABILITY - See page 10 & 11
MAINTAINABILITY PREDICTION AND DEMONSTRATION TECHNIQUES
S. R. Calabro, Aerospace Technology Corp.
AVAILABILITY AND AUTOMATED TEST SYSTEMS
Gerald Margulies, Bureau of Ships
Dinner - Officers' Club, L. G. Hanscom Field - 5:45pm
Reservations must be made before December 5
by phoning Ray Barnes at WElls 3-3500, ext. 354

DECEMBER 9
Monday, 8:00pm
Sylvania Electronic Systems, East
100 First Ave., Waltham

ENGINEERING MANAGEMENT - See page 7
PROLONGING THE 'HALF-LIFE' OF TECHNICAL PERSONNEL
F. Karl Willenbrock, Harvard University
Dinner - Charterhouse Motel, Rte. 128, Waltham - 6:00pm

DECEMBER 10
Tuesday, 8:00pm
Lowell Technological Institute Room NB210

EDUCATION IN WESTERN SEMIARID
Thomas A. Abele, Bell Telephone Labs.

DECEMBER 11
Wednesday, 8:00pm
The MITRE Corp.
Bedford, Mass.

COMMUNICATIONS SYSTEMS - See page 12
AUTOMATIC MESSAGE NETWORKS
Julian Z. Millar, Western Union Telegraph Co.

DECEMBER 12
Thursday, 8:00pm
Raytheon Executive Offices
Lexington

ELECTRON DEVICES - See page 12
TRAVELING-SOLVENT METHODS OF CRYSTAL GROWTH
A. I. Mlavsky, Tyco Labs.
Dinner - Raytheon Executive Offices - 6:30pm
Reservations must be made before December 12
by phoning Miss Connolly at TW 9-8080, ext. 224

DECEMBER 12
Thursday, 8:00pm
Raytheon Executive Offices
Lexington

ENGINEERING WRITING AND SPEECH - See page 14
THE COMING REVOLUTION IN INFORMATION TRANSFER
Christopher Sims, William Marsden,
Arthur LaHaise, Raytheon Company
Dinner - Charterhouse Motel, Rte. 128,
Waltham - 6:00pm

DECEMBER 19
Thursday, 8:00pm
MIT, Room 4-231

NUCLEAR SCIENCE - See page 14
BOILING WATER REACTORS
R. C. Freeman, General Electric Company

Additional engineering meetings in the Boston area are listed in the *ESNE Journal*, which can be obtained from the Engineering Societies of New England, Hotel Somerset, Boston, Mass. 02115. The annual subscription is $1.65 for thirty-six issues.

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D O U B L E M E E T I N G

Maintaining Prediction and Demonstration Techniques

S. R. CALABRO — *Aerospace Technology Corp.*

THE current maintainability prediction and demonstration techniques, specified by the Department of Defense, will be discussed by an analysis and explanation of Navy specification MIL-M-23313 (SHIPS) and Air Force specification MIL-M-26512B (USAF). Areas of similarity and differences will be highlighted.

An illustration of a typical calculation of maintainability prediction will be presented and the application of the log normal distribution of repair time will be discussed. Navy approaches to estimating localization, isolation, disassembly, interchange, reassembly, alignment and check-out time (relating these to the functional level of repair) will be explained.

The technique of failure simulation in maintainability demonstration and the number of failures which should be induced to obtain a figure of merit of mean time to repair will be discussed. The latest changes in the new version of the Air Force specification MIL-M-26512C will be explained, if time permits, through the medium of failure induction calculated for a required confidence level.

An illustration of the calculation of mean time to repair from induced failure data, substitution in the log normal distribution, and a comparison with predicted values will conclude the first presentation.

S.R. Calabro, author of the 1962 McGraw Hill text, *Reliability Principles and Practice,* and President of the Aerospace Technology Corporation, received his B.S.E.E. at City College, New York in 1939. He is the author of several other books and has presented many papers to the IEEE, ASQC and other technical societies.

Availability and Automated Test Systems

G. MARGULIES — *U.S. Bureau of Ships*

THE concentration on system effectiveness in the acquisition of electronic equipment has resulted in accelerated activity in the ancillary software and hardware areas which affect prime equipment availability. Experts within these areas have developed methods that would individually solve a large part of the availability problem—but at a tremendous cost. We must look to an optimum mix of these endeavors to achieve most effectiveness per dollar.

One of the most important developments in ancillary hardware is in the field of automated test systems (ATS). Since fault localization and isolation represents seventy per cent of the time taken for actual repair, ATS gives promise of a drastic reduction in equipment down time.

Most of the work in ATS has been done in the area of aircraft and missile check-out. However, the application of ATS in a shipboard environment presents altogether different constraints. The design of such an ATS must be based on a specific test and check-out philosophy that anticipates failure and repair during a mission without aborting the mission. The design must also consider size and weight constraints both in the fundamental ATS and the peripheral devices necessary for prime equipment interface.

By a frank discussion of the capabilities and shortcomings of ATS, the extent to which it can be used (in conjunction with other support systems to achieve required system effectiveness) can be defined.

Mr. G. Margulies is the Head of the Automated Maintenance Engineering Unit of the Electronic Test Instrumentation and Standards Section of the Bureau of Ships. He received his B.S. in Chemistry and participated in graduate studies in Chemical Engineering at City College, New York; he also studied reliability, mathematics and management at Georgetown University. Mr. Margulies is the Chairman of the Maintainability Group of the Reliability Engineering Technical Committee, ASQC. He is the author of a number of books related to reliability.

MONDAY, DECEMBER 9
Dinner — 6:30pm — Officers' Club — L. G. Hanscom Field, Bedford
Meeting — 7:30pm — Officers' Club
Reservations must be made before December 5
by telephoning Ray Barnes at Wells 3-3500, ext. 3554

Nyquist's Problem in Pulse Transmission Theory

D. W. TUFTS
Harvard University

THIS talk presents the results of some studies that have been made on the following problem: How should one choose transmitted waveforms and a receiver for optimum transmission of a digital-data sequence through a noisy, linear transmission medium?

This problem is an old one in communication theory. It was well formulated in mathematical terms by Nyquist in 1928. Even earlier, as the first telegraph systems were developed, good intuitive understanding had developed.

In this talk only one criterion of performance will be used—namely, that the mean square difference between corresponding elements of the input and output data sequences be as small as possible. Also, except for brief remarks, our discussion is restricted to communication systems that have the same structure as pulse amplitude modulation or pulse code modulation systems.

A central result is that, with or without the addition of an intersymbol-interference constraint, the optimum receiver for any data element can always be expressed as a matched filter and a tapped delay line in cascade. Explicit formulas for the optimum tap gains are also presented for the constrained and unconstrained cases. Three sources of interference are explicitly examined. These are additive noise interference, intersymbol interference, and time jitter in synchronization. Relations have been derived which depict the trade-offs between data correlation, data rate, bandwidth, signal-to-noise ratio, and interference for the case of a bandlimited channel perturbed by white noise.

D. W. Tufts was awarded the B.A. degree from Williams College in 1955 and the S.B., S.M., and Sc.D. degrees from M.I.T. in 1958, 1959, and 1960 respectively. While at M. I. T. he worked at Bell Telephone Laboratories in New York and New Jersey under the M.I.T. Coöperative Program in Electrical Engineering.

He came to Harvard University in 1960 as a research fellow and instructor in Applied Physics. He is currently Assistant Professor of Applied Mathematics.

MONDAY, DECEMBER 9
Dinner — 6:15pm — MIT Faculty Club — Sloan Building, Cambridge
Meeting — 8:00pm — MIT Room 4-231

Automatic Message Networks

MR. Julian Z. Millar will discuss Automatic Message Networks. His talk will include the design considerations, operation, and general problems encountered in the existing store-and-forward computer-controlled message network, AUTODIN, and the Western Union 301 Computer Switching System.

Mr. Millar is currently an Assistant Vice President of the Plant and Engineering Department of the Western Union Telegraph Co. and was responsible for research, development, and engineering on Western Union projects relating to facsimile, radio, wire, and ocean-cable transmission. He was also responsible for automation and data transmission switching systems and related equipment for such systems as Air Force Plan 55 and the Department of Defense AUTODIN system.

Mr. Millar has a very extensive background in electronics. He is a member of the Board of Directors of Microwave Associates and Technical Operations, Inc., Burlington, Mass., and has served on numerous national and international advisory panels. Mr. Millar is a Fellow of IEEE.

WEDNESDAY, DECEMBER 11

Meeting — 8:00pm — The MITRE Corp., Route 62 and Middlesex Turnpike, Bedford

Traveling-Solvent Method of Crystal Growth

THE traveling-solvent method (TSM) is a solution growth technique based on the temperature gradient zone melting method of W.G. Pfann. Essentially, it consists of passing a thin solvent zone through a crystalline mass under the influence of a temperature gradient produced by a heat flow, or by the Peltier effect. The dissolved material deposits on the substrate as an epitaxial overgrowth. If the substrate is a monocrystalline seed, the entire regrown mass is also monocrystalline.

TSM has been used here to grow single crystals of semiconducting compounds from solution. In particular, single crystals of GaAs have been grown at temperatures much below the congruent melting-point, using a thin zone of Ga as the solvent. The parameters that influence zone movement, including zone thickness, average temperature, temperature gradient, and seed orientation, have been studied. For the case of the GaAs-Ga system, the rate of zone movement has been shown to be liquid-diffusion limited. The passage of a pure Ga zone results in considerable purification, as evidenced by the electrical properties of the grown crystals. Also, abrupt P-N junctions can be formed by the passage of a suitability doped Ga zone.

The distribution of edge dislocations in single crystals of GaAs grown from solution in Ga by TSM has been studied using etching techniques. The dislocation density versus distance from the initial growth interface of (111) regrown crystals falls off very rapidly with distance from the interface. Most dislocation elimination occurs within the first 6 mils of growth. Over this distance, changes of dislocation density from 10^4 to 10^3 per square centimeter have been observed. This abrupt change in dislocation density occurs by the agglomeration of dislocations at specific crystal centers, and the subsequent movement of these agglomerates to the periphery of the crystal. By employing tetrahedral samples with exclusively (111) faces, the changes in dislocation density have been found to be isotropic. The implications of this phenomenon in terms of preparing perfect crystals are obvious.

TSM has also been applied to the growth of α-SiC from Cr and from various Cr alloys, of GaP from Ga, and of strontium titanate from various fluxes.

A. I. MLAVSKY
Tyco Labs

Dr. A. I. Mlavsky was educated in England, receiving a B.Sc. with First Class Honors in Chemistry from Queen Mary College, University of London, in 1950. He undertook post-graduate studies at the same institution, and, in 1953, was awarded a Ph.D. in Physical Chemistry for his research on the sorption of organic vapors by liquid sulfur. In 1960 he joined the Materials Research Laboratory of Tyco, Inc., to direct the company's research activities in energy conversion. Upon the incorporation of Tyco Laboratories, Inc., in 1962, he was elected Vice-President and member of the Executive Committee. He also serves as Director of the Applied Research Division, with technical responsibility for TLI's diverse research efforts on the preparation of new electronic materials and devices. Among his most recent scientific accomplishments has been the development of the traveling-solvent method as a general technique for the crystal growth of compound electronic materials. Dr. Mlavsky has written numerous papers and patents.

THURSDAY, DECEMBER 12

Raytheon Executive Offices — Spring Street, Lexington, Mass.
Dinner — 6:30pm — Meeting — 8:00pm
Please make reservations by calling Miss Connolly, TW 9-8080, ext. 224 before December 12

The Coming Revolution in Information Transfer

TODAY emphasis must be placed on the need for rapid dissemination of accurate and clear engineering information. To accomplish this requires the introduction of new communication methods. This discussion will examine specific problems and the application of new techniques in solving these particular problems. The discussion and demonstration of new dynamic communication techniques will encompass the philosophy and application of these new systems. It will describe their advantages, disadvantages, operating costs, and resulting improvements in engineering communications to be expected through their use. Progress in engineering communication will ultimately be along the lines of the systems and techniques examined in this program.


W. MARSDEN
Raytheon Co.


A. LAHAISE
Raytheon Co.

Mr. Sims, who is a section manager at the Raytheon Wayland Laboratory, has for three years directed a group investigating new instructional and communications techniques. He is currently in charge of a project for a major textbook publisher investigating the teaching of modern mathematics using programmed instruction. His group is also examining the effectiveness of communication techniques in technical manuals. A modern approach to information retrieval will be covered by Mr. William Marsden, manager of the Information Retrieval Section at the Raytheon Wayland Laboratory. Mr. Marsden will exhibit a coördinate index system using noncomputer equipment for information retrieval. Audio-visual (AV) techniques will be covered by Mr. Arthur LaHaise, who has been active in technical publications work since 1946. He has also been consultant in AV to such firms as Western Electric, Westinghouse, Republic Aviation, and Sylvania, and is at present responsible for the design and application of AV in a Raytheon plant.


C. SIMS
Raytheon Co.

THURSDAY, DECEMBER 12
Dinner — 6:00pm — Charterhouse Motor Hotel, Waltham
Meeting — 8:00pm — Raytheon Executive Offices, Spring St., Lexington

Boiling Water Reactors

THE second meeting of the Chapter on Nuclear Science will be held December 19 with Mr. R. C. Freeman as speaker. In his talk, Mr. Freeman, Manager of Atomic Power Development at the General Electric Company, will discuss the technical and economic status of boiling water reactors, the outlook for nuclear superheat, and the future cost of nuclear fuel.

February 25 and May 14 are the scheduled dates for PTGNS speakers in the fields of MHD power generation and nuclear instrumentation.

THURSDAY, DECEMBER 19
Meeting — 8:00pm — MIT Room 4-231

Reliability Course

THE Boston Chapters of the Professional Technical Group for Reliability (IEEE) and the American Society for Quality Control are jointly sponsoring a reliability course in the February-March 1964 period.

This course will be a repeat of the course taught by Mr. Dertinger last year. It is oriented toward quality control, manufacturing, production engineering, and reliability engineering personnel working in manufacturing field operations. A minimum of one year undergraduate engineering or equivalent has been established as a prerequisite for enrollment. The content is aligned to the needs for an elementary, basic training in reliability with specific lectures, scheduled as follows: February 3 — Reliability Control Concepts; February 10 — Principles of Maintainability and Availability; February 17 — Data Collection and Analysis; February 24 — Demonstration Testing; March 3 — Reliability Specifications and U. S. Government Requirements; and March 10 — Management of Reliability Control Programs.

Arrangements have been made for the use of facilities at Sylvania Electronic Systems, 100 First Avenue, Waltham, Mass.

The fee for the course is $30 for members of IEEE or ASQC, and $35 for non-members. The tuition fee includes a copy of *Reliability Procedures and Practices* by S. R. Calabro. Advance registration should be mailed to C. Rubin, 52 Strasser Ave., Westwood, Mass., Tel. 326-8575.

Report from Tokyo

C. E. WHITE
Boston Section, Executive Committee

DR. TOMOTA and MR. WHITE having tea at Cafe Terrace of the Imperial Hotel.

THE first issue of the Tokyo IRE Section publication *Denshi,* dated March 1959, carried this statement addressed to all readers: "Remember you are welcome in Tokyo!" The United States delegates to the XIV General Assembly of URSI which was held in Tokyo last September are able to attest to the truth of that statement. Not one of the 130 representatives could be found to dispute the evident effort made by the arrangements committee to make the meetings informative, to provide technical tours which were interesting, and to place each visitor in close contact with life in Japan.

Speaking personally, I can remember many incidents to illustrate this "hands-across-the-sea" interest. During a visit to the Tanashi Branch of the Japanese Electrotechnical Laboratory, I was taken away from the main group and given a short tour of the magneto-hydrodynamics facility simply because of a chance remark I made on the bus enroute. The fact that neither my guide nor the group head and his assistant spoke English did not detract one bit from the information which was passed back and forth in animated fashion. By the use of hands, constant reference to a Japanese-English dictionary, and chalked messages on the laboratory pavement, a fairly concise story of MHD activities at Tanashi, Japan, and Everett, Massachusetts, was provided — to the interest and amusement of all.

Or perhaps the fact that a busy professor at Tohoku University should revise a student schedule to permit me to have him as a guide for most of the day is another token of the welcome tendered us. When Professor Nishizawa called to invite me to Sendai, I was delighted to return the visit which he had made to our laboratories at AVCO in 1961. The extent of the University's work in microwaves and semi-conductors was demonstrated in a visit much too brief. A tour through the new Microwave Institute of the school was a highlight of the trip.

The meeting arranged with Dr. M. Tomota, Chairman of the Tokyo Section of the IEEE, was one which almost didn't occur. Previous to my departure, our plans had been established for a visit which would allow for much conversation and a view of the Yokogawa Electric Works. Unfortunately, Dr. Tomota found himself at the last minute boarding a plane for Foxboro, Mass., on the same day I left San Francisco flying west! We were able to meet for a brief period on my last full day in Tokyo because of his early return. It was a most interesting meeting and I learned of several ties which New England, more properly the Boston Section, has with the Tokyo IEEE activity. One incident in particular had made an impression. This revolved around the gift by Mr. H. B. Richmond, former President of General Radio Co., of a complete set of the *Proceedings of the IRE* to the University of Tokyo, in 1954. Three years later, in 1957, the first local section of the IRE was established in Japan! Negotiations for the gift were conducted by Prof. H. L. Hazen of M.I.T. and Prof. I. Koga, of the University of Tokyo. Professor Koga, on September 19, 1963, was elected the new International President of URSI.

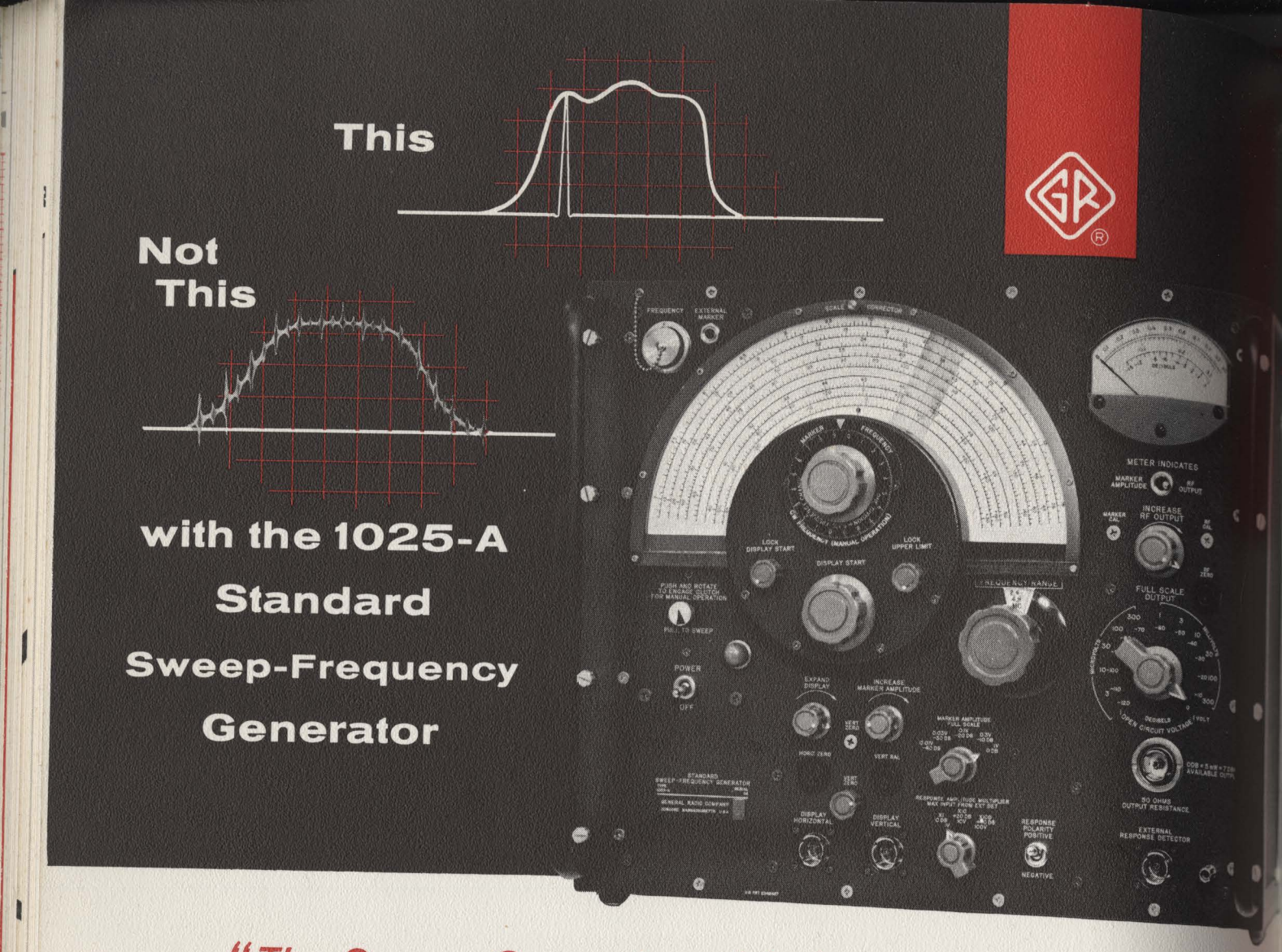
No mention has been made here of the business of the URSI Commissions which is, of course, highly international in character. This is another story, not directly related to our Section, with one execption — several of the principal speakers have appeared before audiences attending Boston Section meetings. We should be justly proud of the part played by our activity in this international meeting.

THE influence of the Tokyo Section has reached far and made itself felt in strange ways. In January 1959 the *Proceedings of the IRE* carried a brief announcement in "Poles and Zeros" to the effect that the Tokyo Section had formed the first IRE Professional Group Chapter outside North America. Your Editor, who at the time was living in the Netherlands, had till then been quite unaware of the IRE activities going on outside the USA. Fascinated by the possibilities, he discussed the subject with fellow IRE members.

The result was the Benelux Section of the IRE, which in July of 1959 became the first IRE section organized in Europe. Independently, a group of Italian members were organizing a section. Announcement of these two sections stimulated into action some members in Geneva, who had earlier been thinking of a section. Other new sections followed, and in 1962 IRE Region 9 (now IEEE Region 8) was established in Europe.

With so many European members thinking about IRE activity it is clear that something would soon have happened in any case. The solution was super-saturated, so to speak. But the crystallization would almost certainly have occurred differently if the Tokyo Section had been less active, or if Dean Ryder had neglected to give our Tokyo members a well deserved notice in the *Proceedings.*

THE EDITOR



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