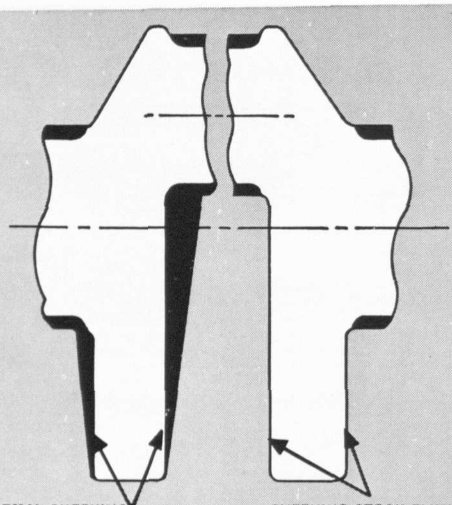
Bind

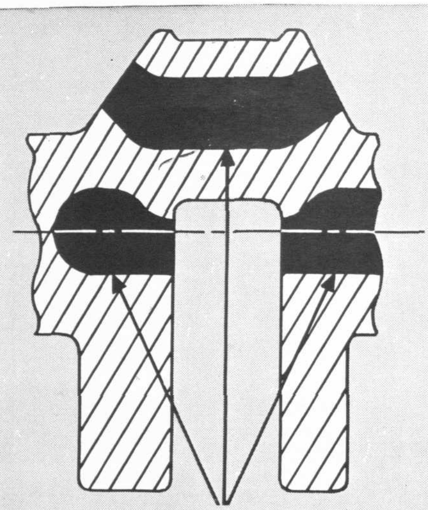
SPARTAN ENGINEER

.25
MARCH



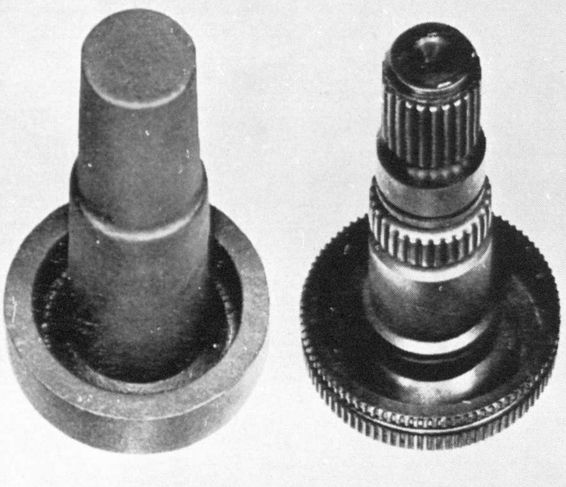
Eliminate Draft Allowance Metal

In designing surfaces perpendicular to a parting line, minimum draft angle requirements can be important to finished cost. By changing these automotive crankshafts to high strength pearlitic Malleable iron castings, the draft angle on sides of counterweights was reduced to one-half of one degree. This eliminated all excess stock formerly required in forming . . . and the machining operations to remove it.



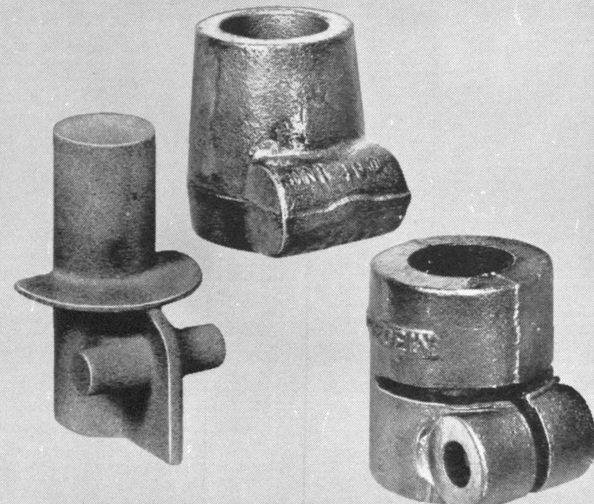
Desired Size Without Excess Weight

These same crankshafts are excellent examples of how to eliminate metal that serves no function. Crankshaft main journals and crankpins are usually solid because of the method used to form them. Made of pearlitic Malleable iron, these areas can be cored out. This substantially reduces the weight of the crankshaft . . . with no loss in functional strength.



Put Metal Only Where It Is Needed

The deep recess at the base of this automotive transmission gear was formerly machined out. Now manufactured of pearlitic Malleable, the recess is created as the part is cast. This eliminates buying unnecessary metal . . . and reduces machining time and cost.



Start Closer To The Finished Part

The versatility of design inherent in Malleable castings can save tremendous amounts of money. Final cost of this part was cut 50% by converting to a Malleable casting. A single core provides the sleeve hole, bolt hole, horizontal slot and vertical slot . . . before any machining is done.

Put High Strength Metal Only Where You Want It With Malleable Castings

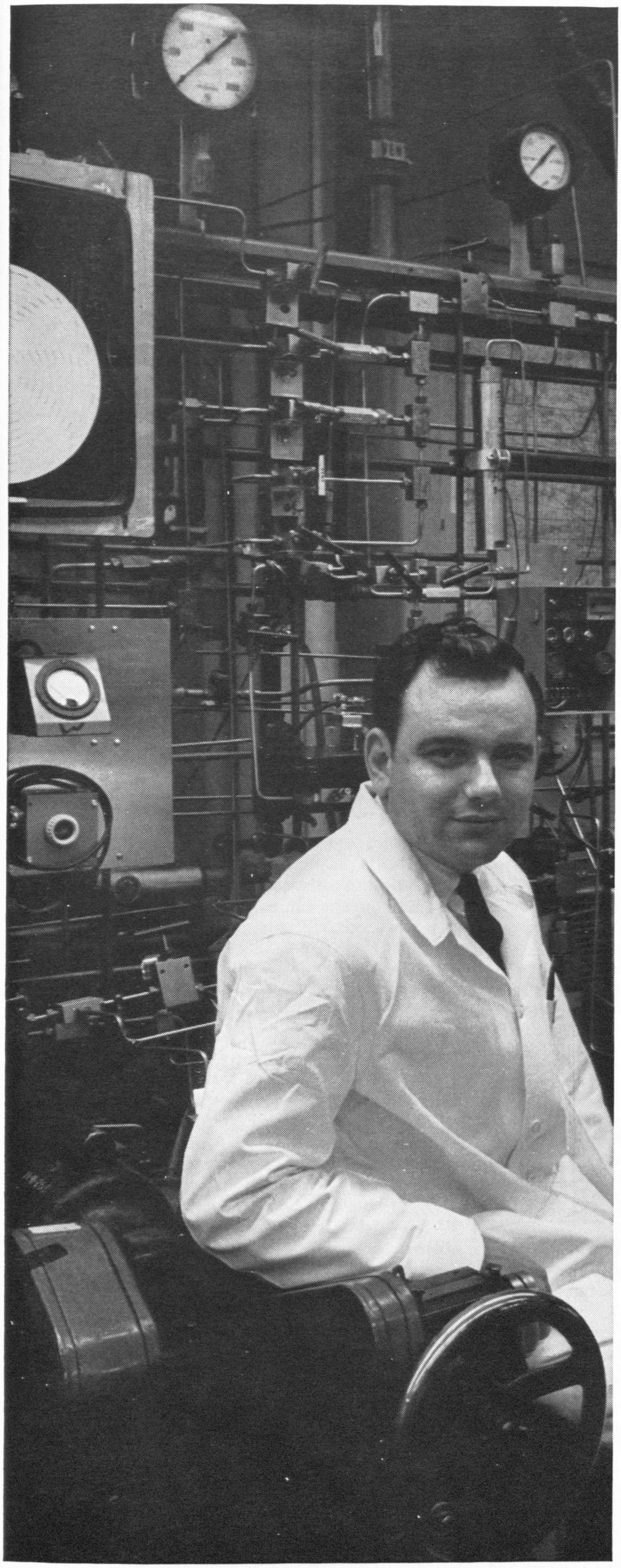
Casting is the most direct method of forming metal parts. Of all castable metals, *Malleable iron provides the greatest strength per dollar.* Malleable also combines excellent machinability, ductility, fatigue resistance, design versatility, low start-up cost, and low production cost. Available in tensile strengths up to 120,000 p.s.i., Malleable castings offer the designer a wealth of opportunities to improve quality and trim costs.

Send for this 16 page Malleable Engineering Data File. You will find this informative brochure is an excellent reference piece.

MALLEABLE FOUNDERS SOCIETY

MALLEABLE FOUNDERS SOCIETY • UNION COMMERCE BUILDING • CLEVELAND 14, OHIO


Assignment: find new ways
to reduce vehicle weight



Spartan Engineer

VOLUME 16 NO. 3 MARCH, 1963

355 3520

Member, Engineering College
Magazine Associated
Chairman: Professor Charles E. Wales,
Wayne State University, Detroit, Michigan

* *

Publisher's Rep.: Littell-Murray-Barnhill, Inc.
369 Lexington Ave., New York 17, N. Y.
737 N. Michigan Ave., Chicago, Ill.

Published four times yearly by the students of the COLLEGE OF ENGINEERING, MICHIGAN STATE UNIVERSITY, East Lansing, Michigan. The office is on the third floor of the Student Services Bldg., Phone 355-8298. Second class postage paid in E. Lansing, Michigan, under act of March 3, 1879.

Subscription rate by mail $1.00 per year. Single copies 25 cents.

Dean's Letter

This is a message to the Seniors -- and to those who hope to be one day.

You have received here an education in mathematics and the basic engineering sciences which, given equal effort on your part, will place you on a par or ahead of graduates of other engineering schools. As yet, you are our best class, based on overall performance, but the Juniors are pushing you hard for honors next year, and there are Sophomores and Freshmen behind them who will challenge all.

We do not think we graduate any who will not represent us well in future years--and the placement personnel of the industries who visit annually ask eagerly for more of you. But let us not expand your hat size further; you know little of actual engineering, and your total education is indeed incomplete.

It is the responsibility of industry to continue your engineering training, our society will provide opportunities for furthering and broadening your cultural education. There is much of engineering art and a practice which cannot and should not be taught on a campus, but must be learned where that art originates -- in the laboratories and production departments of industry. We hope you have chosen for your future employer one who is willing to accept his responsibility in furthering your engineering skills and your technical abilities--who offers you such training as a responsibility to the profession, and not solely for private gain.

You face forty years of continuing education--your whole professional lifetime--and we venture the prediction that upon retirement you will be continuing that practice which we sincerely hope we have taught you--that you will still be learning to learn.

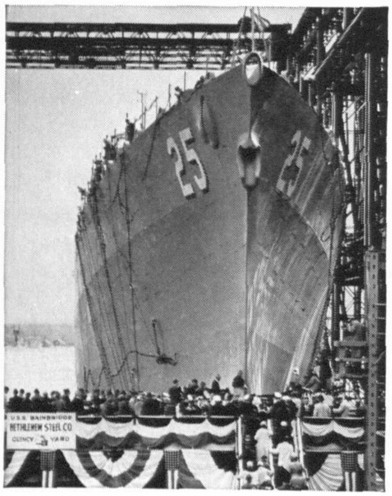
J. D. Ryder, Dean

Opportunities are better than ever at Bethlehem Steel!

What has Bethlehem Steel been doing lately?

. . . designing and building nuclear-powered naval vessels
. . . moved into new research laboratories unexcelled by those of any industry
. . . building new mills, the last word in steelmaking technology
. . . fabricating and erecting steelwork for the nation's great structures

Bethlehem Steel is one of the largest steel producers . . . one of the largest industrial corporations . . . one of the largest structural steel fabricating and erecting operations . . . and *the* largest privately owned shipbuilding and ship repair organization.



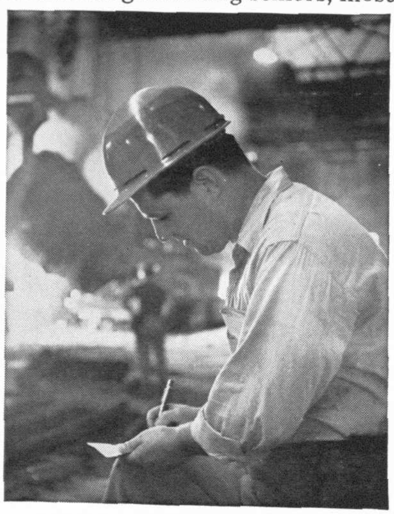
But mere size is only a part of the story. Throughout Bethlehem Steel the key word is *new*. New facilities, new products, new ways of doing things—exciting new developments providing rewarding careers for able and energetic young men who join this organization through the Loop Course.

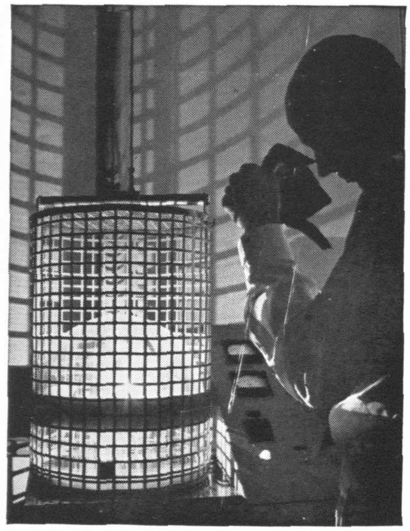
What is the Loop Course?

The Loop Course is our program designed specifically to train men for management careers. New loopers report to our general headquarters in Bethlehem, Pa., early in July. They attend a basic course of five weeks, including talks and discussions by top Company officials, educational films, and daily plant visits (this circuit, or "loop" through a steel plant, is what gave the course its name). The Loop Course is *not* a probationary period. After completion of the basic course, every looper receives his first assignment, whereupon he goes through another, more specialized, training course before beginning actual on-the-job training.

Loopers are Career Men

We select qualified men for the Loop Course on the basis of their potential for careers in management. In most years we enroll over a hundred graduating seniors, most





of them engineers. There are about 2,000 loopers on the job today at Bethlehem, at all levels of management, in our General Offices, and in all of our diverse operations, which include steel and manufacturing plants, research, sales, mining, fabricated steel construction, and shipbuilding.

Read Our Booklet

The eligibility requirements for the Loop Course, as well as how it operates, are more fully covered in our booklet, "Careers with Bethlehem Steel and the Loop Course." Copies are available in most college placement offices, or may be obtained by writing to Manager of Personnel, Bethlehem Steel Company, Bethlehem, Pa.

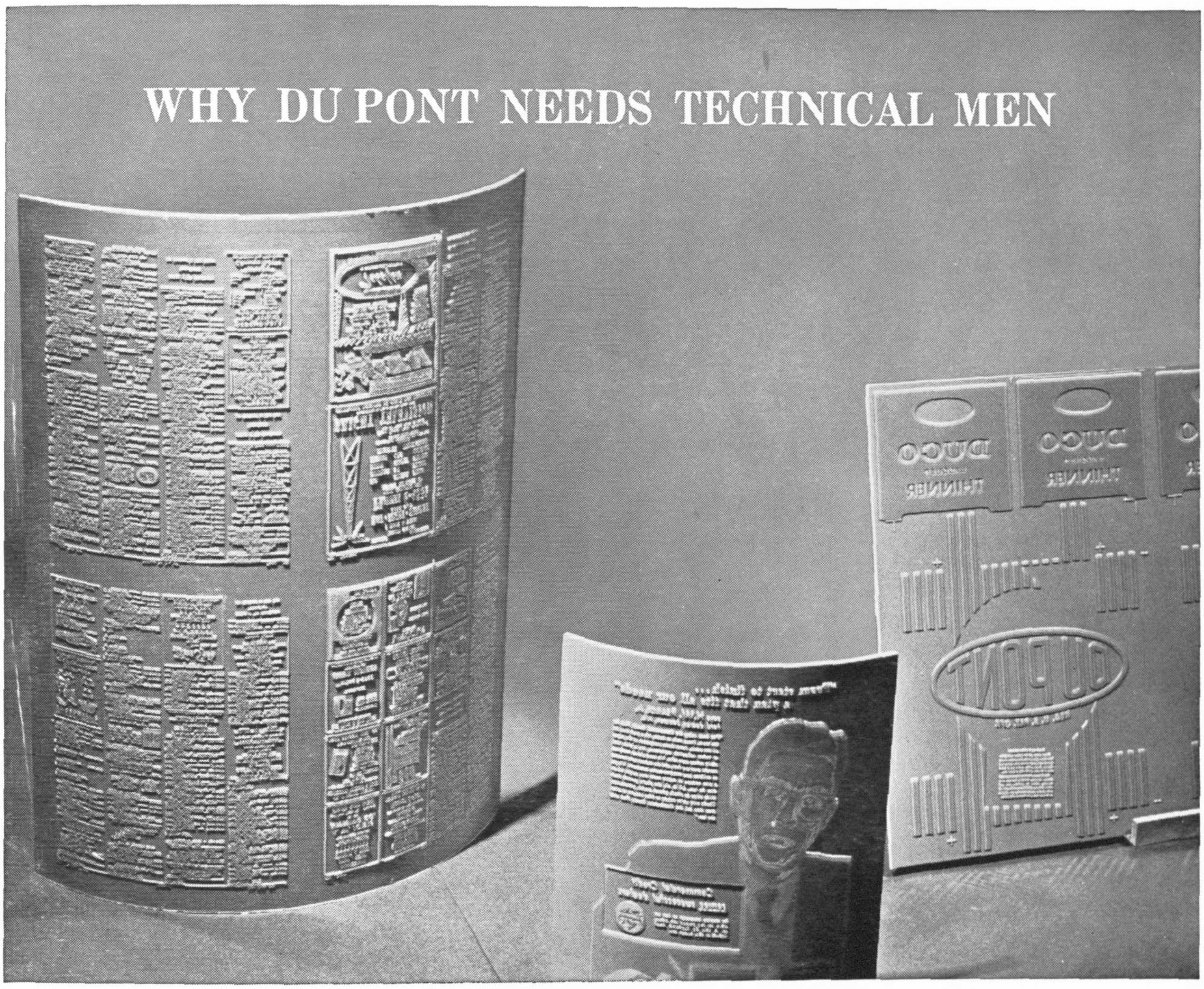
An equal opportunity employer

Steel

BETHLEHEM STEEL

BETHLEHEM STEEL

Opportunities at Du Pont for technical graduates—fourth of a series



Right now Du Pont needs many new mechanical, electrical, civil, chemical, instrumentation, industrial and systems engineers, along with chemists, physicists and mathematicians.

The reason why is very simple: Du Pont manufactures and sells more than 1200 products. And new ones are being developed every day.

Take DYCRIL® Photopolymer Printing Plates, pictured above. We started producing them in 1961. But we had been working on them since 1948. Between these two dates we spent $10 million on research and development. Hundreds of top-flight technical men spent thousands of hours making DYCRIL commercially acceptable.

And with DYCRIL, as with all of our products, it will take a continuing flow of man-hours to make sure that it is manufactured in sufficient quantity—and of optimum quality—to satisfy growing customer demand.

You can see that, with hundreds of diverse products being produced in many plants across the nation, technical men—many of whom were in college, like yourself, just a few years ago—shoulder big responsibilities.

If you're a technical man, and a challenging future in industry appeals to you, write us. Use our coupon. You'll receive information about employment opportunities at Du Pont, and, if you like, about DYCRIL Photopolymer Printing Plates.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

An equal opportunity employer

E. I. du Pont de Nemours & Co. (Inc.)
Nemours Building, Room 2531-3, Wilmington 98, Delaware

Please send me the literature indicated below.

- ☐ Du Pont and the College Graduate
- ☐ Mechanical Engineers at Du Pont
- ☐ Engineers at Du Pont
- ☐ Chemical Engineers at Du Pont
- ☐ Information about DYCRIL

Name__________

Class_____ Major_____ Degree expected_____

College__________

My address__________

City_____ Zone___ State_____

From Phend

No task makes greater demands on the joint wisdom and foresight of faculty and administration than that of containing and directing the forces of expansion and growth. Avenues of opportunity open in different directions. Among these possibilities we must make choices and some of these choices are hard. There was a day when great universities spoke of all knowledge as their province, but no university in fact was ever entitled to make such a claim. In these times of rapid scientific and technological advance, Michigan State University, even in its own limited domain, cannot take unto itself all fields nor seek to be supreme in every promising endeavor. Out of the total range of possibilities for growth and development, we must single out certain areas for our own special concentration, and these choices ought to be the natural consequence of a plan and of a philosophy. The shaping of that plan is a matter of the utmost concern for the taxpayers, for the faculty and for the administration. It is an appropriate subject for continuing discussion and the interchange of views.

The College of Engineering at Michigan State University is keenly sensitive to the urgent need for scientists and engineers at every level of professional competence. Our ties with industry and government are such that we have frequent occasion to observe this need firsthand, and we have felt acutely the pressures for increased enrollment.

Many colleges of limited enrollment have flattered themselves from time to time that they are concerned only with the training of "leaders." For most this is an illusion, if not an arrogant presumption. No college can be so wise or skillful as to compose a freshman class exclusively of young people indelibly marked for success.

There is, however, a kind of leadership to which Michigan State University may very properly aspire. The modern world holds out extraordinary opportunities to graduates in science and engineering. Yet the rate of advance on every front has of late been so swift, the impact of science upon society so profound, that both the substance and processes of education are in many areas totally outmoded. There is at present in the United States the most urgent need to examine the premises upon which we build the professional education of an engineer or a scientist. The demands in rigor and in depth upon purely technical competence have never been so great. At the same time, the desirability of further dimensions in breadth become increasingly apparent. We must consider the possibilities of new systheses in the entire plan of professional training at the undergraduate level. We must be prepared constantly to experiment, to revise and to innovate. Our aim in the College of Engineering at Michigan State University is to lead in the exploration of these many new paths and to provide the model of excellence for undergraduate as well as graduate education in an age in which science and technology have become the dominant forces of culture.

These are high and worthy goals. Their achievement will be by no means easy, and many of the remedies that are perennially suggested for the improvement of instruction will prove inadequate or unfeasible. It goes without saying that there must be fine teachers and good laboratories. There must be understanding and a sincere concern for the problems of the undergraduate --and that concern does exist on our faculty. But the environment and methods of a great university will always differ profoundly from those of the secondary school to which the student has been accustomed. By no conceivable means can it be arranged that each individual student throughout his undergraduate years shall be the object of constant attention and supervision by senior professors alone. It is, nonetheless, those senior professors, renowned in many fields of scholarship, who set the tone, the temper, and the standards of the entire university. The best that any university can offer is the opportunity to learn in the company of those scholars.

Electronic Engineers, Physicists, Mathematicians, BS-MS-Phd

READOUT OF YOUR PROFESSIONAL POTENTIAL AT SYLVANIA ELECTRONIC SYSTEMS

Virtually all of the advanced technical disciplines involved in large electronic system complexes are embraced in the R&D programs at the 17-laboratory organization at Sylvania Electronic Systems. Study the chart below to see if *your* chosen field of endeavor is listed.

	APPLIED RESEARCH LABORATORY Waltham, Massachusetts Central Research Facility for Entire Division	EASTERN OPERATION Laboratories at Waltham, Massachusetts and Needham, Massachusetts	CENTRAL OPERATION Williamsville, New York Advanced Communications Systems Laboratories	WESTERN OPERATION Mountain View, California Electronic Defense Lab; Reconnaissance Systems Lab
Advanced Systems Planning	●	●		
Advanced Phased Array Antenna Systems		●	●	
Aerospace Systems Research & Development	●	●	●	●
Airborne Instrumentation	●		●	●
Antenna Research & Development		●	●	●
Command & Control Systems	●	●		
Communication Techniques Research & Systems Development	●	●	●	
Data Processing & Display Systems R&D	●	●		●
ECM & ECCM Techniques	●		●	●
Electronic Tactical Warfare Systems				●
Information Handling Systems	●	●		
Intelligence & Reconnaissance Systems			●	●
IR Sensor Techniques	●	●		●
Microwave Research & Development	●	●		
Microelectronics Research		●	●	
Navigation Techniques	●		●	●
Operations Research	●	●		●
Optical Data Sensing Systems		●		●
Radio & Radar Research	●	●	●	
Reliability		●	●	●
Speech & Character Recognition Research	●			
Solid State Devices	●		●	
Simulator Systems	●	●	●	
Systems Integration Techniques	●	●		
UHF-VHF Circuit & Component Design		●	●	●

Now consider the opportunity for personal growth offered by our parallel advancement plan. Here, you can pursue your career as an Engineering Specialist, choose Technical Management or go into Program/Project Management. In all cases, the rewards and advancement opportunities are *equal.*

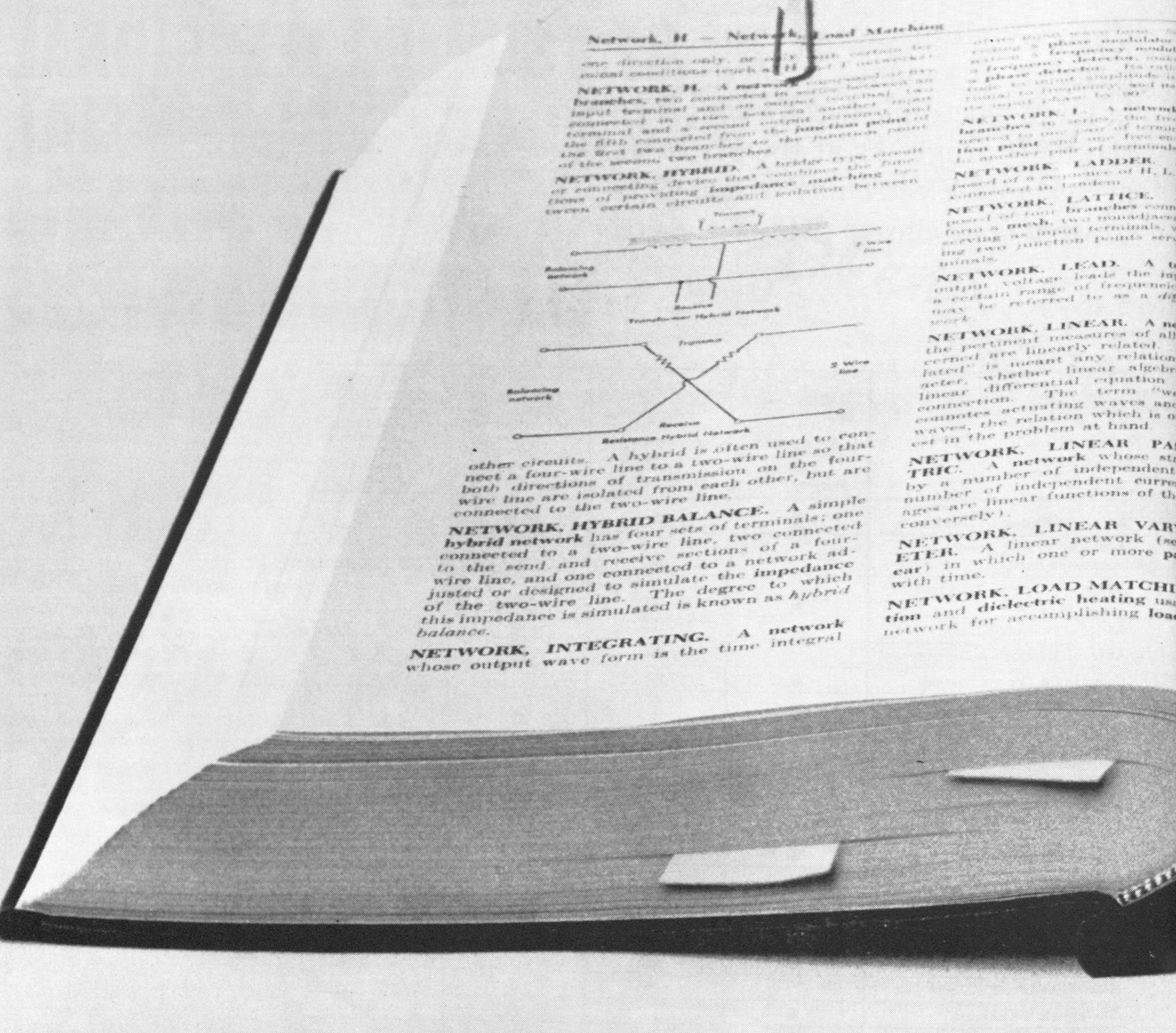
Sylvania Electronic Systems is a major division of Sylvania Electric Products Inc., and provides over-all systems engineering and management on major government projects for the parent company, General Telephone & Electronics.

For further information, contact your College Placement Director or write to Mr. Robert T. Morton.

SYLVANIA ELECTRONIC SYSTEMS
Government Systems Management
for GENERAL TELEPHONE & ELECTRONICS

40 Sylvan Road — Waltham 54, Massachusetts

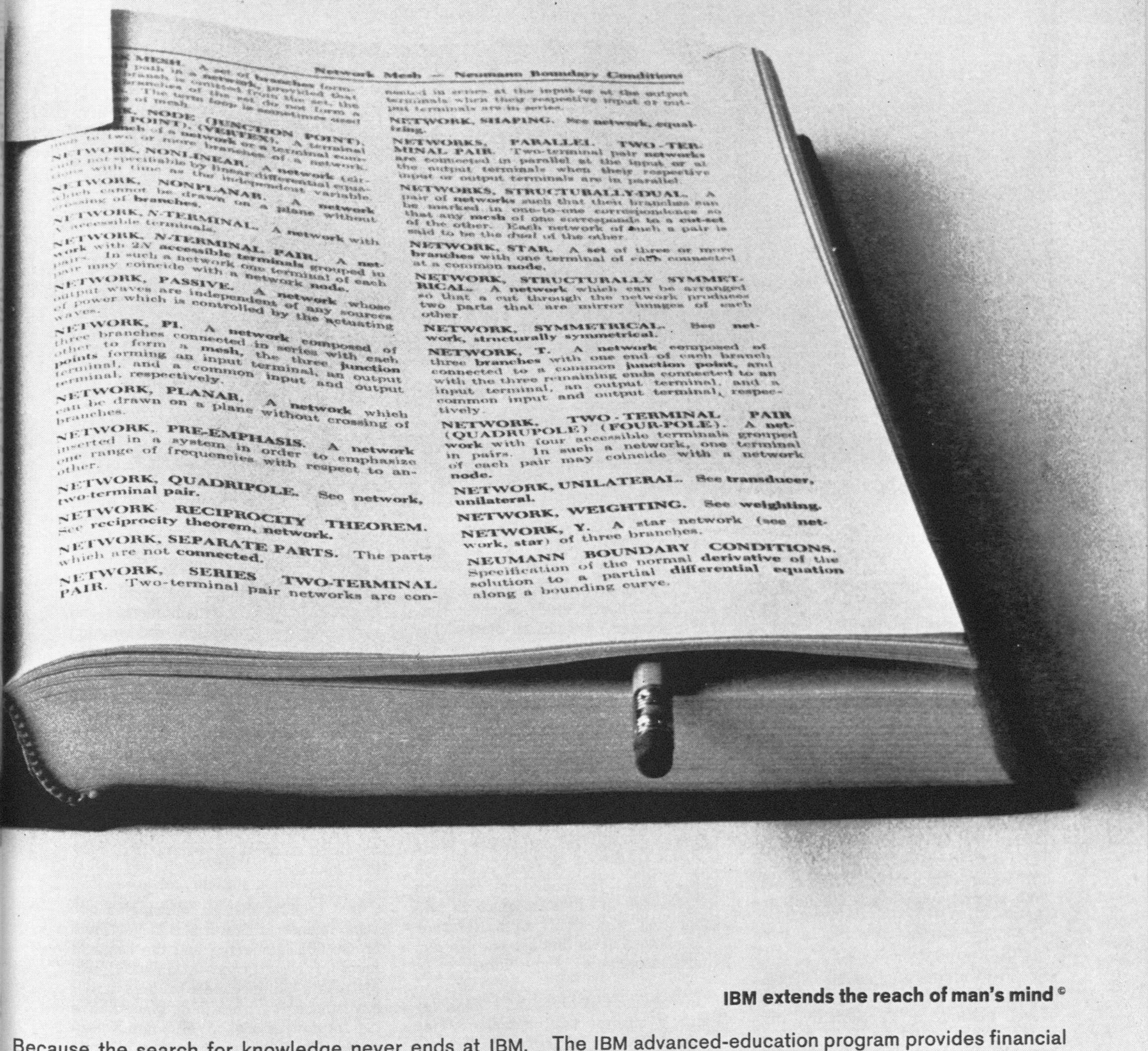
AN EQUAL OPPORTUNITY EMPLOYER U. S. Citizenship required



At IBM® your search for knowledge never ends

At IBM, engineers and scientists are working on some of the most-advanced areas of technology. The study of this new world of data processing technology may lead to significant achievements in research, development, and production—new methods, new systems, and new equipment for extending the reach of man's mind. Seeking basic answers, IBM is embarked on a wide range of research and engineering projects that include the theoretical and practical aspects of: simulation... information-retrieval systems ... magnetic memories ... chemistry ... machine organization ... radiation effects ... mechanical analysis ... and mathematics.

The objectives of IBM scientists and engineers are to synthesize available knowledge, probe new concepts, and develop new techniques. The end results are new ways to broaden the applications and effectiveness of data processing systems for science, defense, government, business, and industry. For example, thin-film circuitry is being developed that will increase the speed, versatility, and economy of future systems. In addition, experimental machines have been devised to read handwritten numbers, and many styles and sizes of printing. Other laboratory work involves information retrieval and automatic machine recognition of voice commands.



IBM extends the reach of man's mind ©

Because the search for knowledge never ends at IBM, data processing discoveries and achievements provide a challenging framework for career opportunity in many new areas of activity. Scientists and engineers can build a rewarding professional future, finding new insights while contributing to IBM's progress in fields such as: magnetic thin films, cryogenics, optics, semiconductors, or solid-state miniaturization. The challenges are varied and great—and career opportunities just as unlimited—in data processing, systems design, applications, circuit-logic studies and design, mathematical research, and advanced programming techniques.

The IBM advanced-education program provides financial support for earning graduate degrees in the field of the individual's choice, or for branching out into new areas. IBM education programs cover on-site training, advanced-degree courses at universities nearby, and competitive, full-time scholarships leading to M.S. and Ph.D. Degrees at a university selected by the employee. IBM, an Equal Opportunity Employer, offers a company-paid benefits program designed to meet the individual's needs as well as his family's. For details, see your placement officer or write to: Manager of Employment, IBM Corporation, Dept. 915, 590 Madison Avenue, New York 22, N. Y.

Dr. James L. Lubkin

FACULTY

During his leisure hours, one of our new College of Engineering professors here at Michigan State, Dr. James L. Lubkin, might be found in one of Michigan's forests trying to sight his three hundred and ninety-fifth species of bird. A glance at Dr. Lubkin's background, however, reveals a very few of these "leusure" hours.

Dr. Lubkin received, from Columbia University, a Bachelor of Science degree in November 1944, in Mechanical Engineering; a Masters of Science degree in October 1947, also for Mechanical Engineering; and his Ph.D. in May 1950, specializing in applied mechanics.

In May of 1950, Dr. Lubkin became affiliated with the Engineering and Applied Physics Division of Midwest Research Institute in Kansas City, Missouri. From 1950, through January 1956, he added many accomplishments to his wide background of experience in engineering.

Dr. Lubkin conducted and supervised analysis calculations of the interior ballistics, longitudal and torsional vibrations of recoilless weapons, as well as some experimental vibration measurements. Numerous classified reports on this subject were prepared by him. He was project head for analytical and experimental study of short-time (10-microsec.) impact on plates. The analysis was carried out using the Mindlin-Uflyand plate theory, allowing for rotary inertia and shear. Dr. Lubkin was also project head for a study of how to apply electronic computers to the analysis of piping flexibility in complex systems, and to rigid-framed structures. He collaborated with Y. L. Luke on a study, for Wright Air Development Center, of the natural modes and frequencies of delta-wing (triangular) plates. Dr. Lubkin served as project head for analytical research on stresses in adhesive joints, in collaboration with Prof. Eric Reissner (consultant.) It is this subject that Dr. Lubkin considers his specialty.

In February of 1956, Dr. Lubkin became a charter staff member of the Central Research Laboratory, American Machine & Foundry Co. in Conn. It was here that he organized and ran a laboratory working on the circular sawing of wood and metals. This work required acquisition and design of laboratory machinery and instrumentation, active supervision of research equipment construction, and various studies of saw vibration and cutting efficiency. This led to considerable experience in the experimental field, including the design and application of strain gage dynamometers and torquemeters, vibration and motion transducers, electrical instrumentation and recorders.

During this period, Dr. Lubkin was a part-time teacher at the University of Connecticut with the title of Lecturer. He taught six graduate courses (M.S. level) including: elementary and advanced vibrations, elasticity theory, advanced engineering mathematics, and advanced strength of materials (a two-part course.)

Dr. Lubkin will be working in two departments at State: the Department of Civil Engineering and the Department of Metallurgy, Mechanics, and Materials Science. As he puts it: "I have much learning to do since I have two organizations to slip into." Because Dr. Lubkin arrived on campus after the beginning of the term, he will be helping Dr. Cutts with one course and getting settled. In spring, he will teach CE880-Matrix methods for the analysis of structures, and AM 813-Theory of Elasticity. Dr. Lubkin expects to become a graduate advisor for masters and doctoral candidates. Through this, he expects to become involved in considerable research activity.

REVUE

by John B. Locke

Dr. Donald S. Gage

"My research interests, in the field of semi-conductor devices, include avalanche multiplication, radiation effects in semi-conductors, and epitaxial processes for making semi-conductor devices," says Dr. Donald S. Gage, a new electrical engineering professor at State. When he is not pursuing one of these areas of research or teaching, however, Gage, with his wife, may be found preparing to sing in the choir at the University Methodist Church.

Gage received his B.S. in Electrical Engineering in 1953 from Northwestern University, and his M.S. and Ph.D. from Stanford University in 1954, and 1958, respectively. At Stanford, he taught sophomore courses on principles of circuits and principles of machines. Returning to Northwestern in 1958, Gage taught nine different courses ranging from junior classes in physical electronics and applied differential equations to graduate courses in semi-conductor theory and on semi-conductor devices. He held summer jobs on the technical staffs at the Bell Telephone Laboratories, Hughes Semi-conductors, and the Gas Dynamics Laboratory at Northwestern University. Gage is presently employed, in addition to his duties at State, as a consultant to Boeing Airplane Company for problems dealing with transient radiation effects in semi-conductors.

Gage belongs to the Institute of Electrical and Electronics Engineers (formerly the Institute of Radio Engineers), the American Association of University Professors, and has been active in the National Electronics Conference.

Gage's main interest in the department of electrical engineering is the Pilot Program of the same department. This program, started two years ago, involves a complete revamping of the curricular for juniors and seniors. The primary objective of the program is to bring this curriculum up to date with the times. Dr. Gage will be working this summer to renew the Materials sections. This spring, he will be teaching courses in this Pilot Program and a course in the regular curriculum.

Dr. Shanker Lal

FACULTY REVUE

by John B. Locke

"Technical Education in India is expanding at a very rapid rate" said Dr. Shankar Lal, visiting professor of Mechanical Engineering here at MSU.

He went on to explain that the number of technical institutions awarding engineering degrees has more than trebled in the past fifteen years. Furthermore, the educational system which is fashioned largely after the British, is slowly changing and being influenced by the American system.

"One of the reasons why I came here," Dr. Lal explained, "is to get a first-hand knowledge of American teaching methods and institutions."

In the British system the responsibility of instructing and examining are usually not entrusted to the same individual. A school in India, be it a high school or a university college, has primarily only the responsibility of instructing the pupil, while the University to which it is affiliated has the responsibility of appointing examiners, having the candidates examined and awarding degrees. It was in this way that Dr. Lal received his school certificate from Cambridge University in 1938.

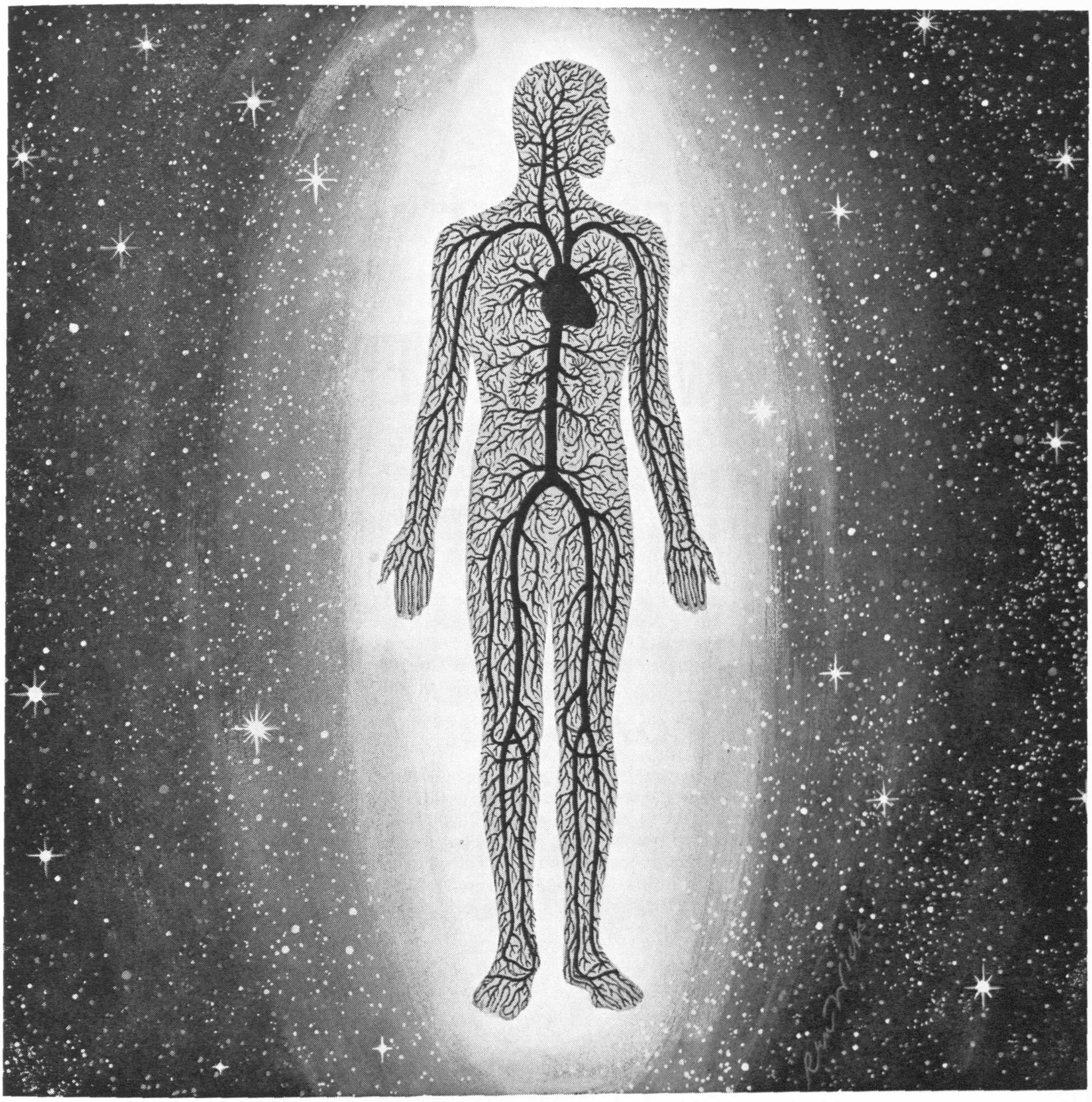
Dr. Lal then studied at Patna University in India from where he received the Intermediate Science Degree. His Bachelor of Science Degree was obtained with honors from the Banaras Hindu University and his Diploma of the Indian Institute of Science was given by the Institute of the same name in Bangalore. The latter was a post-graduate diploma.

There are now nearly a score of institutions in India that offer post-graduate education in engineering and technology. But, in the early 40's, there were none. So Dr. Lal went overseas and studied at the Imperial College of Science and Technology, London, from where he obtained the Diploma of the Imperial College in Aeronautics. He accomplished his Masters Degree in Aeronautics at London University and received his Ph.D., also in Aeronautics, from the California Institute of Technology in Pasadena.

Dr. Lal has served as a lecturer and then an assistant professor in Mechanical Engineering at the Banaras Hindu University. He has been the acting Head of the Department of Mechanical Engineering at Roorkee University and Professor and Head of the Department of Mechanical Engineering at the Tharpar Institute of Engineering and Technology, Patuala. He comes to MSU from Auburn University where he was visiting Professor of Mechanical Engineering last year. During this period he has taught graduate and undergraduate courses in thermodynamics, fluid mechanics, gas dynamics and heat transfer.

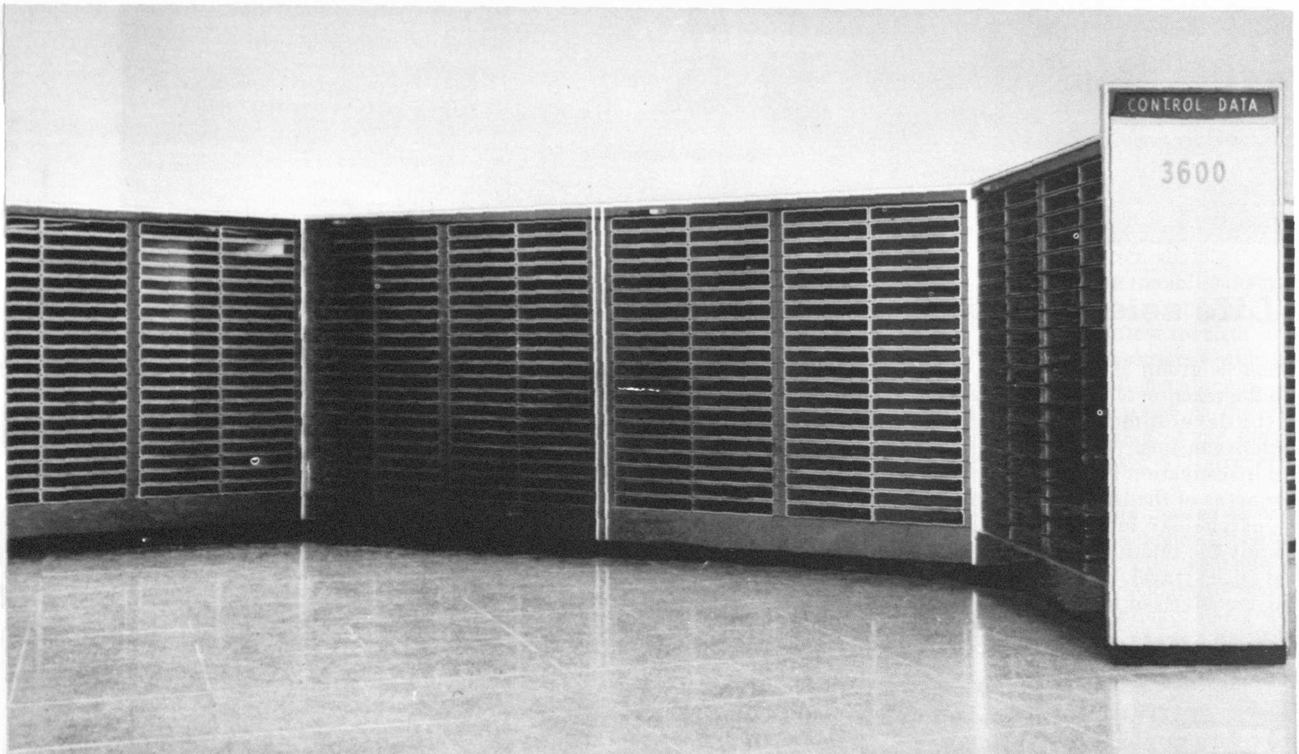
As research engineer at the Natural Gas Turbine Establishment in U.K., Dr. Lal worked on problems connected with high speed flow through cascades. He was also associated with the National Luchvaart Laboratorium in Holland where he worked on the evaluation of test-flight data of the then newly developed Fokker S11 aircraft.

Dr. Lal has worked on problems associated with de-icing of low-drag wing Sectcoris, comprehensible boundary layer theory and performance of liquid rocket propellants using aerodynamic heating. Currently, problems of epi-hydrodynamics hold Dr. Lal's research interests. He is also working on a four-volume series of text-books on basic mechanical engineering subjects to be used in schools in India.



THE MACHINE with an ELEPHANT'S MEMORY

3600 computer at MSU



MSU Photo Service

by John Callahan

The Michigan State Computer Center will soon receive a new million dollar computer installation. The 3600 computer installation is a new system being produced by Control Data Corporation. Michigan State will be the first to receive one of these installations.

The computer itself consists of four separate modules: computing, storage, communications (input-output), and the operatore-maintenance console. The computing module, designated 3604, performs the arithmetical and logical operations. It also translates commands for sequencing operations. The communication module, designated 3602, governs the input-output operations of the 3600. It contains an arithmetic and control section, a storage access control section, and is provided with eight input-output channels. Four data input-output units are supplied with the system. The storage module, designated 3603, consists of a magnetic core storage unit with a capacity of 32,768 51-bit words. It provides a high-speed, random access storage unit. The operator-maintenance console is equipped with all the controls necessary to operate the computer.

In addition to the four basic units, the installation will utilize Input-Output units consisting of a card reader (rate: 250 cards per minute), a card punch (100 cpm), a line printer (1000 lines per minute, 120 characters/line), 6 magnetic tape inputs (83,500 characters per second), and the 160A computer (acquired by MSU last year) to which the card reader, magnetic tape and line printer will be attached.

All of these units combine to produce a large-scale, stored program, general-purpose digital computing system. Calculations and data processing is performed in a parallel binary mode. Instructions are executed step-by-step and are stored internally along with the data. Entirely solid state, the computer uses transistor amplifiers and diode logic units.

INSTALLATION

The computer itself will be installed on the second floor of the Computer Center in a specially constructed room. A sub-installation on the first floor will supply a temperature and humidity controlled environment in the computer room. The air is also filtered to remove dust particles. The sub-installation is now nearing completion and the computer units are scheduled to be installed in April. The entire computer installation should be operational soon thereafter.

FLEXIBILITY

The basic 3600 system has provisions for many additions and modifications. Although the basic system is usually furnished with four bi-directional input-output channels, the system to be installed here at MSU will utilize only two of these. However instead of the normal input equipment, this installation will use the 160A computer (a computer already in use here) as a data source. The 160A will, in turn, have three data input-output sources. The combination of card punch and 160A computer will provide, in effect, four data sources while using only two of the 3600's data channels. Since the 3600 is capable of using up to eight data channels, there will be tremendous room for expanding the system. Not only does the 160A serve as a data source for the 3600, but the computing units of the 160A increase the capacity and versatility of the 3600 system.

Furthermore the computing system itself can be expanded. Up to three communication modules can be added, each having eight input-output data channels. (That's a total of 32 and, using the 160A, 34 data channels!)

Computing modules can also be added for greater arithmetic and logical capabilities (provided the total number of communication and computing units does not exceed five). In addition to the magnetic core units (it is possible to have up to eight, for a total of 262,144 51-bit words) the system here at MSU will be using the external magnetic tape units through the 160A. These magnetic tape units provide a large permanent storage memory system which also increases the storage capacity of the 3600.

Perhaps the newest computer available, the 3600, is expected to relieve the current overload on the Mistic and 160A computers. The extremely high speed and large capacity of the 3600 computer combined with the flexibility and expansion characteristics of the 3600 is expected to provide MSU with a powerful computing tool.

PROJECTED USE

The 3600 has a large mission to perform. Michigan State's first large computer, the Mistic, has been operating at capacity for some time now. The 160A, acquired last year, has relieved some of the strain, however the demand for computer time far exceeds the current capacity. Many programs are being sent to universities and the surrounding areas for running on computers there. With the completion of the 3600 it will be possible to handle at the campus the programs sent out now. At the same time, the expanded capacity of the 3600 will make possible research and problem solving which would not have been attempted before due to the lack of available computer time.

The users of the Computer Center are many. The chemistry department, the physics department, the engineering department, the economics department, and the agriculture department all make extensive use of the facilities. There are several computer classes using the Computer Center and much use is made of the computers by researchers. With the arrival of the 3600 much more computer time will be available to all departments.

CLASSES

Classes to instruct students in the use of the 3600 were begun some time ago. When the installation is ready for use there will be a backlog of persons capable of utilizing the facilities.

FORTRAN

The 3600 utilizes a system of programming known as Fortran. This is a simplified system of programming in which the computer itself prepares part of its program. Fortran permits the use of more familiar mathematical

Continued on page 46

SPARTAN ENGINEERS

by Becky Pagel

In fall of 1962, MSU saw the formation of a new organization in the College of Engineering. This organization, Spartan Engineers, is composed of outstanding freshman students in Engineering who are acting as a nucleus group to create a new and more vigorous interest in the College and its various functions.

Membership is available to any freshman or sophomore engineering student who is a National Merit semi-finalist. At the present time there are 39 Spartan Engineers.

Among the first tasks of the group were the drawing up of a Constitution and the electing of officers. The following officers are serving until the end of spring term: chairman, James Hudek; vice-chairman, Warren Williams; secretary, Becky Pagel.

The Spartan Engineers as a whole have engaged in several activities during the past two terms. Many of the members have been granted undergraduate research assistantships, a capacity in which they do outside work individually with a specialist in their particular field of interest in the College.

Guiding tours for such groups as Sigma Xi, Engineering Alumni, and high school students participating in the Distinguished Alumni Scholarship Tests have been a regular duty of the members. Also, the staff of the Spartan Engineer Magazine is composed of a number of the engineering students. Included in these are John Callahan, Joe Devet, Lester Zischke, Orville Barr, John Stephenson, and Becky Pagel.

Although these people are now assistants, next year the Spartan Engineers will assume complete responsibility for publishing the magazine, which appears four times a year.

Spartan Engineers is divided into five standing committeees, with each undertaking certain projects. Public Relations, Engineering Exposition, Seminar and Program, Finance, and Special Projects are the committees specifically provided by the Constitution.

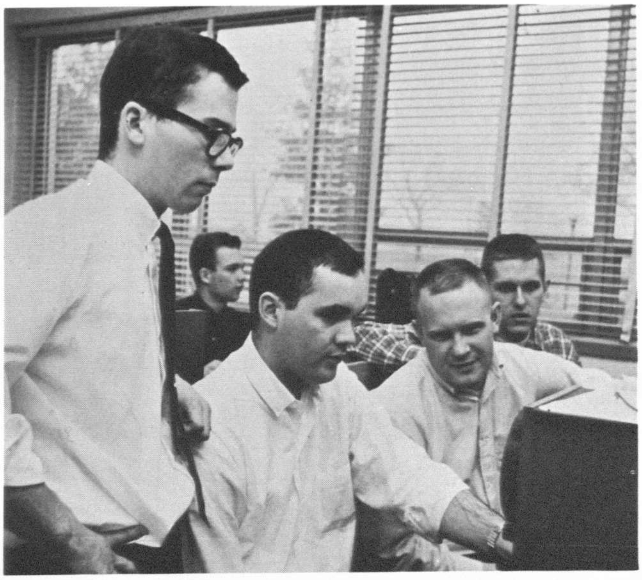
The Engineering Exposition Committee, headed by Jon Dann, has a busy schedule for the months ahead. This group is the coordinator of the many activities of the Junior Engineering Technical Scoeity (Jets) National Engineering Exposition to be held at Michigan State this May 3-5. Jets is a national organization to promote participation in engineering on the high school level. The interest and ability of individuals is tested by these Jets Clubs. 39 states are to be represented, with high school students entering both projects and research papers on a number of subjects. Held in conjunction with this will be the annual College of Engineering Exposition. The arrangement of entrees and elements of the judging are to be decisions of this committee.

Joe Devet, the chairman of Public Relations, has kept his committee functioning at a rapid rate. One of the main efforts of this group is the publicizing of the Jets Engineering Exposition. This is being accomplished in two ways. Letters are being written to two thousand industries, inviting their personnel men to the Exposition to view the achievements of high school engineering students. Also, the heads of science departments from schools in the Michigan, Indiana, and Ohio areas are invited to the Exposition with their outstanding science students. This committee is responsible for the arrangements of sending the Honors College Bulletin to all members to keep them informed of colloquiums and seminars of interest. Furthermore, Public Relations will be sending articles concerning the organization to the home town newspapers of each Spartan Engineers' member.

The Finance Committee, with Dave Gantz as chairman, is making arrangements for a banquet as the semi-climax of the Engineering Exposition. The banquet will be at the UnionBuilding on Saturday, May 4th. This committee is also sending its members as speakers to various high schools with Jets Chapters. These people inform the students about numerous facits of the engineering program at Michigan State.

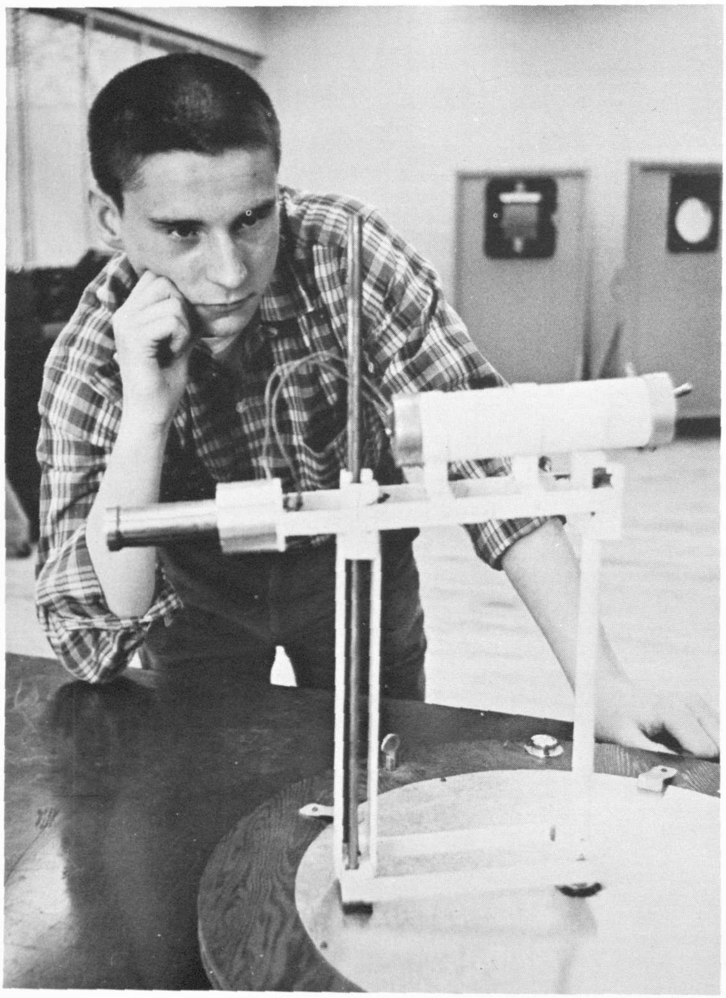
The Seminar and Program Committee, with chairman Tom Hewett, seeks out interesting programs for the Spartan Engineers meetings. Among the speakers provided by the committee were Dean Ryder of the College of Engineering and Dr. Hess from Honors College. The Dean showed slides taken during his trip to India, and he told of the Engineering opportunities in that country. Dr. Hess discussed the different types of education, as well as information on beneficial courses of the University. A special program is planned for spring term to which all engineering freshmen will be invited to promote interest among all the students in this category.

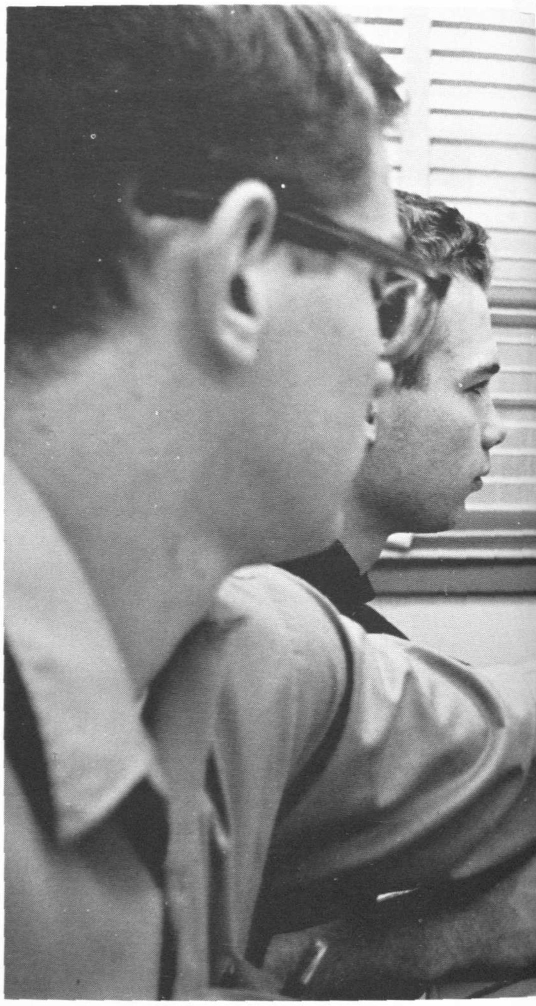
Continued on page 48

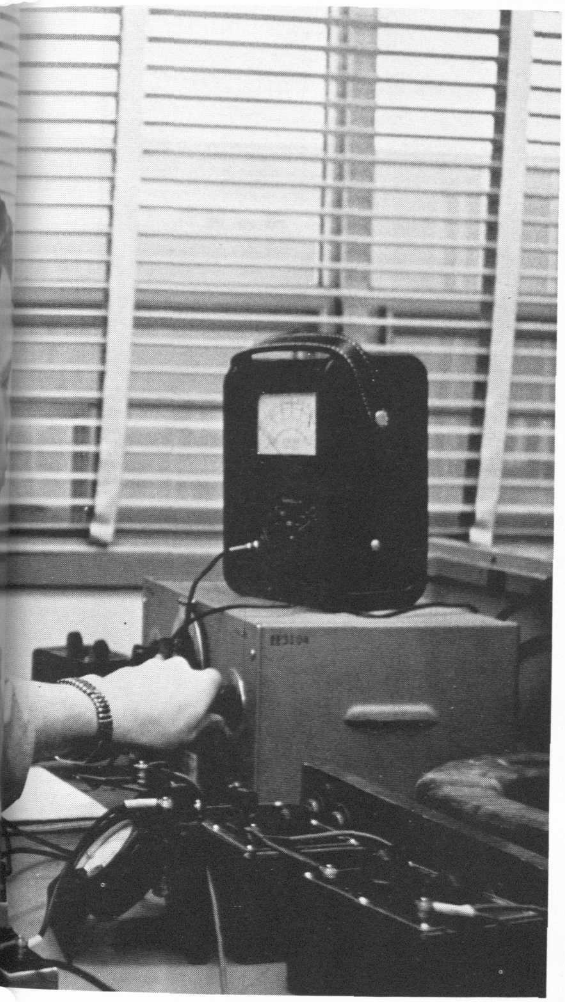


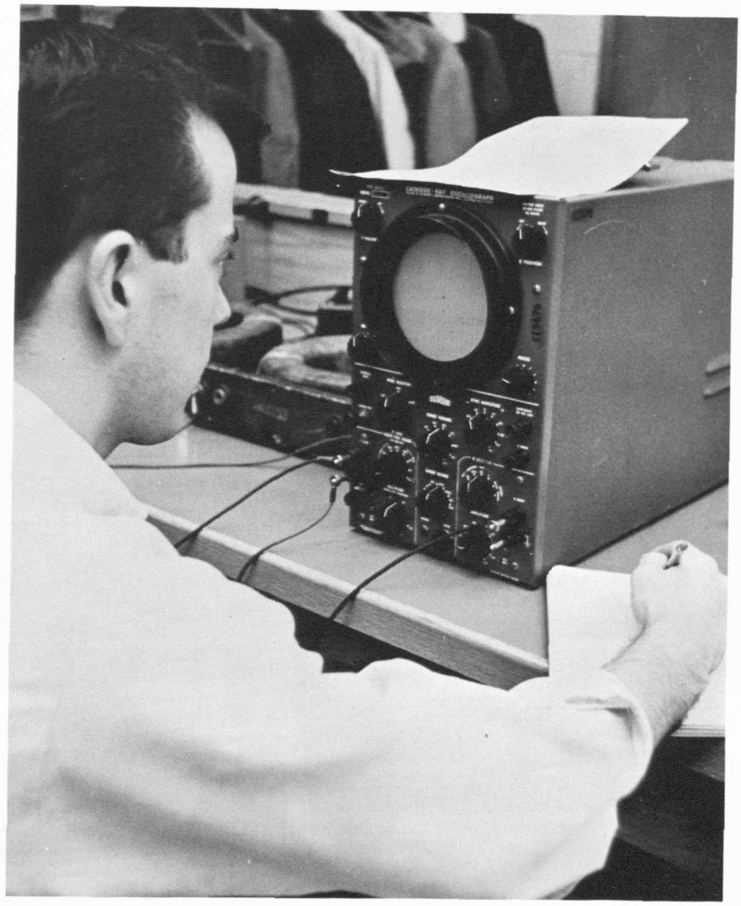
Photos by Mark Krastof

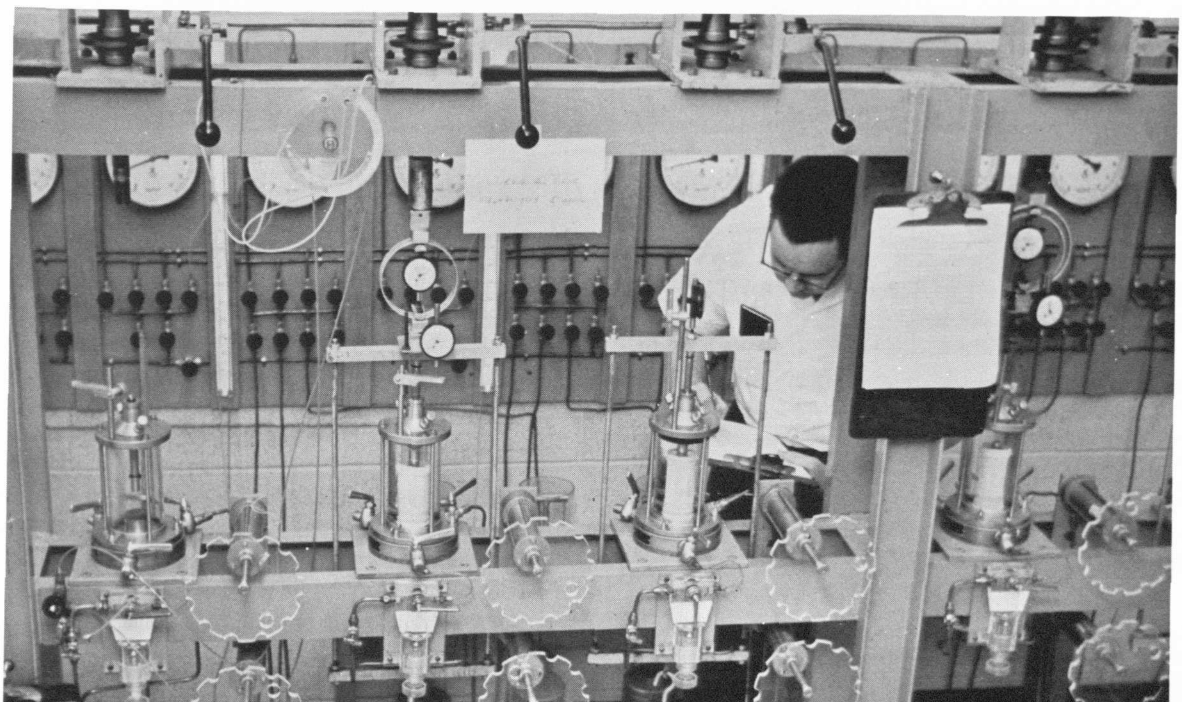
Continued on next page

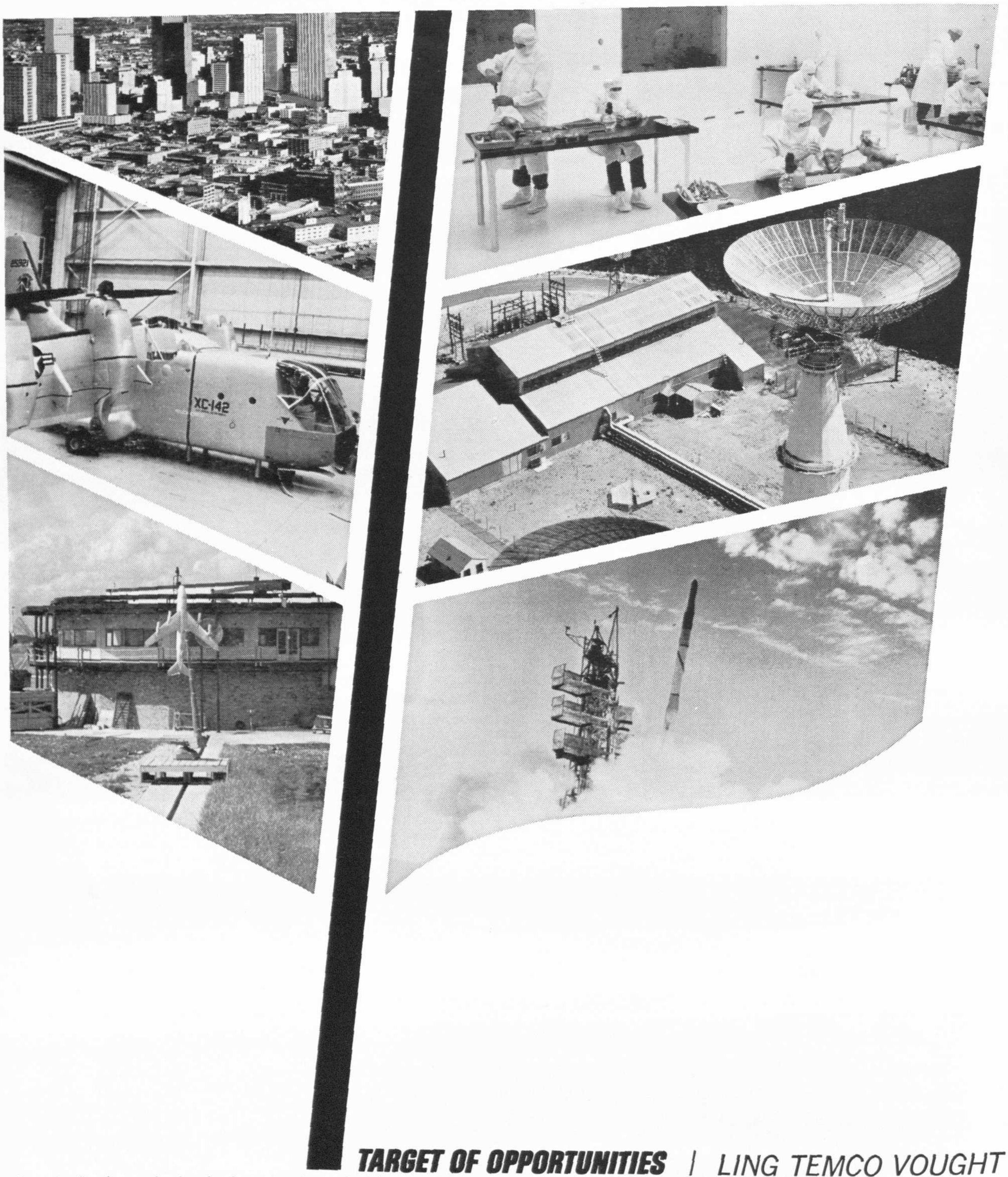











XC-142

JETS

ANNUAL NATIONAL

ENGINEERING

EXPOSITION and CONFERENCE

NORTH CENTRAL DIVISION

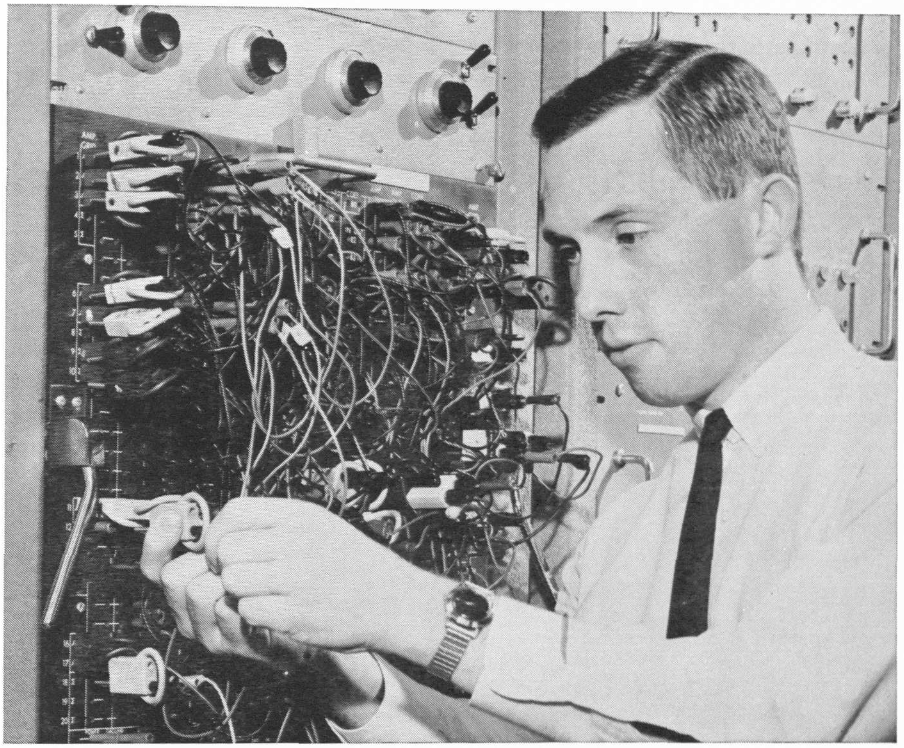
MICHIGAN STATE UNIVERSITY

East Lansing, Mich.

MAY 3-5, 1963

Projects and Technical Papers to be entered in the following categories:

- Aeronautical (Astronautical) Engineering
- Agricultural Engineering
- Chemical Engineering
- Ceramic Engineering
- Civil-Architectural Engineering
- Electrical Engineering
- Electronic Engineering
- Geological Engineering
- Mechanical (Industrial) Engineering
- Metallurgical Engineering
- Nuclear Engineering
- Tool Engineering
- Petroleum Engineering
- Mathematics



Richard E. Covert, Iowa State BSME '62, utilizes an analog computer to study heat transfer transients and their effect on the control mechanism of a mobile military compact reactor being developed by the Allison Division of General Motors under contract to the Atomic Energy Commission. Covert is one of several young engineers now engaged in various studies connected with nuclear powerplant engineering programs at Allison.

● **NUCLEAR ENERGY CONVERSION**—For the last 5 years, Allison, the energy conversion Division of General Motors, has participated in the design of various nuclear powerplants requiring compactness and low weight. Work on these projects has resulted in the compilation of a formidable background in nuclear systems engineering for space and terrestrial powerplants.

Announcement by the Atomic Energy Commission of the selection of Allison as prime contractor for development of MCR (Military Compact Reactor) now creates opportunities for well-qualified Engineers and Scientists in a long-range program in the nuclear field.

The MCR is a lightweight, completely self-contained nuclear reactor power system—easily transportable by truck, aircraft or rail—designed to provide packaged power for a wide variety of applications. It will have a high temperature, liquid metal cooled reactor coupled to a power conversion system. Incorporating long plant life characteristics compatible with military field equipment, the powerplant is expected to reduce the burden which shipment and storage of petroleum imposes on combat forces.

Along with its nuclear, missile and space activity, Allison is maintaining its enviable position as designer and producer of air-breathing engines. Recent developments include advanced types of turboprop engines for greater power with maximum fuel economy and without increase in engine size; a compact lightweight turboprop selected as the powerplant for the Army's next generation of Light Observation helicopters, and thermally regenerative gas turbine engines for a wide range of vehicular and industrial use.

Perhaps there's a challenging opportunity for you in one of the diversified areas at Allison. Talk to our representative when he visits your campus. Let him tell you first-hand what it's like at Allison where "Energy Conversion Is Our Business."

An equal opportunity employer

Allison

THE ENERGY CONVERSION DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

INDUSTRIAL LIMELIGHT

by Sharyn Smith

Water Immersions of Hydroplanes.

SPARTON CORPORATION

Buggy parts to sonar detectors. Wars and top engineering talent paved this road for the Sparton Electronics, division of Sparton Corporation, Jackson, Mich.

Sparton, once the manufacturer of buggy parts in a small plant, now is a leader in the design, development and production of electronic products for military use. Thirty years of technical knowledge and manufacturing experience in radio, television and commercial electronics plus top engineering talent knitted the highly integrated team that has won recognition for Sparton in military electronics.

The Sparton Electronics division, located in a 210,000 square foot modernized building in Jackson, is the largest of three Sparton corporate electronics facilities in North America.

With more than a decade of experience, Sparton electronics is a leader in the design, development and production of sonobuoys for the Department of Navy, Bureau of Naval Weapons.

The sonobuoy is an expendable item, designed to be dropped from an aircraft into the sea, where it detects underwater sounds and transmits them to the dispensing aircraft or other suitable radio receiving stations.

Other areas of production are oceanography, communications and navigation, special products and precision electro-mechanical devices of unusually high reliability. High reliability, demanded by the Space Age is a byword at Sparton Electronics, while quality is combined with modern techniques to meet all commitment deliveries on time, including short term cycle crash programs.

Progress was the key word at Sparton in 1962 and more progress is the word for the future. Engineers completed Sparton's first modern electric computer, miniaturized an important sonobuoy system, designed a new Very High Frequency receiver for the Air Force, and developed the first ultra-reliable miniature limit switch.

A signal data converter, signal data converter control, bathythermograph transmitter set and other equipment have been integrated by Sparton Electronics to form a complete, accurate bathythermograph system. This system transmits and records temperature and depth data from the sea.

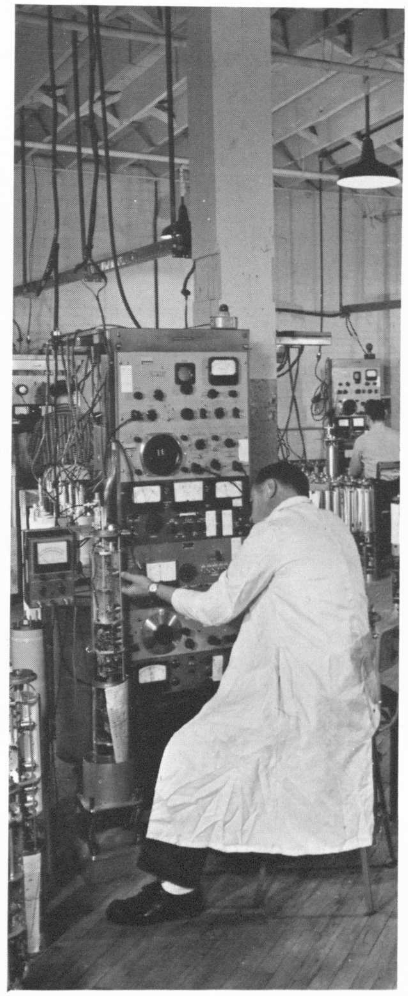
In the field of communications and navigation, Sparton Electronics used the newest developments in circuity, modular and miniturization techniques and navigation equipment, which are constructed of light-weight metals to insure a long life. Equipment includes: airborne instrument landing system; receiver; electronic monitor receiver; frequency division data link receiver.

A wide range of transformers, chokes, and coils, as well as specialized test equipment are designed and produced at Sparton when commercial contracts are not available.

Quality assurance operations specify that all equipment must meet Sparton quality standards; that products fully meet all contractual requirements; and are responsible, in part, for field service.

Personnel, experience, equipment and techniques are forged together to assure the quality of the equipment in accordance with customer specifications. The quality assurance department maintains a full range of equipment for inspecting finished products

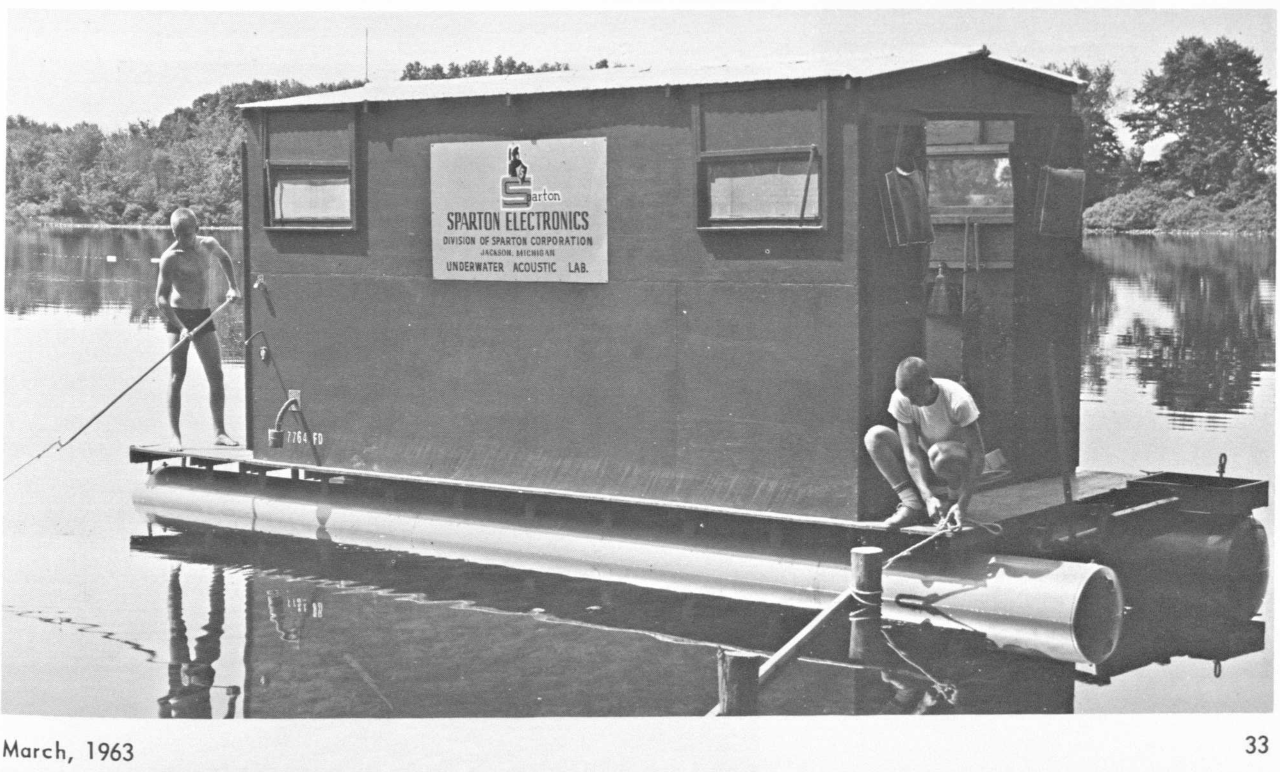
Continued on page 53



Above – General production area, it varies as the equipment made.

Right – More testing of the product.

Below – Floating underwater acoustic lab.

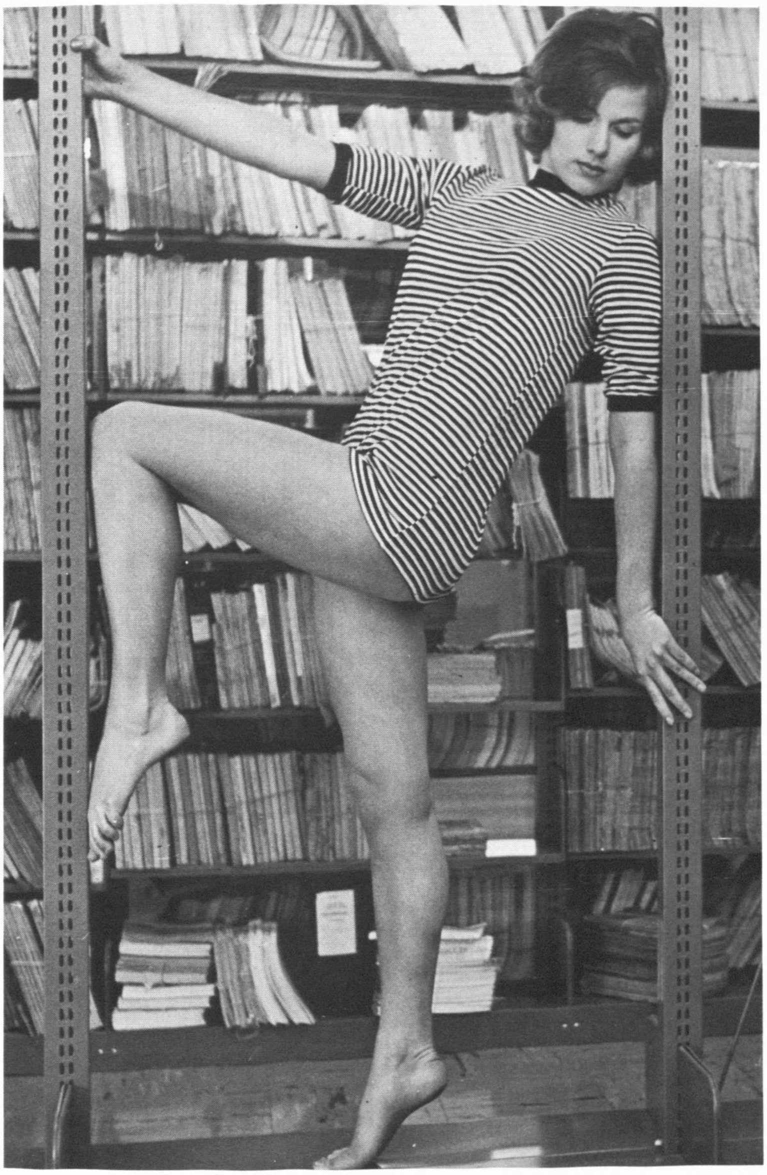


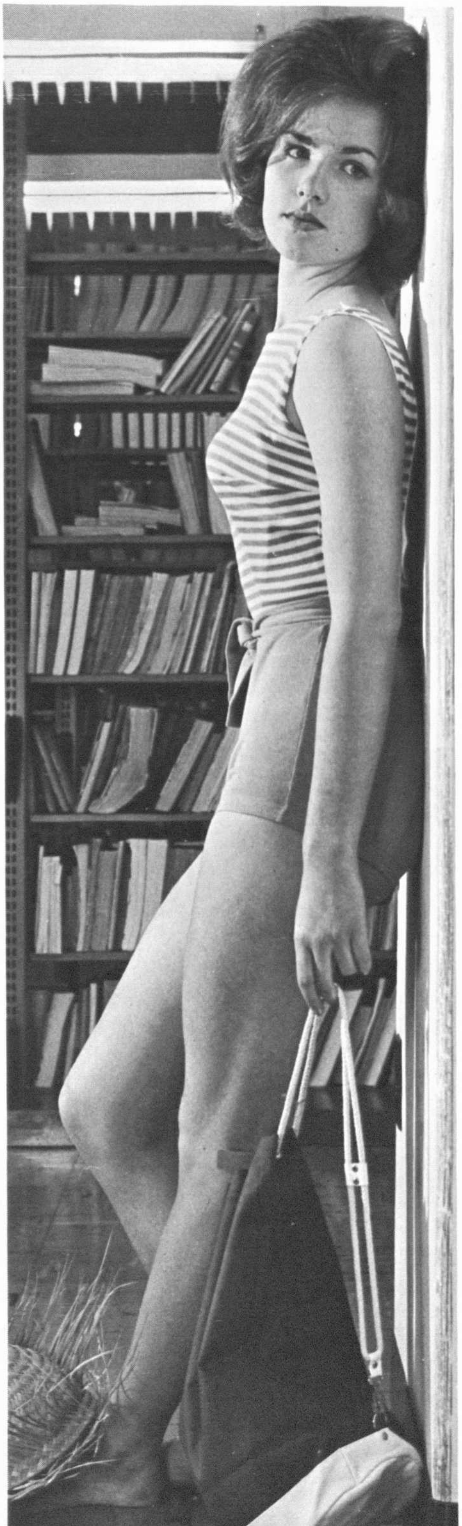
MISS ENGINEER

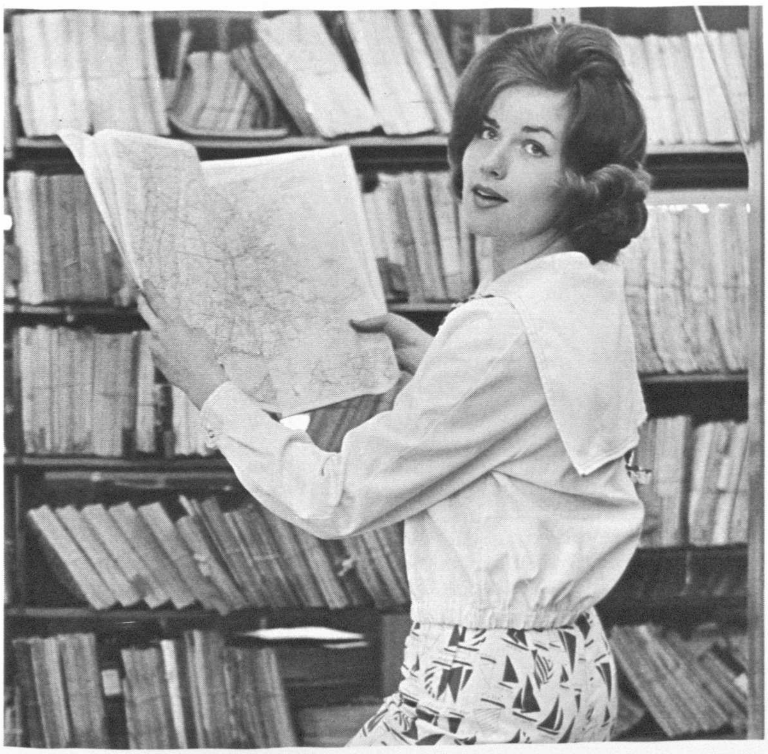
Ilse Steins

Fashions by Scotch House

Photos by Mark Krastof

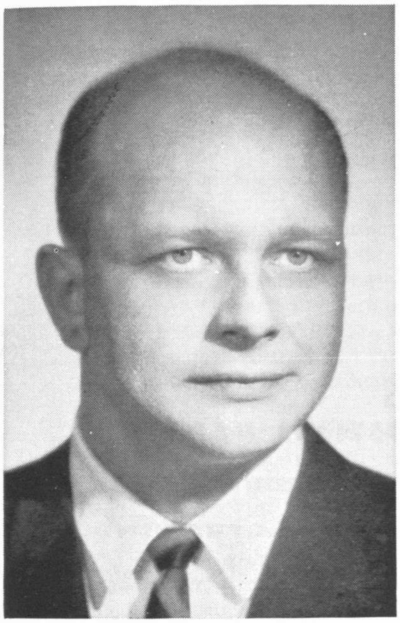




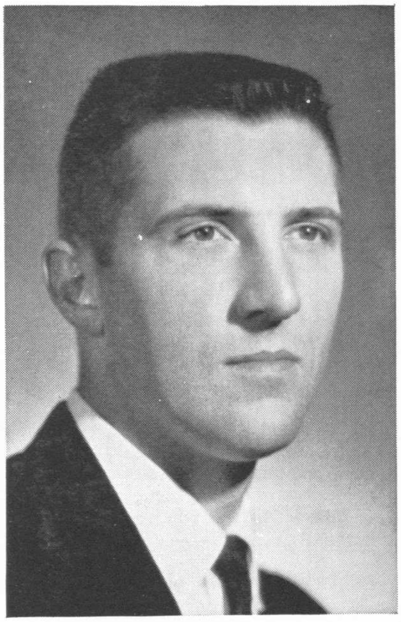


Story on page 44

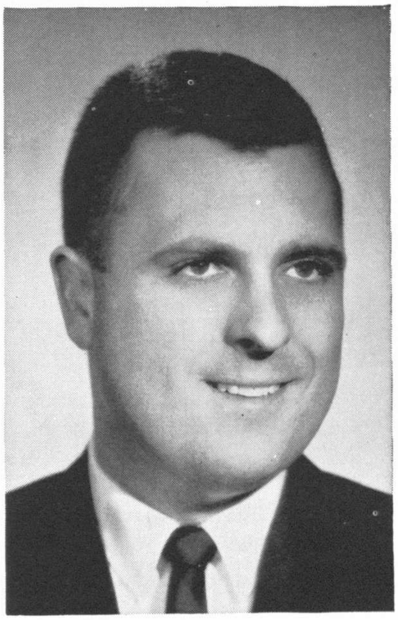
AUTOMATION PROBLEM SOLVERS



MANUFACTURING ENGINEERING
R. H. Menzel
Michigan Tech—BSME—1955



CONTROL ENGINEERING
L. Gall
University of Illinois—BSEE—1960



ANALYTICAL ACCOUNTING
A. E. Morgan
University of Wisconsin—BA—1960

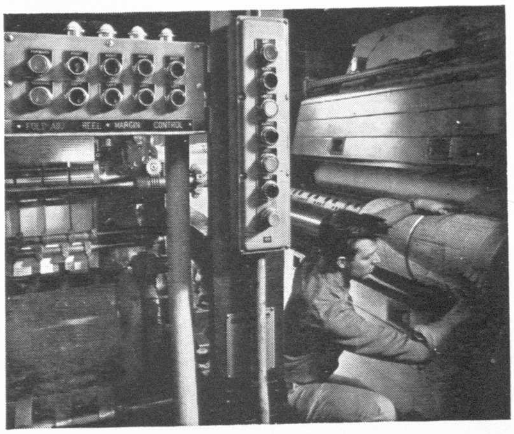
you, too, on a Cutler-Hammer automation team

as a young, creative-minded graduate? Short range, it's an exceptional opportunity—if you spark to the challenge of finding new solutions to tough manufacturing problems. An unusual opportunity to get deeply involved in problem solving right from the start!

Long range, being a key member of a Cutler-Hammer automation team is an excellent way to get the diversified experience so essential to continuing career development and future advancement. It's particularly beneficial if you have aspirations to move into management ranks.

Want to know more?

Write today to T. B. Jochem, Cutler-Hammer, Milwaukee, Wisconsin, for complete information. And, plan to meet with our representative when he visits your campus soon.



A CUTLER-HAMMER AUTOMATION TEAM helped the WALL STREET JOURNAL solve major production and distribution problems of a national newspaper by designing and building control systems for two new, highly automated printing plants. Controls permit the world's fastest presses to produce newspapers at the rate of 70,000 per hour.

Cutler-Hammer is an equal opportunity employer.

WHAT'S NEW? ASK...

CUTLER-HAMMER

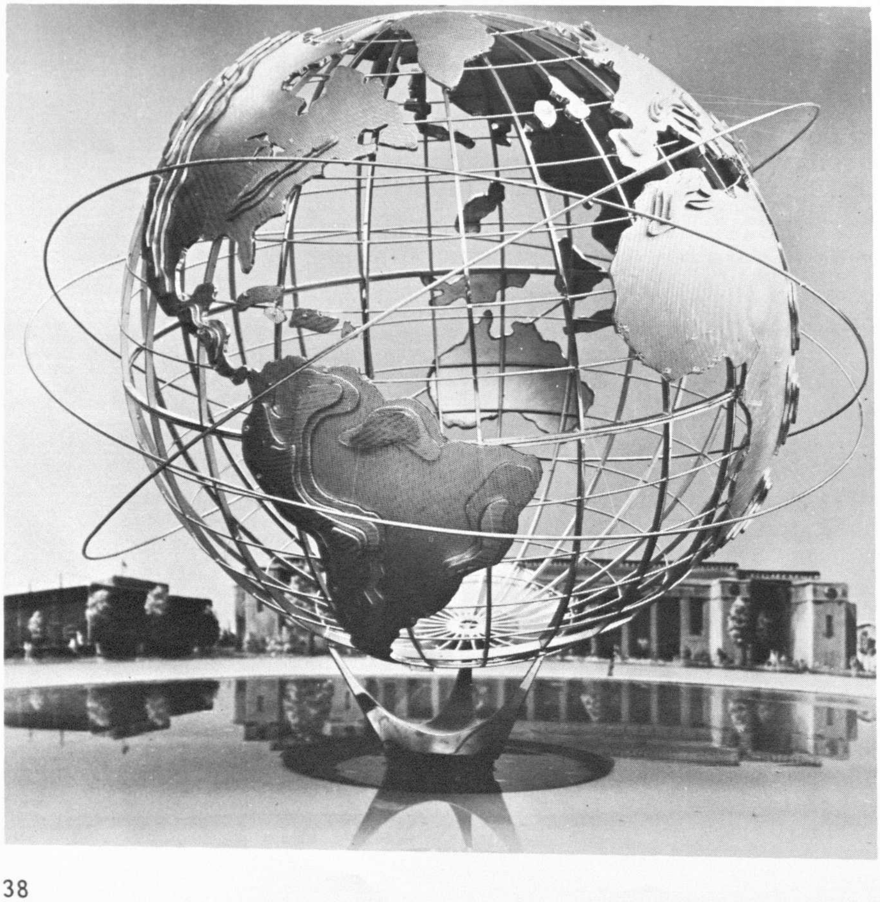
CONTROL

Cutler-Hammer Inc., Milwaukee, Wisconsin • Divisions: AIL; Thayer Scale • Subsidiaries: Uni-Bus, Inc.; Cutler-Hammer International, C.A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer Mexicana, S.A.

How to MAKE A UNISPHERE

AUSTIN J. PADDOCK,
Vice President
US Steel Corporation

Remarks before the Board of Directors
New York World's Fair



This photo of a model of Unisphere permanent symbol of the 1964-1965 World's Fair presented by United States Steel, gives a see-through view of the unique structure. With stainless-steel-clad structural members comprising the latitudes and longitudes, the Unisphere features land masses and mountain ranges fabricated from rigidized stainless steel sheets with a special pattern designed to reflect light. American Bridge Division of United States Steel, which is fabricating and erecting the Unisphere, is starting construction Wednesday, March 6.

During an earlier meeting, you gave us a little homework to do. I am pleased to report today that this homework now is completed. We believe the answers are correct.

Briefly, here is the work assignment you gave us to solve:

Problem: For purposes of monumental beauty only, complete a feasible design for a stainless steel structure 12 stories high, the sole function of which is not to help perform any human work but, rather, by its appearance only, to inspire mankind the world over for ages to come. To make the structure beautiful on both the inside and outside and as viewed from any direction. To make it generate breathtaking awe from any height, when viewed from the level of its base or from the cabin of an airplane above. To make its interior complement its exterior so that each blends, always with the other.

To make it graceful yet grand, light yet massive, solid yet transparent, bright yet diffused. To make it pleasing to see at any hour from dawn to dusk, in shadows or sunlight, rain or snow. And at night, to make it appear with the same beauty under floodlights.

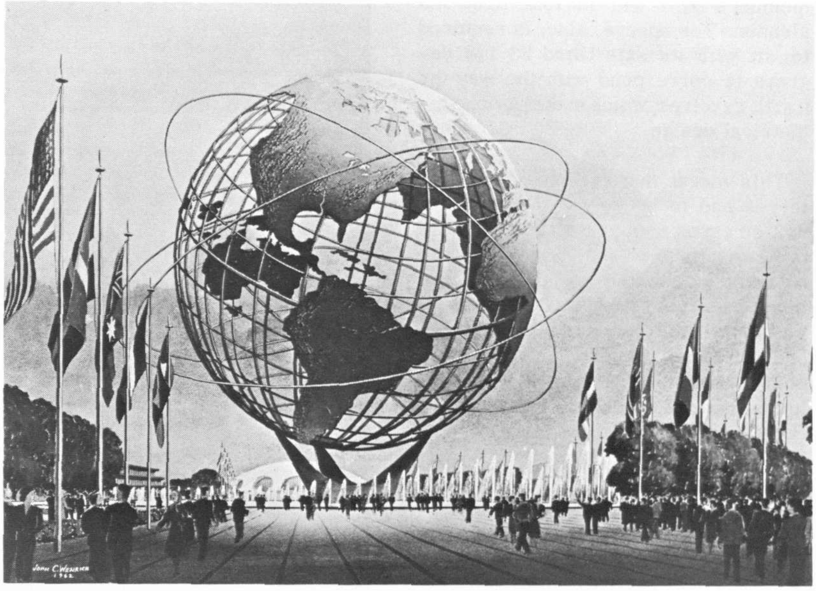
Further: Make it a spherical structure detailing the continents of the earth; where each line, committed centuries ago to a predetermined place, must perform the work of holding it together; where it must be unsymmetrical; where its base must be small yet strong, airy yet solid to keep winds from upsetting it; where basic conditions of esthetic design--determined by nature eons ago -- must be met within the laws of engineering science; where all pieces of the structure either fall in toward each other or fall away from each other; and around which three three-ton, stainless steel orbital rings must be placed without any discernible means of fastening them.

And finally. Make the structure appear effortless, as if creating and building it were of no consequence at all.

This, then, was our homework: Complete a feasible design for the Unisphere.

We are pleased that you entrusted to us the solution of this difficult problem. For there are aspects to this mental exercise that make the Unisphere unique in the history of monumental architecture.

First is the design itself. Symbolic monumental architecture, of course, is not new. The Great Pyramids, the Eiffel



Seen by Artist John C. Wenrich in its permanent setting at Flushing Meadows, this is Unisphere, symbol of the 1964-1965 New York World's Fair to be fabricated, built and presented by United States Steel Corporation.

Tower and the Washington Monument, for instance, each reflect esthetic characteristics of their respective ages that were arbitrarily chosen. In this sense, no predetermined design and esthetic restrictions were imposed, and their creators could do pretty much as they pleased, within the laws of engineering.

The Unisphere departs from this free-flowing, unrestricted use of art. The die -- esthetically speaking -- was cast right from the start, when the decision was made that a model of the Earth be the symbol of the 1964-65 New York World's Fair.

Doubtless, other symbols could have been selected to allow for greater freedom of esthetics -- no one of which ever would have completely satisfied everyone, since tastes do change from generation to generation. The more timeless the design, the more esthetically enduring it is. It is, therefore, no great shock to me that you selected the most timeless design of all, The Earth, as your symbol.

This leads to another intriguing aspect. In a sense, the traditional roles of engineering, design and esthetics in construction have been virtually reversed. Usually engineering feasibility is determined first. The structure was to be a sphere with predetermined lines of support -- the meridian and parallels; with its surfaces-- the land masses -- also predetermined by location and configuration. These fixed esthetic requirements had to be met with sound engineering and good design.

Still another aspect of the Unisphere adds to the weight of the problem. Peter Muller-Munk and his team of industrial designers, who worked with us, put it this way:

"The Unisphere cannot be treated as a building or other traditional monumental structure, for in reality it is a piece of open sculpture. This is perhaps the most demanding form of art. For it must exist from all sides, with no one texture, surface or line out of harmony with another."

So, its inside surfaces must be as appealing as the outside, requiring methods to fasten it together so that bolts, welds and other fastening devices do not mar its beauty.

The engineering and design problems surrounding the Unisphere, we believe, are among the most complex found anywhere.

Since the design specifies an "open" or Armillary Sphere -- to symbolize our ties to the past -- no bracing can be used between the meridian and parallel members. This called for a rigid frame design, strong enough not only to support the sphere but also to resist transverse wind loads. And these

Continued on next page

members still had to look light and slender. The sphere, also, is required to sit with its axis tilted 23 1/2 degrees to correspond with the way the Earth revolves, which makes an unsymmetrical design.

This meant that over 1,500 unknown forces had to be solved to determine unit stresses so that steel could be used to its maximum! These problems were so complex that they were broken into three separate sections, the largest of which involved solving 670 simultaneous equations! By comparison let me point out that, as a general rule, not more than 30 to 40 such simultaneous equations are needed in analyzing some of the more complex modern structures!

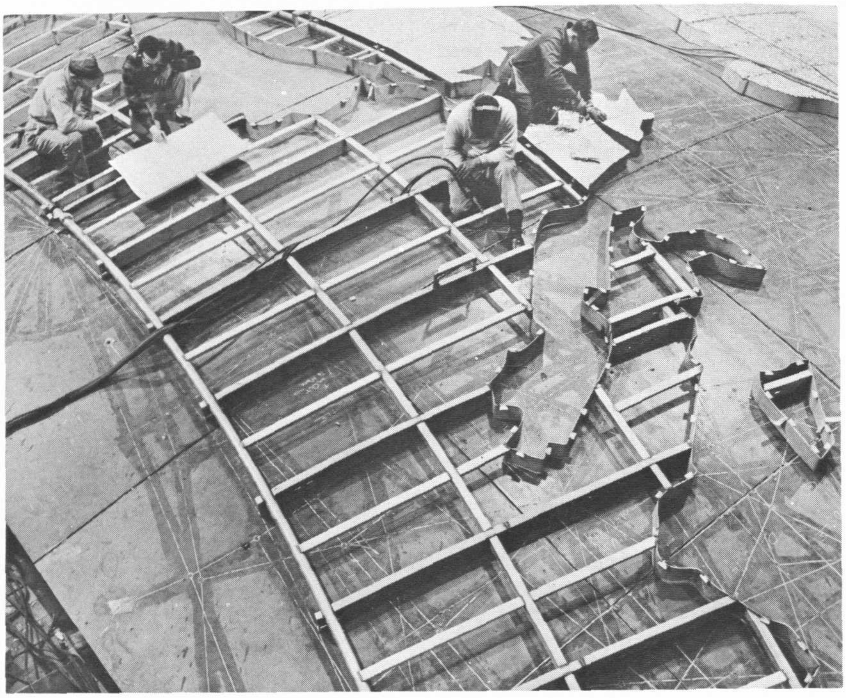
Gentlemen, that is a lot of algebra!

For us to have calculated these 1,500 problems manually might have taken perhaps as long as ten years! But fortunately America's ingenuity and technical genius paved the way for us. We were able to solve our simultaneous equations through the miracle of electronics. We had the use of some of the most advanced electronic equipment anywhere in the world, which belongs to the Electric Boat Company at Groton, Conn., and which is used to solve the detailed problems of building our atomic submarines. As a result, we solved our problems in only a few weeks!

It is safe to say that a few years ago this particular design of the Unisphere would have been too impractical to calculate. For many safety factors would necessarily have been designed into the sphere, obviously making its steel members heavier and, therefore, less appealing. So, it was the pride of perfection that challenged us to achieve the best design by using the properties of stainless fully, so that each structural member, in turn, achieves a light, fine line appeal. We wanted the Unisphere to reflect the best of what can be done in steel -- even when basic esthetics are predetermined. And it can only be done in steel, I might add.

Which brings me to another aspect. It was necessary for the industrial design profession to work side by side with the engineering profession right from scratch.

Our American Bridge Division's structural engineers tell me that right from the start Peter Muller-Munk and his industrial design associates were on the scene. The complexities of the problem were such that neither the engineering side nor the design side



How do you build a continent? Here's the answer worked out by United States Steel's American Bridge Division for Unisphere.

made a move without consulting each other. It was a case of mutual effort and teamwork of the highest caliber. Certainly this speaks well of the progress of design and engineering in this country.

Engineering a final esthetically appealing design for the Unisphere is somewhat different from designing a hood ornament or an exotic park fountain. For one thing, mock-ups can be built close enough to scale so that overall visual effects of the end product can be predicted.

But knowing ahead of time exactly how an open sphere, 120 feet in diameter, will look is another matter. A two-foot model of the structure is seen in an entirely different perspective than if you or I were standing at the base of the real 12-story article--the point from which most people will view the Unisphere.

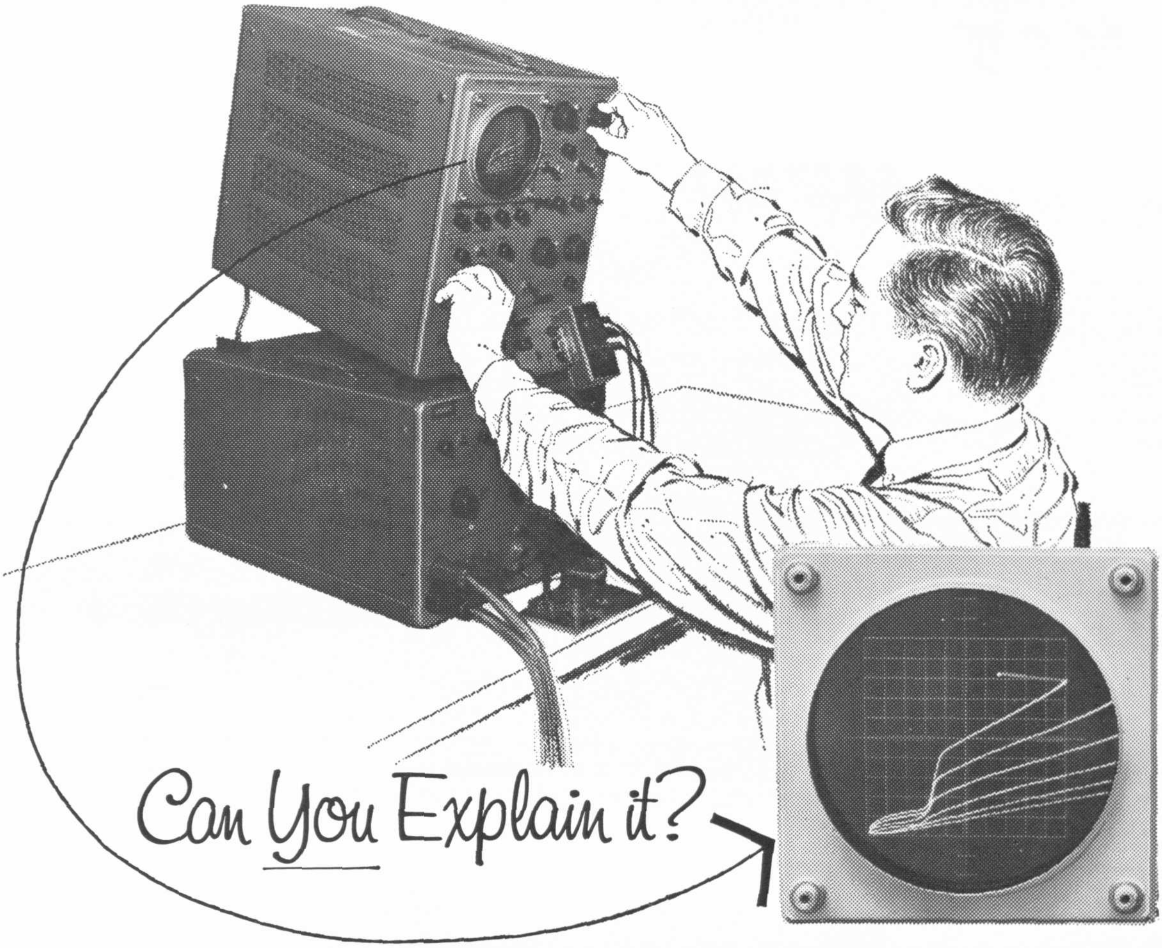
Thus the key problem in design -- except for the unit stresses -- was one of "visual mixture," a kind of optical illusion where something viewed up close looks different when seen farther away. It was this bogy that required a constant interchange of ideas between our American Bridge people and the Peter Muller-Munk designers.

Their first detailed consideration, of course, was the base. When we view a two-foot model of the world from the top side, the base is of relatively little importance. But when people view the Unisphere, the base will be the structure immediately in front of them --rising 20 feet above the reflection pool. Esthetics here is obviously important, and so Peter Muller-Munk created the design for a 70-ton open sculptured base to convey lightness, grace and simplicity and yet kept it engineeringly sound to support a 250-ton sphere. The base also had to hold the sphere steady against wind load over three times as great as the dead load. In fact, we even conducted wind tunnel tests on a model of the Unisphere to be certain of our calculations.

The problem was not too unlike fastening a beach ball to a golf tee -- a slight exaggeration, perhaps, but it does convey the idea that we had some real design problems.

Next on the list was the choice of structural members for the sphere itself. Here again, engineering was used only as a means to an esthetic end. What kind of structural members should be used for the slender meridians and parallels? Should they be round tubex or hollow rectangles? What about their surfaces -- highly reflective or dull? What about joining problems -- welding, bolting or what? How could sections doing most of the support work

Continued on page 48



When a transistor performs like this on a curve tracer, we like to know why. Sometimes the answer is obvious. Then again, we may find it not so easily explained. This our semiconductor device people like. They enjoy sinking their teeth into a knotty problem and sticking with it till they shake out the answer—and it usually doesn't take long at Delco.

Why? Easy.

When you toss a problem to a group of talented men . . . provide the necessary research tools . . . in an environment that encourages personal initiative and achievement . . . you can't help getting results. This combination has helped build a position of leadership for Delco in the development and production of semi-conductor devices.

We intend to keep it that way—through expanding facilities and fresh talent.

Our new R&D center—125,000 sq. ft.—houses laboratories equipped with the latest in sophisticated research facilities. Our new semiconductor manufacturing center—226,000 sq. ft.—scheduled for operation this June, will provide an expanded capability in the production of silicon rectifiers. All of which adds up to new opportunities in research, development and production of silicon rectifiers.

• SEMICONDUCTOR DEVICE DEVELOPMENT—

BS in Physics, Metallurgy or Electrical Engineering; minimum of 2 yrs. experience in high current silicon rectifier development; must be capable of developing these devices and maintaining technical responsibility through pilot production.

• PHYSICISTS, CHEMISTS AND METALLURGISTS

For semiconductor device development; experience in encapsulation, alloying and diffusion, chemistry of semiconductor devices, materials (to lead a program on metallurgical research of new semiconductor materials).

• ELECTRONIC ENGINEERS—

Experienced in machine controls (relay and/or static) to assist in the development and application of static transistorized controls.

• TRANSISTOR PROCESS ENGINEERS—

EEs, MEs, and IEs to develop and create new processes for manufacturing germanium and silicon semiconductor devices and to develop automatic and semi-automatic fabrication equipment. Experience preferred.

If you're looking for an opportunity to fully exercise your personal competence . . . *among men of talent* . . . in unmatched facilities, why not make arrangements to talk with our interviewer when he visits your campus. Or, write for additional information: Mr. C. D. Longshore, Supervisor of Salaried Employment:

An equal opportunity employer

solid state electronics

DELCO RADIO DIVISION OF GENERAL MOTORS

KOKOMO, INDIANA

MSU

NEWS NOTES

Edited by ORVILLE BARR

The Junior Engineering and Scientist Summer Institute (JESSI) will be sponsored by the College of Engineering this year.

JESSI, scheduled for June 16-29, is an exploration in the engineering and science areas of learning. Boys who will enter the 11th or 12th grade in September, or who will graduate in June, will meet in class-size groups with scientists and engineers of the University faculty.

Harwood Phend, assistant to the Dean of Engineering, and associate director of JESSI, is coordinator of the seminar.

"This is a first-time effort to explore engineering and unique areas in science --the areas that are not taught to promising students in high school," Phend said.

"We want to bring out the new concepts in engineering and science," he continued, "to broaden their (high school students) views and give them an idea of what to expect when they reach the college level."

"To be eligible for this conference, boys must have had a total of three to four years of high school math or science. The same qualifications apply to girls who will attend the DePauw University JESSI for girls at Greencastle, Ind.

The students will attend classes in groups of 25 to 30 members. Each group attends three hours of classes in the morning, two in the afternoon and a general session in the evening. The students will be in class six hours daily but will have private conferences with the JESSI staff members during their free afternoon hours.

The total per capita costs for the two-week JESSI is: $120. These fees include all on-campus expenses--room and board at Snyder Hall, field trips, tuition, notebooks, insurance, and costs incident to program activity.

Limited funds are available for student-aid purposes. The granting of aid is based on real need and academic achievement. To qualify for aid, an applicant must have a G.P.A. in all high school academic subjects to date, beginning with the ninth grade, the equivalent of 3.0 or better.

The JESSI program is entering its eighth season and is held on college and university campuses across the nation. The program is administered by Scientists of Tomorrow, a Portland, Ore., non-profit, tax-exempt organization dedicated to public service.

☆ ☆ ☆ ☆

The new library in the Case-Wilson-Wonders complex will bear the name of two workers who lost their lives during the construction of Wilson and Wonders dormitories.

A plaque commemorating the two workers, William R. Mannor and Fred Price, will be permanently affixed to a wall near the entrance of the library.

Copies of the student committee resolution dedicating the library were given to the families of the two men, and to the labor unions and contractors who built the two dorms.

The Price-Mannor library, a student project, is downstairs in the multipurpose area of Wilson. Student volunteers staff the library. It contains over 3,000 paperbacks and hardbacks which were donated by students and faculty and bought with University-appropriated funds.

Through student work and faculty backing, the library became a reality in January. It will serve an estimated 3,000 students six days a week. The library is open 7 to 10 p.m. on weekdays and Sundays.

"The whole library project was student inspired," Richard J. Coehlo, coordinator of continuing education in University College, said. "Students followed tentative plans with book drives, fund campaigns, and other projects to obtain books for their own library."

Recently the main library director, Richard E. Chapin, announced a donation of $5,000 of reference works for the complex library, from the main library.

Continued on page 44

MSU News Notes

Continued from page 42

Before Christmas, graduate advisors and scholarship chairmen from Case and Wilson received money from the University College, the Provost, and the main library to buy $1,500 worth of paperback books.

"We took boxes, went to the book stores, and threw in books of all sizes, shapes, colors and topics," Phoebe Hammer, North Case graduate resident advisor said.

More books reached the library shelves from drives, dances, and even a faculty book dinner.

Beverly Belson, head resident advisor at North Case, offered to give one book for every five that students donated.

One large laundry cart overflowed with 600 books that students paid for entrance to a book dance held in Wilson during Winter registration week. A student band from South Case donated their services as 125 copies of the Crucible, required freshman reading, made the scene.

"I don't know what we can do with all the Crucibles," Coehlo said. "We can probably sell them to incoming freshmen for a dime apiece."

Faculty members and their wives from the Case-Wilson block shelled out books, no Crucibles, for a steak dinner in the Wilson 1962 room. Guests of honor included: Edward A. Carlin, Dean of University College, and his wife; Richard E. Chapin, director of libraries, and his wife; John E. Dietrich, chairman of speech, and his wife. Dietrich gave the keynóte address at the dinner.

Students check out the donated books themselves, on a weekly basis. A public shame system punishes holders of over-due books by posting these students names on the bulletin board near cafeteria lines in their dormitory.

A sign on the wall reads:

All violators will be assigned an additional roommate.

Needless to say, overdue books are a rarity. But if a student fails to return a book and another student needs that book, a phone call to the holder can have the book to him in three minutes.

A unique classification system, the brainchild of Michael Ferrari, graduate advisor of East Wilson, is employed in cataloging the books. Colored dots and dashes tell librarians and students what classification the paperback is.

Computers For Rent

From Applied Dynamics

A well-known need of analog computer users, the ability to expand their equipment temporarily, but at reasonable cost, has been filled by Applied Dynamics, Ann Arbor, Mich., with an announcement of a novel plan for short-term rental of nonlinear computer components. This is the first time an analog computer manufacturer has offered off-the-shelf, overnight delivery of multipliers and fixed function generators for rental over a period as short as a month with the option to buy on a prorated basis.

Problem solving ability of an analog computer, which is essential by a paralelled operating device, is limited by its size, that is, the number of operational elements it contains. Because problem complexities tend to vary widely, most users select computers which contain a reasonable balance of equipment so that problems which most often occur can be adequately handled.

However, when an outsize problem comes along, particularily one with a number of nonlinearities in it, the user has been forced either to buy expensive nonlinear components such as multipliers and fixed function generators or to apply programming tricks to fit the problem to his existing machine. Unfortunately, the latter solution generally requires approximate linearizations that tend to radically decrease the value of the study.

Now a third option is offered the user by Applied Dynamics, that of renting these expensive components for a short period. This approach permits the user to get exactly the type and quantity of equipment desired when it is needed! Also, he is assured of getting up-to-date components which have been factory calibrated to meet highest performance standards.

Equipment available from Applied Dynamics includes quarter-square multipliers; dual X2, dual log X and combination sine-cosine diode function generators; and chassis for 19-inch rack mountings and for PACE computer mountings. Cost is 10% of list price per month; minimum rental period is one month.

The short-term rental plan can be converted into an annual rental plan; in this case all money paid towards continuous short-term rental plan can be converted into an annual rental plan; in this case all money paid towards continuous short-term rental will be applied to the annual charge of 5% per month. Any item rented for six months can be kept a year at no additional cost! Rented equipment can also be purchased; in this case 85% of the paid-in rental money will be applied against 85% of the list purchase price.

MISS ENGINEER

Name: Ilse Steins

Born in: Rega, Latvia

Hometown: Grand Rapids

Age: 20

Class: Junior

Specs: ht.—5', 7½"
hair—brown
eyes—hazel
stats.—37-24-38

Hobbies: dancing
art (major)
skiing
archery
swimming
sailing
studying
modeling

What about the engineers?
"They're terrific guys"

3600

Continued from page 21

symbols and makes it possible for persons using the facility to write their own programs. After receiving the Fortran program, the computer itself translates the program to computer language and determines its own sequencing in order to make the best use of computing time.

With the increasing demand for computing time, the 3600 will fill a definite need. The purchase of the system will provide the University with a large scale computing installation and provide opportunities for expanded research and mathematics programs.

Note: For those interested in the technical aspects of the 3600, the following sections, with excerpts from CONTROL DATA 3600 PRELIMINARY REFERENCE MANUAL by Control Data Corporation, are included.

TECHNICALLY SPEAKING

SYSTEM CHARACTERISTICS;

Stored-program, general purpose computer.
Parallel mode of operation
Single address logic
51-bit storage word (48 bits of data, 3 parity bits)
Six 15-bit index registers
Indirect addressing
Magnetic core storage (options available)
- 32,768 51-bit words in two independent 16,384 word units (alternately-phased)
- 1.0 usec effective cycle time (representative program)
- 1.5 usec total cycle time

Input-Output
- Transmission of 48-bit words (12-bit bytes)
- Four separate bi-directional input-output channels (options available)
- 1.0 usec per word transmission rate

System interrupt
Flexible repertoire of instructions
- Fixed-point arithmetic (integer and fractional)
- Floating-point arithmetic (single and double precision)
- Logical and masking operations
- Variable length data manipulation
- Block transfers
- Indexing
- Storage searching
- Bit sensing

Binary arithmetic
- Parallel addition in 250 nanoseconds without access
- Modulus 248-1 (one's complement) for single precision operations
- Modulus 284-1 (one's complement) for double precision floating-point operations

Solid -state
- Diode logic
- Transistor amplifiers

Console includes:
- Register contents displayed in octal
- Electric typewriter
- On-line card reader

OPERATIONAL CHARACTERISTICS

The primary 3600 System consists of four modules: computing unit, storage, communications (input-output), and an operator-maintenance console.

COMPUTING MODULE

The 3604 Computing module is divided into two parts: arithmetic and control.

Arithmetic

The arithmetic unit performs the arithmetic and logical operations required for executing instructions. It consists of two operational registers, A and Q. Some of the main functions of these registers are:

1) Participating in the operations of addition, subtraction, multiplication, and division.
2) Shifting operations.
3) Count control in Byte Scan and Locate List Element instructions.
4) Control for conditional instructions.
5) Logical and masking operations.

Control

The control section of the computing unit directs the operations required to execute the instructions, and establishes the timing relationships needed to perform these operations in the proper sequence. It also generates to the communications module the preliminary commands necessary to begin the processing of input-output data.

The control section acquires an instruction from storage, interprets it, and sends the necessary commands to other sections. A program step may be a single 48-bit instruction or a pair of 24-bit instructions which together occupy a single storage location as a 48-bit instruction word.

The unit contains several registers and counters.

The program address counter is a two's complement additive register. It provides program continuity by generating in sequence the storage addresses which contain the individual program steps. Usually, at the completion of each program step, the count is advanced by one to specify the address of the next program step.

The program control register holds a program step while it is being executed. If the program step is a pair of 24-bit instructions, the upper instruction is executed first followed by the lower instruction.

After executing an instruction, a half exit, full exit, skip exit, or jump exit is performed. A half exit always allows the lower instruction or a program step to be executed. A full exit advances the count in the program dress counter by one, and executes the upper instruction of the new program step at the address specified by the contents of the program address counter. A skip exit advances the count in the program address counter by two, skipping the next sequential program step. A jump exit allows a new sequence of instructions to be executed; the storage location of the new instruction is specified by the execution address of the jump instruction.

STORAGE MODULE

The 3603 magnetic core storage module provides high-speed, random access storage for 32,768 words. It consists of two independent storage sections, each with a capacity of 16,384 words. These sections operate together during the execution of a stored program and are considered as one 32,768 word storage system. A storage word may be two 24-bit instructions, a single 48-bit instruction, a 48-bit data word, or half of a 96-bit data word. Three parity bits are generated for each storage word; thus, a storage word is 51 bits in length. These parity bits are generated each time a word is read from or written into storage. The location of each word in storage is identified by an assigned number or address. When a word is taken (read) from or entered (written) into storage, a reference is made to the storage address which holds the word. All odd storage addresses are located in one storage section, all even addressed in the other.

The cycle time, or time for a complete storage reference, is 1.5 usec. Since the storage cycles of the two independent sections may overlap one another in the execution of a program, the average effective cycle time for random addresses is about 1.0 usec.

Each 16,384 word storage section is accessible from five sources, one at a time (thus four communication modules and one computing module may have access to a storage section). The equipment requesting access to storage indicates whether a storage request is for a read reference or a write reference. The storage request specifies the location from which the word will be read, or into which the word will be written. The upper 14 bits of the base execution address specify the location in the bank; the lower-order bit specifies which section (odd or even) is to be used. After the storage request is received by the access section, a scanner examines the five access sections, and permits one to be honored. If the storage section is being used by another access unit the requesting unit waits until the current storage reference is finished.

Storage Bank Selection

The 3600 computer may include up to eight storage modules. This requires the provision for addressing any specific module.

The storage modules are numbered 0 thru 7. A 3-bit bank address designator contained in the instruction itself specifies the bank to which the storage reference is to be made. Thus, a complete storage address is an 18-bit composite address (bank address-execution address).

Once a bank selection is made, all operations are confined to that bank until:

1) the bank address is explicitly changed by the Jump and Set Index instruction, an augmented 24-bit instruction, or

2) an Execute instruction effects a jump to a different bank and the instruction executed as a jump.

COMMUNICATION MODULE (INPUT-OUTPUT)

Input-output operations in the 3600 computing system are initiated by the computing unit and governed by the 3602 communication module. The communication module contains a storage access control section, an arithmetic and control section, and provision for up to eight bi-directional input-output data channels. Two such will be in the system which is being acquired by MSU.

Input or output transfer operations may occur independent of, and simultaneously with, operations in the computing unit. Input or output data is transmitted to or from storage directly, and does not pass through the computing unit.

Arithmetic and Control Section

After operating conditions have been initiated, the arithmetic and control unit of the communication module supervises all input-output activity. The computing module directs the selection of a specific external equipment and channel. A 48-bit control word is read from storage and entered into a 48-bit control register in the communication module. The control word specifies a starting address (storage address from which first output word will be read, or where first input word will be stored) and a 15-bit word count (number of words to be transferred.) The word also specifies the input or output operation, and several control conditions.

A storage request is generated by the channel control (for output) or by the external equipment (for input). Along with the storage request, the communication module supplies the storage module with the required storage address. During the storage cycle, the address and the word count are transmitted to the arithmetic section of the communication module. This section decreases the word count by one and increases the current address by one for each word transferred. The word count is examined after each word transferred. The word count has been reduced to zero, the current transfer operation is complete.

Storage Access Control Section

The storage access control section scans the data channels for storage requests. If a request exists, the request, together with the designated storage address, is sent to the specified storage module. Upon completion of the storage cycle, a resume signal is sent to the storage access control, and the scanner resumes monitoring the data channels for storage requests.

Data Channels

Each data channel is bi-directional; i.e., a channel may be used for both input and output communication. Each 48-bit data word is transmitted in 12-bit bytes and is assembled/disassembled in a 48-bit assembly/disassembly register. A parity bit is generated for each 12-bit byte and accompanies the data transmission. Upon completion of the assembly, the 48-bit word is transmitted to the appropriate storage module via the access control section.

Parity bits accompanying output transmissions are checked by the external equipment. Parity bits accompanying input transmissions are checked by the communication module.

OPERATOR AND MAINTENANCE CONSOLE

The 3601 operator and maintenance console contains all the controls and indicators necessary to operate the 3600 system.

Manual Controls

Manual controls include: Run, Step, Selective Jumps, Selective Stops, Computer Master Clear, I/O Master Clear, Clear Storage, External Clear.

Console Display

An indicator panel on the console provides a visual indication of register contents in octal. Provision is also included for manual insertion of data into the registers.

DESCRIPTIONS OF INSTRUCTIONS WORD FORMAT

A computer word consists of 48 bits and may be interpreted as one 48-bit data word, a 48-bit instruction, or two 24-bit instructions.

Instructions designated by three-letter mnemonic codes of four or more letters differ in format and in word length (some are 24 bits; others are 48 bits).

Instruction formats are arranged in four major classes, according to differences in word length and the position of the function code within the format. A typical format from each class is outlined below.

CLASS I

Class I instruction formats are 24 bits in length and have 6-bit function codes. All instructions designated by three-letter mnemonic codes are included in this category. The Inter-Register instruction, indicated by a four-letter menmonic code, is also included.

CLASS II

Class II instruction formats are 24 bits in length and have 9-bit function codes. All instructions in this category are designated by mnemonic codes of four or more letters.

3600

Continued from page 47

CLASS III

Class III instruction formats are 48 bits in length and have 9-bit function codes. All instructions in this category are designated by mnemonic codes of four or more letters.

CLASS IV

Class IV instruction formats are 48-bits in length and have, except for the Register Jump instruction, 9-bit function codes. These formats differ from Class III formats in that the bits of the function code are non-contiguous.

The Register Jump instruction differs from other 48-bit instructions in Class IV in that the 6-bit function code is used.

SPEEDS OF OPERATION
Fixed-Point Arithmetic

Operation	Time (usec)
Add	1.5
Subtract	1.5
Multiply Integer	5.4
Multiply (Fractional)	5.4
Divide Integer	13.0
Divide (Fractional)	13.0

Single Precision Floating Point Arithmetic

Operation	Time (usec)
Floating Add	3.4
Floating Subtract	3.4
Floating Multiply	5.4
Floating Divide	13.0
Add to Exponent	0.8

SPARTAN ENGINEERS

Continued from page 22

John Callahan is chairman of the Special Projects Committee, which was the first part of the organization to become affiliated with the Spartan Engineer Magazine. This committee is planning to coordinate a central radio station for the Case-Wilson-Wonders dormitory group when the final decision on construction of such a facility is made.

These are but a few of the interesting and rewarding activities which the Spartan Engineers have been connected with during fall and winter terms. This group has a worthwhile goal and great potential, and with the guidance of Mr. Harwood Phend, assistant dean of the College of Engineering, will continually endeavor to fulfill its purpose.

UNISPHERE

Continued from page 40

be built up or thickened without appearing out of proportion with the rest of the meridians and parallels?

Ultimately the answers came. For the most part meridians will be eight inches wide and 12 inches deep except at support areas. They will be curved rectangular stainless hollow shapes, highly polished on the outside surface and dull finished on the other three surfaces. The parallels will be curved stainless tubing, six to ten inches in diameter, with a dull finish. The members will be butt welded together.

But the land masses constituted the biggest "visual mixture" problem. Here we had to design representations to a staggering scale. Also, since everything has to fit the curvature of the Earth, nothing could be square in any plane.

First we thought of heavy stainless mesh that could be formed into land configurations. But investigations revealed that the mesh virtually disappears when held against the daylight. So we build a full-sized land section of expanded stainless metal, shipped it to the Unisphere site here at Flushing and hauled it into the air at exactly the spot it would appear on the sphere. Placed that far from the eye, the metal was too transparent and too directional in pattern. The bogy, "visual mixture," again.

Next, we tried various existing patterns of formed or rigidized stainless sheets to diffuse the light, but the patterns also were too prominent. By that time we had learned, too, that the surfaces would have to be of dull finish and also be rigidized in some way. Surfaces of a sphere curve away from the human eye; therefore, a bright metal under floodlights at night would make the land areas "turn black," since only pinpoints of light would be reflected back to the eye.

We finally out-foxed the demons of optical illusion, by creating a special, free style pattern of rigidized stainless steel sheets. The pattern is so designed that light is properly diffused. Also, it eliminates matching and fabrication problems that would have existed in joining stainless steel sheets with a more directional pattern. Here, "visual mixture" works in our favor!

The land masses will be built up "layer-cake" style, like huge contour maps, to conform with topographical highlights of each continent. It was necessary to distort the scale of these contours by exaggerating them 44 times as great as they actually appear on the surface of the Earth. Otherwise they would have appeared too inconsequential on the Unisphere to be particularly noticeable. Using this exaggerated scale, each land mass layer will be five inches high, each representing a change in elevation of 1,000 meters or 3,280 feet.

Land masses will be fabricated in sections roughly ten feet wide and 35 feet long and fastened with hidden bolts to meridians and parallels.

Even the skeleton framework, between the meridians and parallels and behind the land masses, has been designed to blend with all other lines in the Unisphere. These will appear to the human eye as slim lines, which are mileage markers between the meridians.

Finally, there are the three three-ton stainless orbits circling the Unisphere. We struggled with that one quite a while, and we had to go back to the bicycle to solve how they would be kept in place. They will be held the same way the rim of a bicycle wheel is held to its hub -- by taught high strength steel wires, 1/8 inch in diameter, radiating from the Unisphere to the orbits. They, of course, will be too small to conflict with the rest of the sphere.

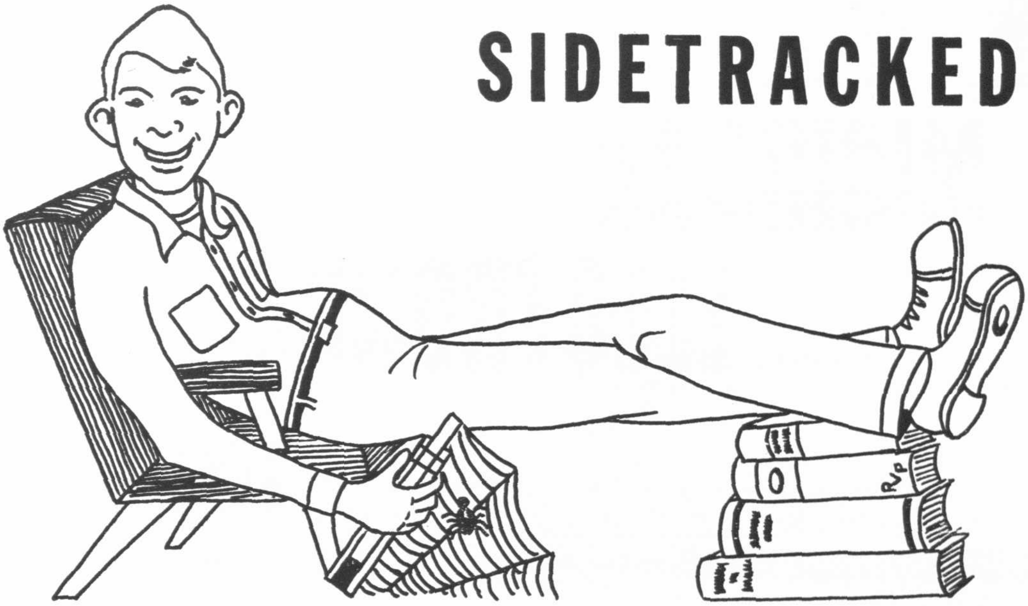
And there you have it -- a close look at what it took to complete what we are convinced is the best design of the Unisphere.

While perhaps the birth of this structure is not as exotic as problems connected with space explorations, the Unisphere, nonetheless, does represent a delicate, intricate exercise in design and engineering skills.

It will, therefore, stand -- not only as a symbol of the World past and of the future -- but it will stand, too, as a symbol of the World past and of the future -- but it will stand, too, as a symbol of what American technology and art can achieve when teamed together.

In this day of ideological warfare -- when fears and doubts plague free men everywhere -- may all who view this piece of open sculpture know that America as a nation has the will, the strength, the patience, and the skills to do its homework very well indeed!

SIDETRACKED



The day after finals, a disheveled Arch. E. walked into a psychiatrist's office, tore open a cigarette, and stuffed the tobacco up his nose. "I see that you need some help," remarked the startled doctor, "Yeah," agreed the student. "Do you have a match?"

* * *

Pro: "You missed my class yesterday, didn't you?"
ME: "No sir, not a bit."

* * *

She: "My dad is an Engineer. He takes things apart to see why they won't go."
He: "So what."
She: "You'd better go."

* * *

After his team had lost an important game, football coach Hugh Duffy Daugherty of Michigan State told a gathering of disgruntled alumni: "I appreciate the wonderful support given me by this group. I shall always treasure your telegram, "We are with you, win or tie!"

Angry Father: "What do you mean bringing my daughter in at this hour of the morning?"
Engineer: "We have to be at class at 7:30."

* * *

For Chem E.'s: We've often heard it said that gasoline and alcohol don't mix. Actually, they mix, but they just don't taste good.

* * *

1st M.E.: "You cuttin' machine design Friday?"
2nd M.E.: "Nope, I can't. Need the sleep."

* * *

Freshman: "I hate this damn place."
Sophomore: "It could be worse."
Junior: "It's rough, but think of the future I'm building!"
Senior; "I hate this damn place."

* * *

Chemistry Professor: "Young man, why aren't you taking notes?"
Student: "I don't have to sir, I've got my grandfather's."

A drunken engineer was lying in the gutter with one elbow on the curb screaming, "If it takes me all week, I'll get over this wall."

* * *

An engineer of a large instrument company was looking over drawings and specifications for a new instrument which had been ordered by one of the firm's largest clients. Attached to the paper were the coded instructions, "MILTDD-41". Not being familiar with those designations, the engineer looked in his technical journals, but was unable to find them. Finally he placed a long-distance call to the customer.

"Would you mind telling me what 'MILTDD-41' means?" he asked.

"Sure, I'll tell you," the customer said. "It means, 'Make it like the damned drawing for once."

* * *

M. E.: "I like mathematics when it isn't over my head."
Ch. E.: "I feel the same way about pigeons."

* * *

Professor to noisy class: "Order please."
A voice from the back of the room, "Two beers."

THE MICHIGAN ELECTRONICS INDUSTRY

by ORVILLE C. BARR

Michigan is a basically one-industry state. That industry is, of course, the automotive industry.

To determine the relative importance of various other manufacturing industries, especially the electronics industry, to Michigan's economic conditions, a general survey of Michigan industry was made. An extensive survey of the electronic industry in Michigan was also made in order to present information of interest to engineering students who wish to find employment in Michigan in electronic research and manufacturing.

In making a survey of Michigan's industry and the relative importance of the various types, several assumptions were made. First, it was assumed that a representative view of industry was that gained by examining defense contracts issued to Michigan manufacturers. A second assumption was that new corporations do not enter dying industrial areas. The author feels one can gain the information desired by examining records of defense contracts issued to Michigan companies and by examining records of the new corporations formed within the state, their products and their capital investment.

To make an analysis easier, Michigan's industries were broken down into five general classes: Electronic and electrical; non-electrical automotive; food; chemical and petroleum; and miscellaneous. The information is from 1957, 1959, 1961.

In 1957, the defense contracts lined up this way: electronics and electrical got 41 contracts or 6 per cent of the total value at 14.6 million dollars which was 3 per cent of the total; non-electrical automotive received 263 contracts or 3 per cent valued at 304.3 million dollars or 70 per cent of the money value; Michigan food industries received only 15 contracts or 2 per cent of the total valued at 0.8 million dollars, less than 1 per cent; Chemical and petroleum received 35 contracts or 4 per cent valued at 4.0 million dollars or 1 per cent of the total; and the remaining 50 per cent of the contracts, numbering 342, accounted for 26 per cent of the total value by adding 112.4 million dollars to the totals. In 1957 the totals for the state were 696 contracts valued at over 430 million dollars.

In order to gain greater insight into the electronics industry in Michigan in the year of 1957, we will next examine the contracts listed above under electronic and electrical. They will be divided up by manufacturer and such information as product and value will be given.

The contracts awarded for electronic and electrical products during 1957 were as follows:

Beck Products Corp., Detroit
- Spark plug cable $31,514,
- Spark plug cable $25,735;

Bendix Aviation Corp., Detroit
- Digital communication system $69,288;

Burroughs Corp., Detroit,
- Test equipment for bomb director set $179,312;

Continental Motors Corp., Detroit
- Engine generator sets $111,955,
- Engine generator sets $59,735;

Electro-Voice, Inc., Buchanan
- Loudspeakers $38,092;

General Motors Corp.,
- AC Spark Plug Div., Flint,
  - Computer $1,156,322,
  - Spark plugs $825,009,
  - Spark plugs $582,000,
  - Spark plugs not available
  - Spark plugs $168,714,
  - Spark plugs $637,790,
  - Bombing navigational system, bombing navigational computer $470,261,
  - Fire control system $370,263,
- Detroit Diesel Engine Div., Detroit
  - Generator Sets $99,130,
  - Engine generator assemblies $880,000,
- United Motor Service Div., Detroit
  - Generator $32,786,
  - Spark plugs $32,091,
  - Voltage regulators and distributor assembly $29,012;

Kirkhof Electric Co., Grand Rapids,
- Main control switch board $180,894;

Lear, Inc., Grand Rapids,
- Installation of autopilot $34,062,
- Indicator, altitude remote $2,556,750,
- Flight control systems, spares, spare parts $3,961,851;

Mechanical Products, Inc., Jackson
- Circuit breakers $37,748,
- Circuit breakers $44,533;

Miller Industries, Spring Lake,
- Antenna $47,164,
- Antenna $51,110,
- Antenna $48,175,

Antenna for aircraft $59,000;
Nucor Research, Inc., Ferndale,
Neutron survey meter $39,113;
R. C. Allen Business Machines, Inc., Grand Rapids,
Turn and slip indicators $43,887,
Turn and slip indicators $153,755,
Turn and bank indicators $56,941;
Regents of the University of Michigan, Ann Arbor,
Studies in radar $50,000,
Electronic measurements $560,000;
Rett Products Co., Detroit
Regulator, generator assembly $258,232;
Sparton Corporation, Electronics Div., Jackson,
Receiver radio, antenna $68,708;
Sun-Lite Mfg. Co., Detroit,
Ballasts, fluorescent lamps $19,815.

If we take this data and divide it up into three groups, automotive electrical, non-automotive electrical, and electronic, we find that the electronic class takes 72 per cent of the value of the contracts, automotive electrical 26 per cent and non-automotive electrical 2 per cent.

This information shows that, if defense contracts are a good indicator, Michigan's electronic industry is three times as important as her automotive electrical industry. Thus, from this and information given earlier, approximately 2 per cent of the total defense dollars coming into Michigan come only because of her electronics industry. That is the way the story was in 1957, anyway.

Before continuing on with defense contracts, let's take a look at the new corporations formed in Michigan in 1957. Available data indicates some 781 new corporations were formed in Michigan in 1957. Of these, 18, or 2.3 per cent, indicated an intention to enter into the manufacture of electronic or electrical devices. They accounted for 2.1 per cent of the capital investment made by new corporations during the year.

In 1959, the defense contracts let to Michigan industry were divided as follows: electronics and electrical got 89 contracts, or 10 per cent of the total and these were valued at 42.3 million dollars, or 16.1 per cent; non-electrical automotive received 258 contracts for 30 per cent of the total with a value of 123.8 million dollars which was 48 per cent of the total; food industries accounted for only 1 per cent of the total by bringing through 11 contracts valued at 0.4 million dollars, 0.2 per cent of the total value; chemical and petroleum received 38 contracts for 4 per cent of the total, valued at 4.3 million dollars, or 1.7 per cent of the total value; and the remaining 55 per cent of the contracts, 473 in number, accounted for 88.9 million dollars, or 34 per cent of the total.

A quick comparison of these figures with the previous ones given for 1957 shows that electronics in Michigan has gained from 3 per cent of the total valuation to 16 per cent, a 533 per cent increase. Losing much ground was non-electrical automotive, which dropped from 70 per cent of the total valuation to 48 per cent, a loss of 31 per cent. Foods and chemicals remained steady at about 0 per cent and 1 per cent respectively. Miscellaneous products increased in percentage of total valuation from 26 per cent to 34 per cent, helping electronics offset the losses in automotive contracts.

Perhaps these figures are misleading, for they do not indicate the actual value of these contracts to the state. One need only compare the total of 430 million dollars in 1957 to the total of 260 million dollars in 1959 to see that Michigan was not in the Federal government's favor in 1959. The gains made by electronics in percentage did nothing to offset the loss of money due to loss of automotive contracts.

Perhaps some idea can be formed about which Michigan electronic firms are shaping up into real assets by examining the breakdown of the electronic-electrical contracts.

In 1959 the electronic and electrical contracts were distributed among Michigan manufacturers in the following manner and for the indicated products:

Allen Electric & Equipment Co., Kalamazoo,
Battery charger $37,482;
Board of Governors, Wayne State University, Detroit,
Research Surface Phenomena in Semiconductors and growth of Semiconductor Crystals $110,000,
Research Surface Phenomena in Semiconductors and the growth of Semiconductor Crystals $45,458;
Bendix Aviation Corp., Research Laboratories Div., Detroit,
Design, development television system for detecting and tracking artificial earth satellites $71,243;
Burroughs Corp., Detroit
Maintenance and service for coordinate data transmitter and associated equipment $950,000,
Maintenance data requirements for data transmitting set $88,336,
Teletypewriters $2,666,323,
Data Transmitting set $350,000;
Charles M. Reeder & Co., Detroit,
Theromopiles $35,000;
Continental Motors Corp., Detroit,
Generator sets $82,800,
Engine generator sets $55,200,
Ignition coil $28,118,
Current and voltage regulator $28,891;
Electric Construction & Machinery Co. of Michigan, Detroit,
Construction of electrical distribution, Selfridge Air Force Base $102,299;
Electro-Mechanical Products Co., Garden City,
Generators $69,960,
Adapter set, engine electrical test not available
Voltmeter gage and clamp assembly $91,903,
Headlight dimmer switch assembly $63,958,
Voltmeter gage $127,249,
Voltage regulator $152,310,
Generator $57,371,
Starter coil switch assembly $26,380,
Light switch assembly $96,901;
The Electric Auto-Lite Co., Wire and Cable Div., Port Huron,
Electrical wire $69,419;
Electro-Voice, Inc., Buchanan,
Loud speaker assembly $38,228,
Microphone dynamic $382,800;
General Motors Corp.,
AC Spark Plug Div., Flint,
Spare parts for bombing navigational computer $53,441,
Spark plugs $144,091,
Spark plugs $470,085,
Spark plugs $904,335,
Spark plugs $109,445,
Spark plugs $57,525,
Spark plugs $42,763,
Spark plugs $137,730,
Detroit Diesel Engine Div., Detroit,
Non-magnetic Diesel generator set, voltage regulators $72,303,
Diesel engine generator sets $1,161,495,
Engine generator sets $143,107,
United Motors Service Div., Detroit,
Electric engine starter $67,549,
Starter assembly $28,646,
Engine generator regulator $31,260,
Distributor ignition system $30,353,
Generators, starters, conduit and conductor assembly, regulator covers $36,866,
Delco-Remy starters $40,310,
Electric engine starter $48,606;
Jervis Corp., Grandville,
Solenoid $54,376;

Continued

Kirkhof Electric Co., Grand Rapids,
Electrical equipment $49,170,
Control board and relay equipment $18,440,
Main control switch boards $132,870;
Lear, Inc., Grand Rapids,
Loft bomb release computer sets $12,638,579,
Design, develop, and fabricate acceleration switch and transducer $29,996,
Brush and amplifier assemblies $107,262,
Altitude indicators remote $154,222,
Altitude indicators $27,270,
Components of automatic flight control systems $463,437,
Develop, fabricate, test remote stand-by altitude-indicating systems $25,000,
Repair, overhaul bombing systems $86,250,
Repair, overhaul controls and indicators $85,000,
Autopilot cancellers $31,629,
Autopilot system $36,592,
Gyro-indicator systems $347,446,
Indicators $95,930,
Indicators $32,500,
Control assemblies $3,175,625,
Gyro-indicating units $2,927,416,
Altitude controls $89,015,
All altitude indicators $75,000,
Altitude indicators $330,200,
Controller assembly $2,145,772,
Loft bomb release computers, equipment, spare parts $3,857,582,
Engineering and installation of radio sets in aircraft $73,619,
Altitude indicators and gyroscopes $532,181,
Various components MC-1 automatic flight control system $1,488,003;
Michigan Tectronics Inc., Detroit,
Power electrical cable assembly $41,455;
R. A. Miller Industries, Spring Lake,
Navy-type antenna $22,950;
R. C. Allen Business Machines, Inc., Grand Rapids,
Turn and bank indicators $44,255,
Turn and slip indicators $83,022;
Turn and slip indicators $34,210,
Turn and slip indicators $44,520,
Turn and slip indicators $116,160,
Transmitter, rate gyroscope $56,117;
Ram Meter, Inc., Ferndale,
Tester aircraft motor generator, engineering data $34,000;
Ray Whyte Electric Products, East Detroit,
Electric cable assembly $92,847;
Regents of the University of Michigan, Ann Arbor,
Crossed field electron devices $100,083;
Rett Products Co., Detroit,
Generator assembly $438,007;
Sparton Corp., Electronics Div., Jackson,
Sonobuoys $1,709,115,
Design, develop and furnish bathythermograph transmitter sets (see article in this issue) $117,119;
Strand Engineering Co., Ann Arbor,
Data recorder $59,800,
Control transmitters $193,618;
Worden Specialty & Machine Co., Plymouth,
Engine generator regulator control $83,244.

Dividing this up as we did for 1957's data, we find electronics accounts for 87 per cent of the value of the electronic and electrical contracts, up from 72 per cent in 1957; automotive electrical accounted for 11 per cent, taking a steep dive from 26 per cent in 1957; and non-automotive electrical accounted for 2 per cent, remaining steady from 1957.

One interesting point is the rapid advances made by Lear, Inc., of Grand Rapids. They moved from having 44 per cent of the total valuation of the electronic-electrical contracts to 68 per cent.

Before moving on to 1961, let's look at the new Michigan corporations of 1959.

Of the approximately 1000 new corporations formed in the state during 1959, 25, or 2.5 per cent, indicated a definite intention to manufacture electronic and/or electrical products. They represented 2.6 per cent of the capital investment made by new manufacturing corporations.

In the last year to be covered, 1961, the defense contracts were split up as follows: electronic and electrical received 65 contracts valued at 30.7 million dollars for 7 per cent of the number and 9.3 per cent of the total value; foods received 30 contracts worth 2.2 million dollars to the state and thus accounted for 3.5 per cent of the contracts and 0.5 per cent of the total valuation; chemical and petroleum received 3.5 per cent of the contracts in the form of 31 contracts valued at 2.3 million dollars, about 0.7 per cent of the total valuation; non-electrical automotive received 285 contracts valued at 234.2 million dollars, 33 per cent of the total and 71 per cent of the value; and Michigan's miscellaneous industries received 461 contracts valued at 61.0 million dollars, 53 per cent of the number and 18.5 per cent of the dollars. The totals for the state in 1961 were 330 million dollars from 872 contracts.

The electronic-electrical contracts awarded to Michigan firms in 1961 were distributed among the following manufacturers for the indicated items:
Acromag, Inc., Southfield,
S/L/M for instrumentation amplifiers $31,500;
The Bendix Corporation, Detroit, Bendix Systems Division,
ADVENT satellite communications system $1,400,000,
ADVENT communications satellite system $42,193,
Electronic equipment $600,000,
ADVENT satellite communications system $2,980,000;
Burroughs Corp., Detroit,
Depot level maintenance, computer system, sub-assemblies, components and aerospace ground equipment $100,000,
In-service testing support for Atlas radio guidance computing system $44,000,
Coordinate data transmitting sets $3,000,000;
Continental Motors Corp., Detroit,
Starter assembly $34,930;
Electro-Voice, Inc., Buchanan,
Microphone $83,992,
Research and development work, miniature hand-set radios $336,824;
Elox Corp. of Michigan, Troy,
Electrical-discharge machine $31,887;
General Motors Corp.,
AC Spark Plug Div., Flint,
Maintenance, Thor weapon systems inertial guidance system and ground equipment $500,000,
AGE and airborne spares and spare parts guidance subsystem $2,150,000,
Spark plugs $58,500,
Spark plugs $265,045,
Spark plugs $3,292,191,
Spark plugs $72,563,
Spark plugs $192,012,
Spark plugs $327,565,
Spark plugs $94,800,
Spark plugs $49,422,
In-service engineering for the inertial guidance system and associated AGE of the Thor weapon system $50,000;
Detroit Diesel Engine Div., Detroit,
Diesel generator set, voltage regulator $44,332;
United Motors Service Div., Detroit,
Coil ignition $36,712,
Regulator assembly $30,909,
Starter assembly $80,711,
Starter assembly $41,410,
Horn, electrical $53,349,
Starter assembly $152,289,
Headlight dimmer switch assembly $60,920;
Hurd-Darbee, Inc., Detroit,
Radio-graphs $49,789;

Continued on page 54

A Practical Fuel Cell From General Electric

A step toward the long-sought goal of a practical fuel cell that will operate on inexpensive fuels such as natural gas has been demonstrated by scientists at the General Electric Research Laboratory.

Fuel cells are devices that convert chemical energy directly into electrical energy without the use of moving parts. Most earlier fuel cells announced by General Electric and others have operated on hydrogen, a fuel substantially higher in cost than the common hydrocarbons (natural gas, propane, coal, and gasoline). Cost factors are therefore likely to limit hydrogen fuel cells to specialty applications such as power sources for spacecraft and portable military communication systems.

General Electric's new cell operates at high temperatures and incorporates novel features for "self-starting" and for maintaining itself at approximately 2,000 degrees F. without the use of externally applied heat. The new cell is the result of work carried out at the Metallurgy and Ceramics Research Department of the Research Laboratory and includes contributions from Ralph E. Carter, William A. Rocco, H. Stephen Spacil, and William E. Tragert.

"The achievement of a fuel cell that runs on inexpensive hydrocarbon fuel offers the hope that power generators of this type may someday be used for industrial applications, vehicles, and even bulk energy production," Dr. Guy Suits, General Electric vice president and director of research, said.

Dr. Suits cautioned, however, that "a great deal of research and development remains to be done before fuel cells operating on natural gas become marketable products."

The novel cell has a solid electrolyte made of zirconia, a refractory oxide. Several of the cells have been stacked together in the form of a "fuel battery." It is estimated that the maximum efficiency of fuel batteries of this type would be in the neighborhood of 30 per cent, using natural gas as the fuel. Greater efficiency may be possible with other hydrocarbons. By comparison, the typical internal-combustion automobile engine is about 20 per cent efficient, large central-station power plants achieve about 40 per cent and hydrogen fuel cells operate in the range of 50-80 per cent efficiency.

(In a fuel cell-as in a conventional battery - electrons move from one electrode to the other, then pass outside through a circuit in which they do useful work as an electric current. Unlike a conventional battery, however, the fuel cell draws its energy from a fuel that is piped in - natural gas, in the case of the new cell - instead of consuming its own electrodes.)

In the new General Electric fuel cell, the natural gas breaks down into carbon and hydrogen. Carbon builds up inside the cell to form one electrode. Oxygen is obtained from air which is introduced into the other electrode (molten silver), and yields its electrons to the carbon and combines with part of the carbon to form carbon monoxide gas. The electrons are conducted out of the cell as an electronic current. To supply heat for the self-sustaining feature of the cell, the left-over carbon monoxide and hydrogen gases are burned within the cell assembly.

Laboratory versions of non-self-sustaining cells have operated on natural gas and oxygen at current densities of up to 150 ampered per square foot at 0.7 volt. Similar cells on life test at lower current densities have been operated for as long as 3,000 hours without deterioration.

Among the advantages of the new cell is the fact that it does not require significant quantities of expensive catalytic electrode material. General Electric scientists also point out that the solid electrolyte has great structural and chemical stability.

In his announcement, Dr. Suits emphasized that General Electric has research and development programs encompassing a wide variety of fuel cell types. General Electric's Direct Energy Conversion Operation in Lynn, Mass., is presently engaged in the development, manufacture and sale of fuel cells and has a contract to provide the power source for the two-man "Gemini" spacecraft.

SPARTON CORP.

Continued from page 32

and components. Full residence facilities are maintained for an U.S. Air Force inspector and staff at the plant.

Within the framework of this quality control system, Sparton Electronics has a range of equipment permitting such tests as altitude, temperature, humidity, vibration, shock and radio interference.

Thus Sparton, because of this quality control system, has a proven record of producing high reliability equipment in both large and limited volume as well as prototype and experimental runs.

Sparton has certain controlled clean room areas devoted exclusively to the assembly and testing of high reliability components. The newest developments are utilized.

Assembly operations in the controlled areas are dehumidified and temperature controlled; assembly operations are dust free; ultrasonic cleaning methods are used. Checking equipment is fully automated, completely self-contained and produces visual, typewritten and punched tape information on the reliability at stages in the assembly.

With a well-integrated team or researchers and engineers, supported by broad production facilities, Sparton Electronics is looking for new horizons to conquer.

Sparton Electronics is advantageously located within a day's drive of all the major universities and technical colleges in the Midwest, where talent and facilities to conquer these new horizons is abundant. New talent is integrated with experienced electronic engineers and technicians who have earned national recognition for their capabilities.

The parent Sparton Corporation is a publicly owned and professionally managed company with assets in excess of 7.0 million dollars and a favorable ratio of assets to liabilities. Common stock, listed on the New York Stock Exchange, is held by 7,000 shareholders.

Continued from page 52

Lear, Inc., Grand Rapids,
Amplifiers $40,068,
Gyro-control and amplifier $535,810,
Automatic flight control system and data $1,119,854,
Gyroscope, displacement roll and pitch $1,991,430,
Indicators, altitude $268,726,
Services and materials to put bomb computer systems in condition $74,000,
Improvements of remote-altitude indicators $110,811,
Spare parts, ground control system, equipment and data $1,228,975,
Synchronizers $27,728,
Automatic flight control system components $2,034,564,
Altitude indicators $189,357;
Mechanical Products Co., Jackson,
Circuit breaker $44,200,
Circuit breaker $102,063,
Circuit breakers $282,494;
Peer, Inc., Benton Harbor,
Monitor and control equipment $196,527;
Pneumo Dynamics Corp., Grand Rapids,
Rate gyro transmitter $56,140;
R. A. Miller Industries, Spring Lake,
Antennas, used with radar equipment $25,545,
Antennas $49,514,
Antennas $43,954,
Antennas $30,274;
R. C. Business Machines, Inc., Grand Rapids,
Indicators $31,682,
Transmitter, ground support and data $53,324;
Ram Meter Inc., Ferndale,
Aircraft test stand inverter $60,920;
Ray Whyte Electric Products, East Detroit,
Regulator, engine generator control $66,501;
Regents of the University of Michigan, Ann Arbor,
Services to conduct research in field of combat surveillance, radar, infrared and surveillance information processing $4,000,000,
Service on electronic countermeasures modification $25,000,
Research services satellite detection $258,000;
Rett Electronics, Inc., Warren,
Design, develop and fabricate generator, regulator, rectifier, and starter test stands $49,800,
Voltage regulators $26,890;
Sparton Corporation, Electronics Div., Jackson.
Radio receiver (see article) $123,966;
The Warner & Swasey Co., Duplex Div., Lansing,
Engine generator, automatic Diesel $139,830,
Generator plant $26,688,
Diesel engine generator $67,520.

This data can be broken down into the following: electronic, 80 per cent of the dollar value of the electronic and electrical contracts; automotive electrical, 18 per cent; and non-automotive electrical 2 per cent.

Of the 459 new corporations formed in the state in 1961 for which data is available, 22 or 5 per cent indicated an intention to manufacture electronic or electrical equipment. Data was not available for more than 80 per cent of the new corporations so the numbers indicated above should not be compared with those of previous years.

The reader will recall that in 1957 the electronic and electrical contracts accounted for 3 per cent of the total dollar value of the defense contracts issued within the state, in 1959 this had risen to 16 per cent, and now we see that in 1961 it fell back to 9 per cent. It appears that the Michigan electronics industry is making gains, although rather ragged, in the nation's eyes. The loss of this industry to the state would be felt by many in the forms of loss of jobs, sagging tax rolls, etc. This industry is important to Michigan.

Not all Michigan electronics firms get defense contracts. Here are a few which failed to get into the data presented above. Conduction Corp., Ann Arbor, produces microwave equipment and components. They are a leader in the field of three-dimensional radar which is becoming more and more important in our defense effort. Applied Dynamics of Ann Arbor currently has a 3 million dollar backlog for its analog computers. Vemco Products Inc., Detroit, produces electronic traffic counters and industrial garage door operators. The Heath Co., Benton Harbor, is the world's largest producer of electronic equipment in kit form for home entertainment, amateur radio, industrial and research laboratories, and educational kits. They produce everything from analog computers to transister radios, all in kit form or some preassembled. Berry Industries Inc., Birmingham and Ann Arbor, produce electronic garage door openers. A leader in the field of home entertainment, Voice of Music Corp., Benton Harbor, is another famous member of Michigan's electronic industry. Kal Equip of Otsego and Fox Valley Instrument Co. of Cheboygan manufacture electronic automobile test equipment.

No, Michigan is not a one industry state. Why? You and I both know that automobiles have at least one important competitor, electronics!

This pretty five-feet-eight, blue-eyed coed was chosen as Miss Spartan Engineer for January, 1963. Margery Wiegand graduated from Ferndale High School in Pleasant Ridge, Mich., a small town outside Detroit.

Margery, a sophomore, is majoring in business education. During the summer Ford Motor Company is graced by her presence as a stenographer. As an active participant in student activities, she works with the Social and Publicity committees in West Mary Mayo dormitory.

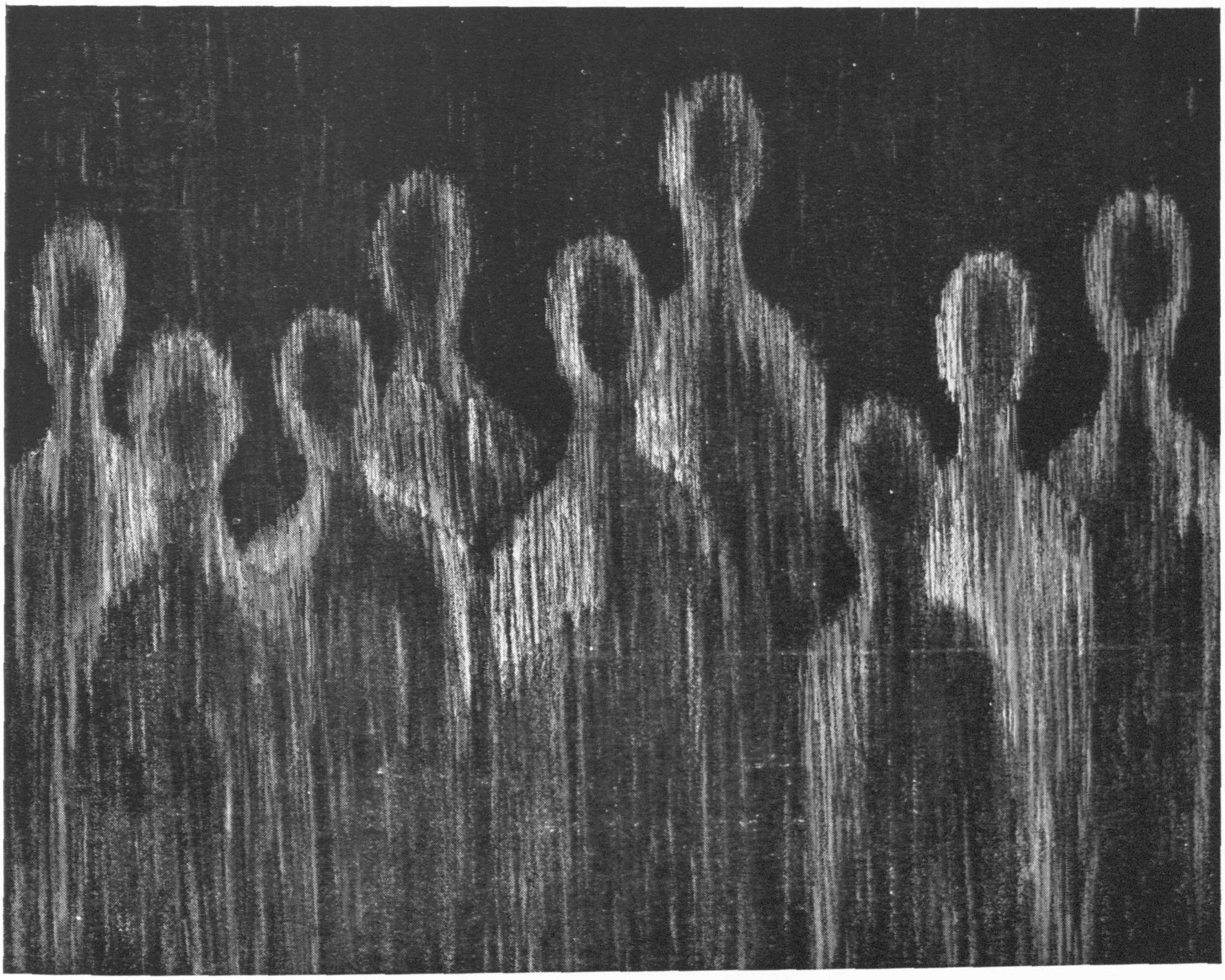
During her free time Margery likes to ski, skate and dance. Margery intends to live in an apartment next year and she is socially uncommitted at the moment.-------------HURRY

PAUL DUGAS
309 E. Shaw
Won the Free Subscription to our Magazine by naming Margery

The design is thousands of years old. Called "Man," it has evolved reasonably efficient techniques for coping with weather, saber-toothed tigers, city traffic, floods and income taxes. □ But now it faces a problem of a new order of magnitude...survival beyond the protective cocoon of the earth's environment. In this airless, weightless, radiative region, man needs a big assist. Douglas is working to provide it. □ Douglas scientists are far along in studies of ecological systems for the maintenance of human life under extra-terrestrial conditions. These research areas cover the varied life and physical sciences and engineering systems which are involved. They range from psycho-physiological analyses to the actual planning of the establishment and support of cities on the moon.

EARTH'S MOST COMPLICATED SYSTEM

...A STIMULATING AREA FOR CREATIVE ENGINEERS



The above is only one of hundreds of interesting assignments at Douglas. If you are seeking a stimulating career with an organization in the thick of the most vital programs of today and tomorrow, we invite you to contact us. Write to Mr. S. A. Amestoy, Douglas Aircraft Company, 3000 Ocean Park Boulevard, Santa Monica, California. Box 600-X. Douglas Aircraft is an equal opportunity employer.

DOUGLAS

THE ADVERTISER'S INDEX