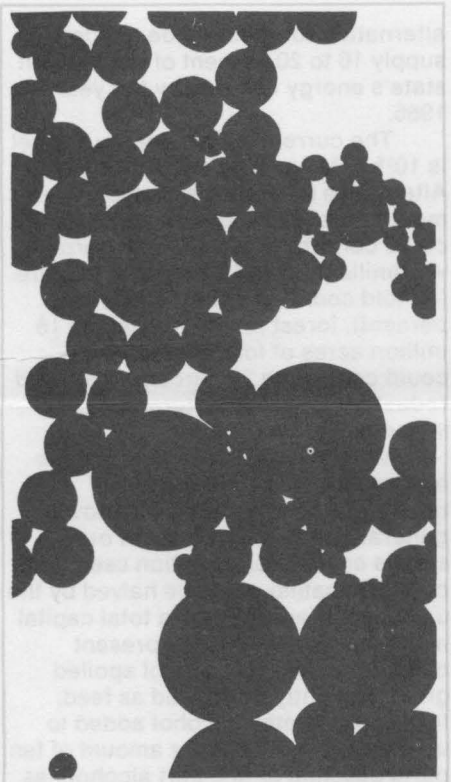


**IT RESEARCH
TO DERIVE FROM NEEDS OF SOCIETY**

MKC
gT226i



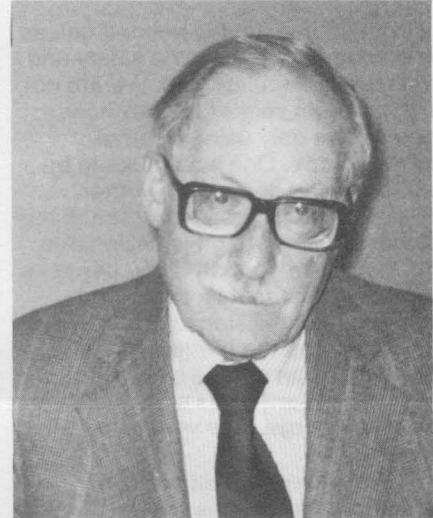
Volume 2, Number 3
Spring Quarter, 1976

His office is remarkably uncluttered for a man who is both Director of the Space Science Center at the University of Minnesota and Research Officer of the Institute of Technology, yet William G. Shepherd imparts the impression of being as orderly as his surroundings. He is busy. He is concise. Demands on his time are unrelenting, but recently, he granted the new editor of ITEMS a lengthy interview, ranging over a number of general and specific problems which scientific and engineering researchers will be facing in the next few decades. Gerry Shepherd talks readily and easily. He projects an image of a warm man, sincere in his concerns for the world's future. However, as a scientist, he is fully confident that the problems we face in solving the critical energy crisis and the fundamental research that will have to be undertaken along the way to overcoming the primary concern, will indeed be solved.

Shepherd, an electrical engineer and a physicist, and former academic vice-president of the University, and presently research officer of IT, has a perspective on the direction in which the research activities of the Institute are moving. He is aware of the problems that must be solved, and though quite willing to discuss them for publication, states that, "What I am attempting to do is to give a perspective on the activities as I see them from my position as research officer. . . I guess I would want to enter a disclaimer that in a limited series of articles of this sort, one can't cover all of the activities. . ." There is the disclaimer, and here is the interview. Because of its length and scope, ITEMS will carry portions of it in the next several issues.

Dr. Shepherd, what direction do you anticipate major research efforts in the Institute of Technology may take over the next five to ten, or possibly more, years. How will we interface with research efforts of other universities and of industry?

"Well, I think that a good part of the research carried on by the Institute of Technology is going to derive from needs of society. That doesn't mean that it's all going to be applied research, but I think there is going to be a continuing thrust towards the solution of societal problems and those problems are going to be such that it will require the cooperation of universities and industrial firms. The



William G. Shepherd

most outstanding example of that, I think, is in the field of energy. We have already described (in past issues of ITEMS) some of the activities going on here. But, the fact of the matter is that the solution of the energy problem is going to be so urgent that it's going to attract a great deal of interest and effort on the part of people in the universities, and of people in industry. If we don't get it solved before the turn of the century, the economy of this country is going to start downhill. It's no accident that the United States uses as much of the world's energy as it does. We have a highly intensive energy economy, and if that is cut, we will lose a major edge. Our own internal resources of oil and gas are being rapidly depleted. The kind of industrial economy that we had in the days when we were highly dependent upon coal was quite different from what we are dealing with now. If we return to coal as our prime source of energy, we are going to have to worry about how we can convert a solid fuel into a liquid or gaseous fuel. There are lots of problems to be solved in this, because you have to worry about environmental considerations."

What kinds of research will be needed to solve these problems?

"I think that there are going to be a number of fundamental problems that have to be resolved in order to solve the energy problem. I mentioned the diminishing resources of oil and gas. There are other alternative ways of generating energy. . . nuclear power is one, both the fission and the fusion approaches to that. There are problems about obtaining enough of



the uranium fuel that is needed unless the breeder reactor can be safely and successfully implemented. We are not using uranium very efficiently now, since we are only using a rather scarce isotope. One would like to be able to convert some of the other non-fissioning isotopes of uranium into another element which is fissionable. And, if you can do that, if you can take one of the abundant isotopes and convert it into a fissionable fuel, then you can extend the lifetime of... or extend the span of time over which we would have uranium as a possible source of energy, by a very large factor.

"Well, there are all sorts of metallurgical problems that are involved if you are going to do this sort of thing... problems of refining the uranium, separating its isotopes, and the like. The methods that have been used are quite expensive, relatively speaking, and there will be research carried on which will try to find more efficient and cheaper ways of separating the isotopes. That involves a number of fairly fundamental studies of what are called plasmas, gas plasmas. These are gases that are ionized and excited."

Is that sort of fundamental research going on here in the Institute of Technology?

"Right, it's going on here, and will continue to need support."

What departments are most involved in this research?

"Well, at the moment, Electrical Engineering, and Chemical Engineering and Materials Science are involved. There are people here who are looking beyond the period when we can depend upon fossil fuels or nuclear fuels... The long range prospects for nuclear energy depend on whether fusion ever works. To my knowledge, nobody at this university is doing anything in the fusion area. There are just a few centers in the country where that problem is being studied. If it does come about it will probably be about the turn of the century, by the time it can be demonstrated.

"We have been extravagantly expending the energy which the sun stored in the earth for billions of years. In a short span of time these resources will be depleted. One of the things that man is going to have to accomplish is to learn how to live on income, I mean

the energy income, and the only energy income we have is from the sun. So, a lot of research is going to be directed to how we can use the sun's energy efficiently. How do you capture it, how do you convert it efficiently, either into electricity or a gaseous fuel of some kind, hydrogen, for example. And then, how do you transmit it?"

Dr. Shepherd paused, and after reflecting a few moments, continued.

"I personally believe that this can be a very exciting time for people to come into research and engineering development. Because the problem we are faced with is vital to the long term existence of man. Except for the possibility of energy obtained from nuclear fusion, all other sources of energy depend on expenditure of fossil fuels or resources that are finite and can be used up. Unless we can find an alternative source for energy like the sun, or like fusion, the end of civilization as we know it... have known if for two hundred years, is in sight. Not for us living now, but in sight for the next few generations. I am confident that it is going to be solved, but what could be a more exciting challenge than to be a part of solving the on-going possibility of civilization? It's as fundamental as that."

Alternative Resources Discussed At Two-Day Energy Conference

A meeting April 27 and 28 organized by the State Energy Agency drew some 450 representatives of industry, government, academia, and various public interest groups to the Howard Johnson motel to discuss alternative energy sources in anticipation of the pending reduction in the supply of oil and natural gas to the region.

The Energy Agency's director, John P. Millhone, showed the magnitude of the immediate problem by citing our dependency on Canada for half of our petroleum (a supply that is presently in jeopardy) and on Northern Natural Gas which predicts a five percent per year reduction in its supply in the near term future. Since petroleum and natural gas respectively constitute 40 and 30 percent of the state's total energy budget, these anticipated reductions mean that

alternative sources will be needed to supply 10 to 20 percent of our present state's energy use rate by the year 1985.

The current state's energy budget is 10^{15} BTU per year or $33 \cdot 10^6$ KW. Alternative sources discussed at the meeting were urban wastes (which could contribute two to three percent), windmills (four to 18 percent), manure (all told could contribute three percent), forest residues from the 16 million acres of forest land (which could contribute 23 percent), and field reduction from agricultural land (43 percent of present rate).

Millhone discussed the promise and costs of solar energy for residential heating as well as power generation (the 25 percent of our state's energy consumption used for comfort heating could be halved by the use of solar energy with a total capital investment of $\$14 \cdot 10^9$ at present collector costs). The use of spoiled grain, currently prohibited as feed, fermented to ethyl alcohol added to unleaded gasoline in the amount of ten parts gasoline to one part alcohol has proven to be an effective fuel expander in Nebraska and shows promise for Minnesota.

The group heard the Minnegasco proposal to build a $250 \cdot 10^6$ cubic feet per day pipeline quality gas plant utilizing Minnesota's peat. Twelve million tons of peat per year would be required to produce a total of 4.7 million KW in total energy, 3 million KW of which is in pipeline quality gas and the balance in energy-rich residues.

Discussion of the possibilities of using Minnesota's fast-growing cattails showed that about 300,000 acres of peat land planted in cattails could permit the continued operation of the gasification plant as the peat was exhausted. Similarly, 1.3 million acres of the land planted in tree farms could also suffice. For long-term considerations the possibilities of tree farming one third of the forest area for energy or alternatively double cropping the presently used agricultural land by sowing winter rye at fall harvest would supply 100 percent of the state's energy needs from existing farmlands without diminishing food productivity.

The immediate as well as long-term needs seem to focus on convenience fuels for transportation and comfort heating.



Everett Dale, President, Alumni Association

ALUMNI BOARD ALLOTS FUNDS

The IT Alumni Board, at its spring meeting, April 21, voted to appropriate \$750 from its current treasury balance for Dean Richard Swalin's discretionary fund. A like amount has been given to this fund for the last two years. Among other things, the Dean uses that money to support this news letter.

The Board also voted to give Assistant Dean Paul Cartwright the sum of \$1000 for the expressed purpose of recruiting Merit Scholarship winners and finalists to the University of Minnesota, and specifically to the Institute of Technology. Recruiting students from lists made available by the National Merit Foundation has been successfully followed for many years by several universities, including at least one Big Ten school.

In a recent meeting with members of the Alumni Executive Committee, Dean Cartwright expressed his appreciation for this financial support and promised to pursue the project vigorously.

In his summary, Mr. Millhone emphasized the inevitable deployment of our renewable resources of solar, wind, and biomass in the long run along with the immediate increase in use of coal. He further cited the technological and political uncertainties in the deployment of breeder or fusion reactors as reasons for not developing plans at present that rely on the certain availability of these long-term energy sources.

Finally, by far the most promising alternative resource appears to be our ability to conserve, without impairing our productivity. Estimates made by the agency suggest that we are capable of saving up to 50 percent of our present consumption with very little in the way of capital needed, and with time to execute very short indeed.

IT STAFF ACTIVITIES

William W. Gerberich, of Chemical Engineering and Materials Science, has been invited to present a talk at the Gordon Research Conference on Solid State Studies in Ceramics, July 26-30 at Plymouth, N.H. He will dis-

DALE ASSUMES LEAD ON ALUMNI BOARD

First Vice President Everett Dale ('49 BEE) has taken over the leadership of the IT Alumni Board from President Horace Davis, who resigned on May 1, because he is being transferred out of the country.

Dale brings a wealth of experience to the office. He was IT Alumni President in 1968, and in 1975, as second vice president, he was in charge of planning and coordinating the Annual Meeting, including all arrangements for both the afternoon seminar and the evening banquet. Ev's experience and enthusiastic leadership will assure us a successful program next fall.

Two other changes in the Board's Executive Committee were also announced by Davis prior to his resignation. Noel Stone ('42 BEE) asked to be relieved of his duties as second vice president, due to the press of business. Secretary-Treasurer Dr. Wayne Schmaedeke ('63 PhD) of Minnegasco agreed to accept the second vice president appointment and is now proceeding with the plans

for the Annual Meeting next November. Mark Mund ('53 BME) of the Donaldson Company was appointed to fill the current term as Secretary-Treasurer.

PRESIDENT MAGRATH TO BE ANNUAL MEETING BANQUET SPEAKER

University of Minnesota President C. Peter Magrath has accepted the invitation to be banquet speaker at the IT Alumni Annual Meeting on Friday November 5, 1976, at the Radisson South Hotel. Dr. Magrath has indicated he will speak on the importance of technology to our state.

Outstanding Achievement awards will also be presented to selected distinguished alumni at the banquet. The usual necessary, but very brief, business meeting will be held.

A seminar will precede the banquet. This year the seminar will be held on campus in Murphy Hall Auditorium. The committee to plan this year's seminar is being headed by Dr. George A. Champine ('56 BS, '75 PhD) of Univac, and Dr. Anthony F. Yapel, Jr., ('67 PhD) of 3M.

cuss "The Mechanics of Thermally-Activated Crack Growth."

Donald S. L. Cardwell, of the University of Manchester, Department of History of Science and Technology, has joined the Department of Mechanical Engineering as a Hill Visiting Professor, for spring quarter, 1976. A historian of technology, Dr. Cardwell is presenting a series of public lectures entitled "Energy and Power: A Scientific and Social History." These lectures will be videotaped and will form a permanent teaching resource at the University of Minnesota.

G. K. Wehner, of the Electrical Engineering Department, is presenting an invited paper "Sputtering of Multicomponent Materials" at the "Second International Conference on Sputtering and Its Applications," University of Nice (France), May 17-21.

ITEMS

ITems is a quarterly publication of the Institute of Technology at the University of Minnesota, with special support from the I.T. Alumni Association. Material from this publication may be reproduced without cost, but credit to *ITems* will be appreciated. Requests to be placed on the mailing list or other inquiries may be directed to Clarence A. Berg, at the above address. Phone (612) 373-4838.

Dean Richard A. Swalin
Associate Dean Walter H. Johnson
Assistant Dean, Industry and Professional Relations Arnold A. Cohen
Assistant Dean, Student Affairs Paul A. Cartwright
Director, Continuing Education in Engineering and Science M. E. Nicholson
Assistant to the Dean and Director of Special Programs Clarence A. Berg
I. T. Alumni President Everett Dale
Editor Marchet Reeve

The University of Minnesota adheres to the principle that all persons shall have access to its facilities, activities, and employment without regard to race, creed, sex or national origin.



Morris E. Nicholson, Director, Continuing Education in Engineering and Science

U of M Joins AMCEE

The University of Minnesota has joined with ten other colleges of engineering into The Association for Media Based Continuing Education for Engineers. The purpose of the association is to develop and use video and other media for continuing education programs in engineering. The institutions represented include, Case-Western Reserve University, Colorado State University, Georgia Institute of Technology, Illinois Institute of Technology, Massachusetts Institute of Technology, Southern Methodist University, Stanford University, the University of Michigan, the University of South Carolina, and the University of Southern California.

Directors of Continuing Education in Engineering and Science in these institutions recognize that there is an increasing need for the practicing engineer and scientist to improve his professional expertise through specialized learning packages which are particularly relevant to his job. This organization will bring together, on a national level, a network of institutions to develop media based educational materials in a program of continuing study for engineers at mid-career. The association will enable the institutions to identify courses or components of courses which can be used effectively on a national basis, thus making it possible to produce media based materials in a cost effective manner through an expanded national audience.

One of the goals of the association is to establish a co-management of continuing education in engineering and science.

Because of the complexity and variability of the roles of engineers and scientists in industry, it is difficult on a local level to identify needs for the practicing engineer. Although each of the institutes has made attempts to identify the needs of the practicing engineer, it is felt that a feedback system for client university co-management of continuing education may be to develop a more effective market analysis of the needs of the practicing engineer.

Currently, seven of the eleven institutions are operating instructional television fixed service broadcast systems similar to the UNITE system. Most of the programming currently

being undertaken are regular credit courses offered by the engineering colleges. It is the plan of the consortium to develop media based materials which can either be made available to companies beyond the range of the instructional television networks, or companies in the television systems specially designed to meet the skill and management needs of the practicing engineer.

The program offerings will vary from skill refresher courses for the engineer at mid-career, to advanced "state of the art" topics for engineers and scientists involved in research and development.

Currently, the consortium is seeking funds to provide for the development of media based materials from the National Science Foundation and the Sloan Foundation. Each institution is privileged to seek funds from the consortium to develop video based materials. A review board of consent of consortium members will attempt to identify the kinds of programs most needed on a national level for the professional development of the practicing engineer. It is anticipated that through fees collected for the use of the video based materials, that within three years the consortium can become self supporting and continue to develop quality learning packages to meet the needs of engineers which cannot be met through formal university credit offerings.

INCREASED INTEREST IN PROFESSIONAL ENGINEERING REGISTRATION

During the past several years there has been an increasing interest in becoming registered as Professional Engineers. In April, 152 individuals took the Professional Engineers Examination, and 262 took the Engineer-In-Training Examination. This is approximately ten per cent more than at any time during the last several years.

To help individuals qualify for the Engineer-in-Training exam, the CEES office has made available the Iowa State set of videotapes entitled "Fundamentals of Engineering Review." This was offered at the University of Minnesota's Minneapolis, Waseca and Rochester campuses.

At a recent joint meeting of the MSPE and the ASME in St. Cloud, over fifteen engineers indicated a desire to take the EIT exam during the next year. In order to help them prepare for the exam, the "Fundamentals of Engineering Review" videotape program will be made available to them during the fall quarter, prior to the November examination. These videotapes were also made available to regular IT students through the Engineering Library. During March and April, these tapes have been used over 190 times.

THREE ENGINEERS COMPLETE PROFESSIONAL DEVELOPMENT RECOGNITION PROGRAMS

During the past several months three additional engineers involved in the PDR Program have completed their educational objectives. They are John Molok, a manufacturing engineer at Honeywell, Inc., Norman L. Ledebor, a supervising mechanical engineer at Northern States Power Company, and Thomas C. Atchison, formerly associated with the U.S. Bureau of Mines.

CONTINUING EDUCATION ADVISORY COMMITTEE FOR PRACTICING ELECTRICAL ENGINEERS FORMED

Through the joint efforts of the Consulting Engineers Council and the Department of Continuing Education in Engineering and Science (CEES), an advisory committee for continuing education of the practicing engineer has been established. The initial members are Mr. Thomas G. Johnson of Jacus Associates, Mr. George P. Ellison of Ericksen, Ellison and Associates, Mr. Victor Mikulich of Ellerbe Architects, Engineers and Planners, and Mr. Neal Bodin of Ulteig Engineers, Inc. Also acting for the Consulting Engineers Council is Mr. Larry Breimhurst, currently the director of continuing education for the Consulting Engineers Council. A program for the year 1976-77 will be announced in the summer issue of IItems.



Registration Beginning Now For Summer Courses and Workshops

The Department of Conferences of Continuing Education and Extension will hold a series of three short courses entitled "*Machine Design Update: Synthesis and Dynamics of Machines*" to be held mid-June on campus.

- The courses are:
1. Computer Aided Mechanism Design, June 21, 22
 2. Computer Aided Dynamics of Mechanisms, June 23, 24
 3. Machine Vibration Control, June 25

Complete information and registration materials can be obtained from Tom Richards, Department of Conferences, 219 Nolte Center, telephone 373-3157.

In addition to the regular Summer Session courses offered by IT, there will be two special workshops, one of particular interest to elementary and secondary school teachers and the other intended for the general public. *Aerospace Engineering Workshop for Elementary and Secondary School Teachers* will be held July 5 to 17. Offered under the cooperation of the National Aeronautics and Space Administration (Lewis Center), Civil Air Patrol Liaison Personnel (United States Air Force), Minnesota Department of Aeronautics, and the Department of Aerospace Engineering and Mechanics of the University of Minnesota, the workshop is designed to provide teachers with a background in recent discoveries in the space sciences which can be used as the basis for new or existing classroom programs. Participation in the workshop is by application, and enrollment will be limited. Application forms and further information may be obtained from the Aerospace Workshop Coordinator, 107 Aerospace Engineering Building, University of Minnesota.

In December 1975, Congress passed and the President signed into law the Metric Conversion Act, officially launching a coordinated metric conversion program in the United States. *Measurement and the Metric System (I of T 3501)* is intended for anyone concerned—teachers, engineers, businessmen and women,

mechanics, nurses, homemakers—to become familiar with the measurement system that will predominate within the next 10 years. No technical background is necessary for this course, offered for 4 credits first term of summer session, and in a 2-credit, 2-week workshop second term. Information on registration can be obtained from Summer Session, 135 Johnston Hall, University of Minnesota.

Chemical Engineering Ranked Number 1 in National Survey

In a study conducted by William Gill, Provost of Engineering at SUNY-Buffalo, as part of an effort to estimate quality of graduate education offered by engineering departments at SUNY-Buffalo, 478 questionnaires were sent nationally to engineering deans, department chairmen and faculty. The questionnaires and the procedure used for reporting results were very similar to those used by Roose and Anderson in the American Council on Education study of "A Rating of Graduate Programs (1970)." One hundred seventy-eight replies were returned, and according to Gill, "an effort has been made to obtain and report the data in an objective way, but sophisticated statistical design and analysis procedures were not employed."

The University of Minnesota's Institute of Technology ranked 13 (of 26 institutions) in overall engineering programs. In individual departmental ratings, IT's Chemical Engineering ranked No. 1 nationally in quality of its graduate faculty; Mechanical Engineering ranked No. 5; and Aerospace Engineering ranked No. 7.

Although Gill cautions that the study should be viewed in the context that it is not entirely comprehensive and has not been designed with the care given to statistical design that characterized the two previous American Council on Engineering studies, Rutherford Aris, head of the Chemical Engineering department said, "I think the trends and general relationships that the report reveals are accurate." Dr. Aris noted that the Gill report was a peer rating arrangement and said he believed the department's success was due "primarily to Neal Amundson's

leadership. . . he has brought the department from nothing twenty-five years ago to its present place by attracting young people and in building up both research and teaching."

Rutherford Aris Speaker at M.I.T.

Rutherford Aris, head of Chemical Engineering and Materials Science at the University of Minnesota, was a speaker at a Massachusetts Institute of Technology convocation March 4-5, on "The Future of Chemical Engineering" which included dedication of the Landau Building, MIT's new \$14.6 million chemical engineering building. This new facility was built entirely with funds from private and corporate donors.

Aris, addressing nearly 500 MIT alumni, spoke on "Academic Chemical Engineering in Perspective," presented a brief history of chemical engineering from the time of Aristotle to the present. It was in the 19th century that "out of the demands of industry for the technical chemistry of specific processes there gradually grew the notion of chemical engineering as bridging the gap between physical chemistry and mechanical engineering or metallurgy. In 1880 George E. Davis coined the term 'chemical engineer' and a year later the Society of Chemical Industry was founded." In speaking of the modern day academic chemical engineer, Dr. Aris said, "Goal oriented research is the necessary life blood of industry and basic research to some degree a luxury; in the academy it is the other way around." He continued, "it is on finding the proper balance between detachment and concern in the largest sense, or between theory and application in the narrower scope of professional matters that the future of academic chemical engineering turns. . ." In concluding his talk to the MIT audience, Dr. Aris said, "Our young engineers—and perhaps, a fortiori, our older ones—need to be made aware of the interaction of technological development and social change. The only place where this can be studied distinterestedly is the academy where the primacy of the obligation to understanding permits the necessary detachment."



MEET YOUR LIBRARIANS. . . Donalda Burnham of the Engineering Library



Donna Burnham

Library, but Assistant Professor Donalda Burnham has been Engineering Librarian since 1960, and has recently been named Acting Coordinator of the Institute of Technology Libraries.

The resources of the IT Libraries, which include Engineering, Mines, Metallurgy and Chemical Engineering, Chemistry, Physics, Architecture, Mathematics, and Geology, total approximately 218,000 volumes, with access, through MINITEX (Minnesota Interlibrary Telecommunication Exchange), and through data base searching, to enormous quantities of reference material. This service and information is available to the public as well as the university patron. In 1975, 2,922 library loans were made to industry.

Despite some very real problems arising from an inadequate book budget, the need for a security system

and understaffing of the Engineering Library, "exciting things have been happening" said Mrs. Burnham. She, and her staff of four manage, through professional skill, patron pressure, and perhaps through desperation, to keep abreast of demands of academic and professional use. On a "quiet" Friday in January, 1,042 people were recorded as having used the Engineering Library.

Mrs. Burnham credits the high morale of her staff to the support and interest of the IT Engineering Library Committee—five faculty representatives and a representative from the IT Dean's office. She credits equally the individual contributions of *Marion Parnacott*, assistant to the librarian, who "sees that everything runs as smoothly as possible," *Crystal Clift*, reference librarian and in charge of data base searching, *Deborah Kerben*, in charge of technical services, and *Kaye Arnold*, in charge of circulation and reserves.

Mrs. Burnham received her degree in library science from the University of Minnesota, and her experience includes service in public and medical libraries prior to coming to the University of Minnesota Libraries. She worked in the Chemistry Library for four years before coming to Engineering in 1960. This summer, in Knoxville, Tennessee, at the June meeting of the American Society of Engineering Education, she will be part of a panel of experts discussing engineering libraries as they relate to continuing education.

BOOK REVIEW

Floorman, Samuel C. **THE EXISTENTIAL PLEASURE OF ENGINEERING.**
St. Martins. 1976, 160p. L. C. 75-9480

This construction engineer wastes little time in going for the intellectual jugular of Jacques Ellul, Lewis Mumford, Rene Dubos, Charles Reich, Theodore Roszak, and others of similar persuasion he terms as "antitechnologists." Writing with prose of clarity and grace he turns to the time of Homer with "warmth and considerable literary feeling" to chronicle the unabashed pleasure man has taken in *things*, the fruit of technological advances and the engineers' labors. He marks 1950, the year the decision was made to build a hydrogen bomb as the end of a Golden Age of Engineering, and the start of a time when the previously mentioned men emerged as the protagonists of a movement to focus public disgust and distrust on technology. Floorman detects in these critics echoes of the Luddites—English textile workers who destroyed new machinery ordered for the mills out of fear of losing their jobs. Floorman provides reasoned answers to these outcries and one can close the book with the feeling he would have the engineer once again re-emerge as home faber, i.e., man the creator.

L.P.R.

ITEMS

INSTITUTE OF TECHNOLOGY
University of Minnesota
107 Lind Hall
Minneapolis, Minnesota 55455

ISSUED QUARTERLY

Second class postage
rates paid at
Minneapolis, Minnesota