

Particle Technology Laboratory Exerts Worldwide Leadership

There are probably any number of people who consider themselves to be reasonably well-informed who have been puzzled in the past few years upon reading newspaper accounts of the increasing concern about the effects of aerosols upon the environment of the world and the plants and animals living upon and in its crusts and waters.

If they bother to ask themselves any questions, it may be only to wonder how all the little metal containers holding detergents, paints, perfumes, colognes and deodorants, along with the myriad of twentieth century "necessities" packaged in this manner, can make enough difference to alter the environment to the extent claimed when they are released into the atmosphere.

In the event they are interested, a trip to the dictionary may be helpful. There they will learn that an aerosol is a, "colloidal system, such as a mist or fog, in which the suspending medium is a gas."

At this point there comes the realization that the haze from an automobile tail-pipe, the "majestic" plume from a smoke stack, shining in the sun as it rises, and the fume-belching incinerator joins with other identified sources to produce aerosols and, in fact, far outstrips Chanel, Gurlain and Lysol, along with everything else that comes in pressurized cans and bottles, as aerosol sources.

Fortunately for the layman's understanding of the subject at hand, the particle technologist has a definition for the particle as it interests him that can be understood with ease by the non-scientist. Members of the Minnesota group concern themselves with particles of a size that bridges the gap between gas molecules and microscopic objects. Expressed in terms of physical measurement, this refers to particles from .002 of a micron to 100 microns, a micron being equal to one-millionth (10^{-6}) of a meter which is 1.1 yards. In this region several properties make such particles important. Among these are; they are chemically active and the ones that are toxic are obviously of even more concern.

Here at the University of Minnesota the confusion anent the scope of the word aerosol is also avoided. The sign on the door reads, "Particle Technolo-

gy," and identifies an office area occupied by some of the members of a laboratory group in the Mechanical Engineering Department of the Institute of Technology that has pioneered continually with both basic and applied programs since 1954 making it the first laboratory in the United States and, perhaps, the world to become continuously and exclusively concerned with the study of particles and/or aerosols as such.

Work in the area was first begun well before 1954 as evidenced by the publication, "A Study of Dust Determination," by F. B. Rowley and J. Beal in 1928.

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Straub Award Goes To Michigan Faculty Member

Dr. Steven Wright of the University of Michigan received the Lorenz G. Straub award for 1977 from Acting Dean of the Institute of Technology Walter C. Johnson at a special colloquium held at the St. Anthony Falls Hydraulics Laboratory on the afternoon of Thursday, April 27th.

The annual award for a meritorious doctoral thesis in the field of hydraulic engineering or a closely related area, was presented to Dr. Wright for the thesis he completed under Dr. Norman Brooks at the California Institute of Technology. Dr. Wright also spoke on a subject based upon his thesis, "A Unified Approach to the Analysis of Buoyant Jet Discharges." Professor Emeritus Joe W. Johnson, Department of Civil Engineering, University of California, Berkeley, then presented, "Research Needs for the Civil Engineer in Coastal and Ocean Engineering Projects."

Members of the awards committee, in addition to Professor Johnson, were Dr. Ven Te Chow, University of Illinois, Urbana, and Dr. Roger E. A. Arndt, Director, St. Anthony Falls Hydraulics Laboratory.

The award is funded by an endowment honoring Dr. Straub, a member

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(L. to R.) Dr. Steven J. Wright, 1977 Lorenz G. Straub award winner for a thesis done while a Ph.D. candidate at the California Institute of Technology and his wife, Dale Wright, shown with Professor Joe W. Johnson, University of California, Berkeley, who spoke at the annual award colloquium.



(L. to R.) Dr. Lorenz Straub's sister, Marie Caylor, a guest at the award colloquium honoring her late brother's memory, visits with Mary H. Marsh, Administrator, Civil and Mineral Engineering, and Dr. Roger E. A. Arndt, Director, St. Anthony Falls Hydraulics Laboratory. Dr. Arndt had previously won the Straub award in 1968 for his thesis while a graduate student at the Massachusetts Institute of Technology.

of the faculty of the University from 1930 until his death in 1963, excepting for a few wartime years when he was with the Office of Scientific Research and Development.

Soon after coming to Minnesota Straub started planning the St. Anthony Falls Hydraulics Laboratory. It was dedicated in 1938. In addition to designing the building Straub also supervised its construction.

He was associated with some of the world's largest water resource and hydroelectric developments as an engineer consultant. Befitting his career, international in scope as it was, the award bearing his name has previously been awarded to engineers from other countries including the Indian Institute of Science, Belgium and Great Britain.

A VERY BUSY MONTH ABROAD

From Monday, April 10 until his return to this country on Wednesday, May 12 Professor of Biochemistry and Chemistry Victor A. Bloomfield was in various European countries as well as Iran, delivering lectures, taking part in conferences and visiting scientific laboratories.

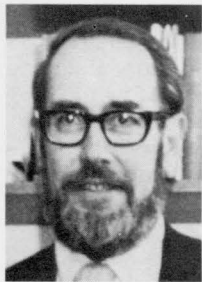
Wednesday, April 10 through Friday, April 14 he attended the International Conference on Electro-optics of Macromolecules and Colloids at Brunel University, Uxbridge, England, and presented a paper titled, "Rotational Diffusion Coefficients of Complex Macromolecules". The following day, Saturday, April 15 he began a four day stay in Tehran, Iran, lecturing on, "Physical Factors in Bacterial Virus Assembly," at the Institute of Biochemistry and Biophysics of the University of Tehran and doing collaborative work with Professors J. Naghizadeh and A. Massih.

He next presented, "Physical Chemistry of Bacterial Viruses," to the Department of Physical Chemistry at the Universidad de Extremadura, Badajoz, Spain, on Friday, April 28. Monday, May 8 found him in Airy, Scotland, where he attended the International Dairy Federation Conference on the Chemistry of milk proteins. On Tuesday, May 9 he delivered the main lecture of the event, "Association of Proteins"

—courtesy of the *Chemistry Communicator*.



FROM DEAN JOHNSON'S DESK



The quality of an educational institution depends primarily on the quality of the individual faculty members. Our faculty in the Institute of Technology is continually judged through review by

colleagues in the particular discipline throughout the world. I am particularly pleased to inform you that three members of the I. T. faculty have been elected to membership to the National Academy of Engineering earlier this spring through what is perhaps the most rigorous peer review process occurring in this country.

This prestigious award is given in recognition of: "important contributions to engineering theory and practice, including significant contributions to the literature of engineering." in recognition of, "demonstration of unusual accomplishments in the pioneering of new and developing fields of technology," and in recognition of, "professional integrity, as well as . . . engineering accomplishments."

Professors L. Edward Scriven, Aldert van der Ziel and Kenneth T. Whitby were the I. T. faculty elected in the most recent selection process. Current I. T. faculty members who have been elected earlier are Professors Rutherford Aris, Philip G. Hodge, Robert Plunkett and William G. Shepherd. Emeritus Professors Ernest R. Eckert and Richard C. Jordan are also members.

Professor Scriven received his undergraduate degree from the University of California at Berkeley and his Ph. D. at the University of Delaware. He came to the University of Minnesota at 1959. He was promoted to the rank of professor in the Department of Chemical Engineering in 1962. The citation on his election to the National Academy of Engineering indicates that he is recognized for:

"application of fluid mechanics to fundamental problems of absorption, interface stability, coating flows, surface wetting and oil recovery."

Professor van der Ziel received his undergraduate degree from the University of Groningen, Holland, and the Ph. D. from the same institution in 1934. He came to the University of Minnesota in 1949 as a professor in the Department of Electrical Engineering. The citation on his election reads:

"contributions to the study of noise in electron devices and contributions to graduate education."

Professor Whitby received his undergraduate degree and his Ph.D. degree from the University of Minnesota. He joined the faculty in 1946 and was promoted to the rank of professor of Mechanical Engineering in 1966. His citation indicates that he is recognized for:

"contributions to the theory, design and field testing of aerosol instrumentation, and pioneering measurements of air quality."

The National Academy of Science, a sister organization with emphasis on the sciences, elects members in a similar manner. The following I. T. faculty are members of the National Academy of Science: Professors Bryce L. Crawford, Edward P. Ney, Alfred O. C. Nier, Herbert E. Wright and Emeritus Professors I. M. Kolthoff, and William J. Luyten.

Election to one of the National Academies not only represents a recognition of previous contributions of scientists and engineers but also identifies experts to act as consultants to the federal government on a variety of scientific and technology questions. Students, faculty and staff of the Institute are proud of these accomplishments and extend congratulations to the newly elected members.

Control Science Center Receives NSF Funding

The Center for Control Science has received approval of funding by the National Science Foundation for a cooperative research project on the design of complex systems between the Center and the Department of Automation, University of Budapest, Budapest, Hungary. The project's present time allotment extends from July 1, 1978 through June 30, 1980.

A portion of the program involves an exchange of faculty members between the two institutions. K. S. P. Kumar will be the principal investigator for the Center for Control Science.

We Acknowledge A "Sin of Omission"

The last issue of IItems carried a story concerning energy-related research projects being carried out by scientists and engineers in the various Institute of Technology departments. The story was written as a part of the observance of a National "Sun Day."

Unfortunately the editor wrote a story that was a few lines too long for the remaining space. As an aftermath he relearned something he had known for years. There is danger in taking the easy way out and snipping off the last paragraph.

In this instance the paragraph that fluttered to the floor was one that listed projects which had received their initial funding from the Minnesota Energy Agency. This was particularly unfortunate inasmuch as the Agency had committed a total of \$123,243.00 from its 1977 supply of dollars toward the support of five projects undertaken by the I. T. faculty.

These were, in all instances, particularly important dollars used for the "start-up" of projects expected to generate additional funding support after a preliminary look at initial results gives evidence of continuing promise.

IITEMS

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PARTICLE TECHNOLOGY—*from page 1*

Also, in 1954, Kenneth T. Whitby was given the responsibility of heading the laboratory and remained in this position until 1971.

Early in this period, 1955, the National Institutes of Health provided a grant to support investigations of air pollutants. The laboratory is now conducting research under funding provided by its 12th grant from the same organization.

At the present time, other funding originates from the Environmental Protection Agency, the Department of Energy, the National Science Foundation, the U. S. Bureau of Mines the General Motors Corporation and the State of Minnesota.

In this era of grantsmanship the Particle Technology Laboratory stands somewhat apart from many such laboratories. It does not apply for grants in competition with industrial and academic laboratories. Rather than anxiously scanning lists of problems for which grants will be awarded competitively, the people here prefer to identify an existing problem felt to be important, do an analysis of the capabilities it can focus upon it, thoroughly familiarize the staff with the subject and then approach a funding source that possible solutions or additional information can be of benefit to.

While less prestigious laboratories might find the method could lead to financial malnutrition, in this instance the approach has served well. People remain occupied with research in familiar areas where their efforts yield maximum return, accumulated results have relevance to existing data and progress toward long-term goals is contributed to rather than interrupted.

Scientists like to consider their work as an orderly progression involving the acquisition of knowledge and the solving of problems involved therein. This attitude, however, does not rule out a factor that might be called the lottery of circumstance which, when operating, can exert a strong influence upon the career of scientists.

Such a factor may have been in operation in the spring of 1948 when, after he had been awarded his second Bachelor's degree, K. T. Whitby, in need of a summer job, went to work for Professor John M. Mackenzie. The work was in the area of particle technology and, moreover, specialized

equipment installed for research that was being conducted for a group of local millers was becoming available to accommodate other projects as the work for the millers "wound down".

Putting these circumstances together it followed that Whitby's Ph.D. would be in the field of particle technology.

Today the group offers only three courses in particle technology. "The thing that counts is the core material contained in the three courses," says Whitby. The rest of the time completing a major in particle technology is spent, "putting the frosting on in the form of work in a live laboratory."

Success with this method of training is attested to by the fact that more particle technology students have trained at Minnesota than at any other school in the country and by the fact that the graduates are in high demand.

As a part of the basic research conducted in the aerosol field, technique development by laboratory staff members has led to the design of eleven patentable instruments that are now on the market and widely used. In fact, Whitby designed his first such instrument as a graduate student and the laboratory has established a worldwide reputation for developing such aerosol instrumentation.

For the past five years work in this area has been under the direction of Dr. Benjamin Y. H. Liu.

Liu and Whitby share the attitude that to design an instrument to meet a particular need is not enough. They look at the task as unfinished until the device is being used on a widespread basis.

Research in certain aspects of the field of Particle Technology is not for stay at home types. Whitby says that about ten years ago it became increasingly apparent that, "... you can't simulate air pollution in a laboratory."

The solution was to take the laboratory to the pollutants and, in the form of mobile air pollution laboratories both conceived and built here on the Minnesota campus, three laboratories now can be found traversing the highways en route to the air pollutant testing sites they are assigned to monitor at.

The first two, built for the California Air Resources Board and the United States Environmental Protection Agency, were moveable fully equipped laboratories, but because of power requirements, unable to operate without an outside source of electricity.

By now both have been in operation a sufficient length of time to have proven that they are, "a very powerful research tool."

The newest one, the University of Minnesota Mobile Laboratory, built under the sponsorship of the Environmental Protection Agency and the Particle Technology Laboratory, has true mobility. It can perform a full range of sophisticated experiments both from stationary field positions and while in motion.

This now means that the "walls" of the Particle Technology Laboratory are now extended to include any position the mobile unit can drive to and allows the staff to engage in increasingly important roadway studies and point source distribution experiments.

To cope with the data accumulated during test runs the laboratory is equipped to process data first accumulated on a nine-track tape deck then reduced by a separate program run at the conclusion of each day's testing on a Digital Equipment Corp. 11/10 computer that has complete compatibility with the Particle Technology computer located in the Mechanical Engineering Building.

An idea of the demand for the services of this unique unit can be gained from a partial schedule of its activities for the summer now at hand.

Diesel engine emissions from a passenger car were determined from a sampling run at the Minnesota State Fairgrounds race track. This was done under contract with the auto manufacturer. Then, under Electric Power Research Institute contract, it collected data to be used in building an instrument for use by the Environmental Protection Agency and Northern States Power Co. for on-site monitoring. The month of August finds the lab scheduled to be in Tennessee and Mississippi, the heart of TVA land, sampling at new, coal-burning power generating sites for a four week period.

By no means complete, this list provides the reader with a "mini-sample" of the unit's usefulness.

Meanwhile, "back at the laboratory" the Particle Technology faculty is at work on their diverse projects. Listed under the names of their principal investigators, are the following projects:

Dr. Benjamin Liu's work for the Department of Energy on the charging of

David E. Hagford, President, I.T. Alumni Association

A REPORT FROM THE I.T. ALUMNI PRESIDENT

My last column described the goals your Institute of Technology Alumni Society (ITAS) had set for the coming year. The following brief summary describes our progress toward these objectives:

GOAL: ESTABLISH WAYS FOR ITAS TO PROVIDE SERVICES TO THE STUDENT BODY.

1. Establish a file of engineers (at present, 80 volunteers) willing to spend time with I. T. students to acquaint them with the industrial scene. All contacts to be coordinated through the I. T. student counseling office.

2. Organized, with the Student Board, a series of brown bag discussion hours centered around different engineering disciplines. These sessions offered the students an opportunity to discuss engineering with people at work in the various branches of the professions. Five sessions have taken place to date. Plans are now being made to continue this program during the next school year.

GOAL: ESTABLISH WAYS FOR ITAS TO OFFER A USEFUL SERVICE TO THE ALUMNI.

Noon luncheon seminars were planned and held. The sessions drew standing-room crowds and, in some instances, late reservation requests had to be turned away. It appears that a topic of concern was identified and a useful time and format for presentation found. Plans are already made to continue a series of luncheon seminars in the fall.

GOAL: STUDY THE POSSIBILITY OF ITAS SPONSORING A FACULTY RECOGNITION PROGRAM.

A study was made to find out whether it was appropriate for ITAS to sponsor a recognition program for the I. T. faculty. It was concluded that a program such as this is very difficult to carry out. In general, the alumni have been away from the Institute for a number of years and consequently are not in a position to accurately evaluate the current faculty performance in a manner required to conduct a meaningful recognition program. Based on this study, your ITAS board decided that a faculty recognition program should not be started.

GOAL: INITIATE ACTIVE LIASON BETWEEN THE DEPARTMENTS AND THE ITAS BOARD REPRESENTATIVES.

A joint board meeting was held to

allow department heads to meet the respective ITAS board member representatives and share ideas on joint participation. Some active liason has resulted during the year but at a relatively low level. This is an area where additional effort needs to be focused.

GOAL: IN ADDITION TO THE NEW GOALS, CONTINUE THE PRESENT ALUMNI FUNCTIONS.

1. Science and Technology Day, scheduled for Nov. 10, 1978.
2. Continued support of the Merit Scholar Program within I. T.
3. Continued support of ITEMS.
4. Participation in I. T. Advisory Council.

Although the year is only half over, it has been busy and exciting. Your board has been very active in a number of areas. I again want to encourage you to actively participate in the activities your board is pursuing.

Your comments and suggestions are always welcome.

Dave Hagford, President ITAS

I. T. ALUMNI LUNCHEON SEMINAR SERIES START AGAIN IN OCTOBER

The I. T. Alumni Services Committee recently concluded its first-ever luncheon-seminar series in May. The three session series, "Can You Survive Company Politics?" featured University of Minnesota Professors Blaine Cooke and William Weitzel. Professor Cooke, Business Administration, spoke on the realities of corporate politics; Professor Weitzel, Industrial Relations Center, introduced interpersonal relationships as a key to survival in a "political" environment.

This fall another series will be offered during October, November, and December. This next series will focus on career management. The sessions will cover three aspects of this vast topic: Continuing professional education, coping with occupational stress, and avoiding over specialization.

Science & Technology Day Set for Nov. 10

The annual Science and Technology Day, sponsored by the I. T. Alumni Association, has been scheduled this year for Friday, Nov. 10. As in past years the day will consist of two parts; an afternoon seminar and an evening banquet.

This year's program is being coordinated by Dr. George Champine of Sperry Univac, second vice-president of the alumni organization.

This year's seminar theme will be "Emerging High Impact Technologies". A number of major technological advances have been made recently in several disciplines including physics, chemistry, computer science, chemical engineering and electrical engineering. These advances have resulted in a number of new products for the consumer and industry that will change the life style of society as a whole. They will furnish the topics covered at the afternoon seminar. Included are:

- Robotics . . . its major applications are now underway in industry.
- Speech generation/recognition by computer . . . every telephone becomes a computer terminal.

- Superconductivity . . . applications to generators, power transmission.
- Magnetohydrodynamics . . . a high efficiency prime power source.
- Tribology . . . new advances in control and application of friction.
- Ultra-fine particles . . . characterization and applications.

The 40th annual banquet will be held in the evening at the Radisson South for the Institute of Technology Alumni Association and friends. Last year's event set a new attendance record with approximately 500 present. This year's banquet is expected to be larger and will have a keynote speech on the vital association between technology and economic prosperity, both at individual and corporate levels.

Alumni who have achieved unusually successful careers in business, technology, education or government will also be honored.

All alumni and others interested in attending are invited to both the afternoon seminar and the evening banquet. Tickets are not needed for the seminar. Information on obtaining banquet tickets will be made available early in October.



Ohio State Metallurgist Accepts IT Deanship

Roger Staehle, professor of metallurgical engineering at Ohio State University, has been named dean of the Institute of Technology. He will succeed Walter Johnson, acting dean since last November. Johnson will return to the teaching faculty in the School of Physics. He had previously served as the associate dean for the past seven years.

Staehle, 44, holds bachelor's, master's and doctor of philosophy degrees from Ohio State University where he has been a member of the faculty since 1965.

A metallurgical engineer, he serves as a consultant to many national corporations, including the 3M Company, and has written more than 60 publications concerned with corrosion. He is a member of the National Academy of Engineering and is editor of *Corrosion Journal* and *Advances in Corrosion Science and Technology*.

Subject to the regents' approval, Staehle's appointment will be effective Feb. 1, 1979.

Staehle's research activity can best be highlighted by the fact that his research budget alone consumes 15 percent of the Ohio State engineering budget.

Student Career Development Programs To Continue

As a part of the I. T. Alumni Society's efforts to expand interactions with I. T. students, a series of noon-hour campus seminars have been arranged which have the objective of aiding students in planning their future careers. The overall program is being coordinated by Dr. Tony Yapel of 3M Company, First Vice-President.

A typical career development seminar has generally involved several industrial scientists and engineers briefly discussing the duties and opportunities involved in their current job. The presentations are often followed by a period of time devoted to answering any questions students may have regarding technical areas in industry or academia. An effort has been made to keep the program format informal to encourage interchange among the students and visiting scientists.

The first of these career planning sessions was held on Feb. 28. The program was aimed primarily at freshmen and sophomore "unclassified" students who have not yet decided on a major field. Nearly forty students attended, including a sizeable number of juniors and seniors who have already selected their majors. At this program, four scientists with varying technical backgrounds (chemical and electrical engineering and physics) from 3M Company made short presentations, then fielded questions from the students. The latter were particularly interested in both the scientists' current research or engineering duties and the reasons behind each scientist's selection of his or her specific career path.

A second series of noon-hour career planning sessions was held during E-Week, May 1 to 5. One specific field of engineering was featured each day: Electrical Engineering (May 1); Chemical Engineering (May 2); Architecture (May 3); and Mechanical Engineering (May 4). Industrial scientists and engineers again gave overview presentations, conducted panel discussions and answered student questions on each discipline. The I. T. Alumni Society expects to continue sponsoring career planning programs of this nature in the future, holding at least one such session per quarter. Considerable assistance has been received from the I. T. Student Board, the I. T. Dean's office staff, the U. of M. Student Counseling Bureau, and a large group of scientists from 3M Company in planning, organizing and publicizing these initial programs.

In a related development, both the I. T. Dean's Office and the Student Counseling Bureau are very interested in obtaining the names of scientists and engineers in the Twin Cities area who would be willing to occasionally spend a few hours of their time discussing career opportunities with students either at their offices or at other mutually agreeable locations. Such encounters would be informal in nature and would probably involve one or two students carefully selected by University staff members. The primary objective would be to give the student the opportunity to meet an industrial scientist or engineer experienced in his field of interest.

The I. T. Alumni Society is looking for volunteers willing to participate in these career planning programs. You need not be an University of Minnesota alumna to take part and you can

be assured your help will be truly appreciated, both by the I. T. Alumni Society and the students whose careers you will be helping to shape.

Those interested are urged to call Dr. Tony Yapel at 733-1068.

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particles, a study for the Environmental Protection Agency in particle filtration and for the National Science Foundation on ultrafine particles. Dr. Virgil Marple's project for the U. S. Bureau of Mines studying coal dust, using instruments developed here and establishing the first computerized measuring system for coal dusts. Dr. David Kittleson has spent three years studying and measuring diesel aerosols. This, in anticipation of problems that have with the recent EPA announcements, suddenly become a "hot" subject. Dr. Peter Mc Murray also investigates nucleation in the atmosphere, or where do the ultra-tiny particles come from?

A number of the staff are involved in what is the last year of a three year grant from the U. S. Bureau of Standards which involves assisting the Bureau in the accumulation of expertise in particle technology and in developing instruments for measuring sulfur containing particles.

Among the last remarks made in a conversation, Dr. Whitby said, "We have not institutionalized our activities. Our research has changed quite drastically about six times."

It might be quite safe to speculate that as new problems connected with particle technology emerge it is highly probable that they will be carefully researched here and that a large constituency will ultimately benefit.

The awarding of a highly regarded honor to Dr. Whitby is referred to in Dean Johnson's column that appears elsewhere in this issue of ITems.

On August 16 through 18 many of the Particle Technology Laboratory faculty mentioned in this story, along with scientists from other laboratories, will hold a two-day short course in Aerosol Measurement on the Minneapolis campus of the University of Minnesota at the Nolte Center for Continuing Education. Full information on the short course can be obtained by writing the Department of Conferences, Nolte Center, 315 Pillsbury Drive, S. E., University of Minnesota, Minneapolis, MN, 55455.

IBM & Honeywell Offer Similar Programs

The Institute of Technology and Honeywell are developing a program of instruction in advanced technology for engineering managers similar to one that IT and Conferences and Institutes have held for International Business Machines since 1968.

This year the two firms will each hold their programs at separate locations. The two sessions will be staggered by one day in order for the approximately 14 IT faculty members who will serve as instructors to be able to serve both locations concurrently with starting dates shortly after Labor Day.

Technical programs for the Honeywell collocation have been developed with the participation of Associate Professors Mahmoud Riaz and Jack H. Judy of the Electrical Engineering Department. Both have been

previously involved with the IBM program for a number of years.

Each of the two events will be limited to approximately twenty students.

A feature of both courses will be the availability of a number of small computers for use by the participants. Although these managers have been IBM or Honeywell employees for a number of years none have yet had experience working with computers. They will be used to solve problems related to technical presentations as well as the solution of problems involving standard programs.

The first week will consist of the presentation of scientific background and the second will address itself to the state of the art technology.

M. E. Nicholson will act as a roving academic coordinator for both programs.

structure of microprocessors. Basic programming is covered, a number of examples illustrate important machine features. The importance of program development aids is emphasized in a discussion of editors, assemblers and operating systems. Various methods of communicating data between a microprocessor and other devices is included with a discussion of various peripheral interface chips. The application of microprocessors in digital control systems is also discussed.

The course emphasizes considerable "hands-on" experience with about one-half of each day spent in the laboratory in exercises coordinated with the lectures.

Each student will have access to the microprocessor units. Laboratory experiments use a University of Minnesota developed microcomputer based on the Motorola 6800 microprocessor.

Enrollment is limited to twenty-eight. For information about housing, registration or parking: Mr. Guentzel at above address. About content, write or call: Professor L.L. Kinney, Dept. of Electrical Engineering, 123 Church St. SE, University of Minnesota, Minneapolis, MN 55455. Phone: (612) 373-5626.

Coming Continuing Education Programs

TRANSIT SYSTEMS THEORY

A One-Week Course
Monday through Friday
August 7-11

NOLTE CENTER FOR CONTINUING EDUCATION, 315 Pillsbury Dr., SE, East Bank, Minneapolis Campus, Minneapolis, MN, 55455. Fee: \$300 + \$100 for optional second session, Feb. 7-8, 1979 (See Below). This course is intended to prepare professionals for transit system design and planning activities in industry and public agencies. Emphasis is placed upon the theory of automated guideway transit, but in a manner in which the characteristics of all types of transit systems are considered. Understanding of the elements of cost-effective design is emphasized throughout. The emphasis on systems design will aid participants in developing the ability to analyze and synthesize engineering systems of all types.

An optional feature of the course is a return two-day visit six months after the initial program. This will give participants an opportunity to discuss text material studied in the interim and to relate individual projects developed with other participants and with the instructor.

The instructor will be J. Edward Anderson, Ph.D., professor of mechanical engineering at the University of Minnesota. He is president of the Advanced Transit Association and a member of the Transportation Research Board/National Research Coun-

cil. He has lectured on new transit technology and its applications both in Western Europe and Asia and was a consultant to the Raytheon Company in 1975 and 1976.

Mail inquiries to: Gordon Amundsen, program director, Department of Conferences, Nolte Center, 315 Pillsbury Drive, University of Minnesota, Minneapolis, MN, 55455 or call (612) 373-7839.

FUNDAMENTALS of MICROPROCESSORS with APPLICATIONS

A Four-Day Shortcourse
Monday through Thursday,
August 28-31

The course, offered by the Department of Electrical Engineering, will be held in the Electrical Engineering Building, 123 Church St. SE, located on the Minneapolis East Campus. FEE: \$350 which includes all course materials, laboratory time, banquet and coffee breaks. Lodging help from: James Guentzel, Administrator, Department of Electrical Engineering, 123 Church St. SE, Minneapolis, MN 55455 (612) 373-5404.

This course is intended for those who have little or no experience with microprocessors or microprocessor based systems. A bachelor's in Electrical Engineering is assumed. Little or no background in digital electronics is required.

The course begins with the

VIDEOTAPE REVIEW SEEN AT TWO RANGE LOCATIONS

During a recent winter quarter while an evening class, "Engineering Fundamentals Review," was in progress on the Minneapolis campus the class meetings were videotaped and upon completion of the course the tapes were sent to the range office of the Higher Education Coordinating Board.

Patrick L. Baudhuin, the range office director, then made arrangements for the tapes to be viewed by approximately 40 engineers working and living in the vicinity of Hibbing and International Falls to attend classes in those two cities where they were shown.

This marks the first time that the University has provided an educational service on the range through the office of the Higher Education Coordinating Board's area office.

The comments by viewers that were received by Baudhuin indicated a favorable response on the part of the students and showed them to be enthusiastic about this form of educational outreach by the Institute of Technology.



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