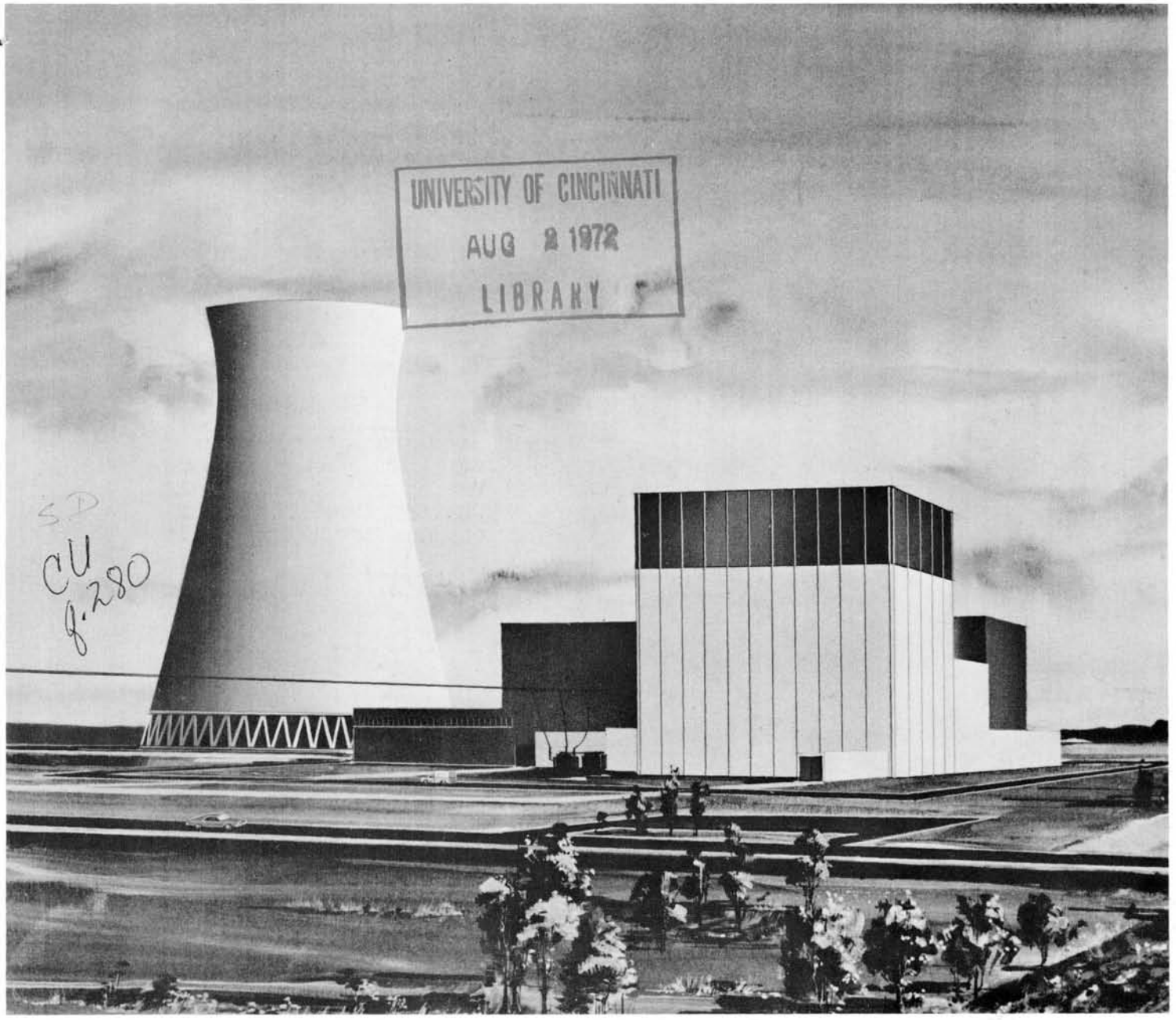
COOPERATIVE ENGINEER

UNIVERSITY OF CINCINNATI
MAY, 1972



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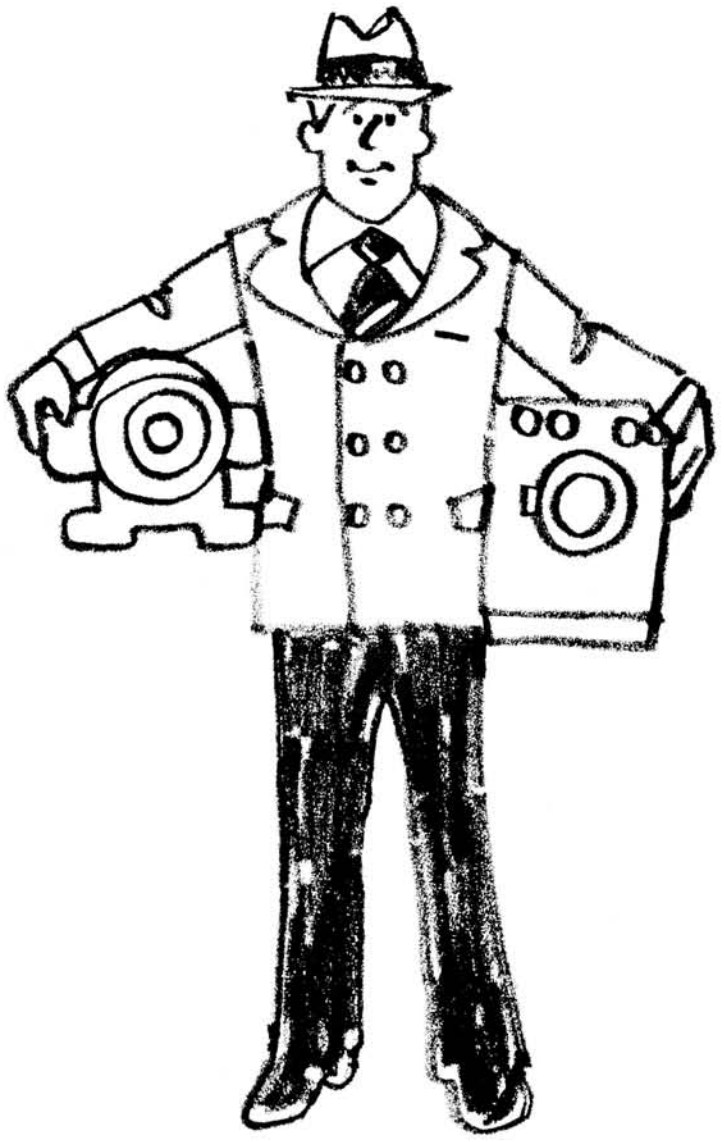

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COOPERATIVE ENGINEER
UNIVERSITY OF CINCINNATI

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This is the May, 1972 issue of the COOPERATIVE ENGINEER (Vol. 49, No. 4), which is published quarterly by the students of the College of Engineering in Room 647, Baldwin Hall, University of Cincinnati, Cincinnati, Ohio 45221. Subscription rates $2.00 per year. 2nd class postage paid at Cincinnati, Ohio.

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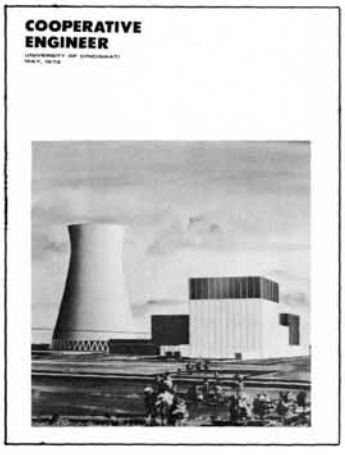


Featured on the cover of this issue is an artist's conception of the Zimmer Nuclear Power Station.

EDITORIAL

By unwritten standards set up in the other colleges of the University of Cincinnati, the engineers are quite active, even to the point of being radical. It would be naive to presume that the engineers are as active as is needed to straighten out all the problems of the college. Nonetheless, the goals that have been achieved, departmentally and college-wide, are the same ones that the students of other colleges are still attempting to obtain.

Perhaps the most dramatic illustration of this idea is what Engineering Tribunal alone has accomplished. One of the more important results of Tribunal's work is the wide-spread use of Pass-Fail in the college. This came as a result of a group of Engineering students seeing a need and being willing to work to realize their goal. Students being on faculty committees is another similar result of a group of Engineering students working hard so that the future students could have a loud voice in the affairs of the college that affect them. The teaching evaluation is a project that the Tribunal inherited from Tau Beta Pi and finally has organized and redesigned to the point that the results have meaning and some emphasis in the college. The new Professional Practice Calendar was supported by the Tribunal this year and, after years of trying, was accepted by all factions involved. The most interesting fact concerning this is that the Engineering Tribunal proposed a very similar calendar two years ago. This year's Tribunal supported and organized the Annual Engineering Dance but also proved that the dance could be a social success as well as a financial one. Here again, other colleges are eliminating such social events and, even in our own college, this is the first dance in years to be at all successful. This year, through the Tribunal's request, the Dean of the college agreed to open his office to anyone for any reason one afternoon a week. When this was done, our college was the first to have this opportunity. Even now the Tribunal is working on trying to support and develop changes recommended by the Academic Climate Reports of last spring. The most prominent effort is the support of an "A-B-C-N" grading system that would eliminate the stigma of an "F" and the disasterous effects of an "F" on the Cumulative Point Average. Realistically, this may not be accepted for years but the Tribunal feels it would be a better educational system and is,

thus, worth working for.

Many other achievements and goals made by Tribunal and the various students groups in the Engineering College could be mentioned. A more important point, though, is the reason why Engineering students are willing to work in the manner. As Tribunal President, I cannot speak for each person individually but I do know the feeling that seems to prevail. In the past, the Engineering College has had many student leaders who have set precedents and worked hard to make things better for us. This history is what controls many of us since if we do not also work and try to move forward, we waste what efforts have gone before us. This sense of history and pride in our past accomplishments is one thing that no other college has. In my opinion, it is what has allowed us to progress so far, so quickly.

As my last opportunity to address the Engineering College, I would like to thank the many people that have worked with me this year. In my opinion, we worked hard and I hope we moved forward. I challenge the people who worked with me this year, and those who did not have the time, to make next year a proud step forward in the history of the Engineering College. I only remind you that none of us has time to waste the progress we have achieved, only time to build upon it.

Randall Allemang, M.E.
President, Engineering Tribunal

Letters to the Editor

Dear Editor:

After carefully reading the letter to the editor concerning the need for vending machines in Rhodes or Baldwin (March issue of the *Cooperative Engineer*), I thought it might be a good idea to look at another important side of man's needs, a major reason for eating and drinking, the brain. Considering the problems of the many that have been and are physically undernourished, I feel, there is even a greater multitude that is intellectually undernourished, an alarming number may be found in the professions, even engineering.

To get more specific, I find there are more and more, even among my own acquaintances, "professionals" that are concerned, almost obsessed, with what they can buy with the money they "make", rather than with the contribution they make to their profession. Engineering, as well as every other vocation, is in need of more concerned creative people. The enclosure to this letter is concerned with the responsibility of "The Creative Engineer".

Sincerely yours,

Charles A. Cummings
A Part-time Professional Student
And/Or R&D Project Engineer

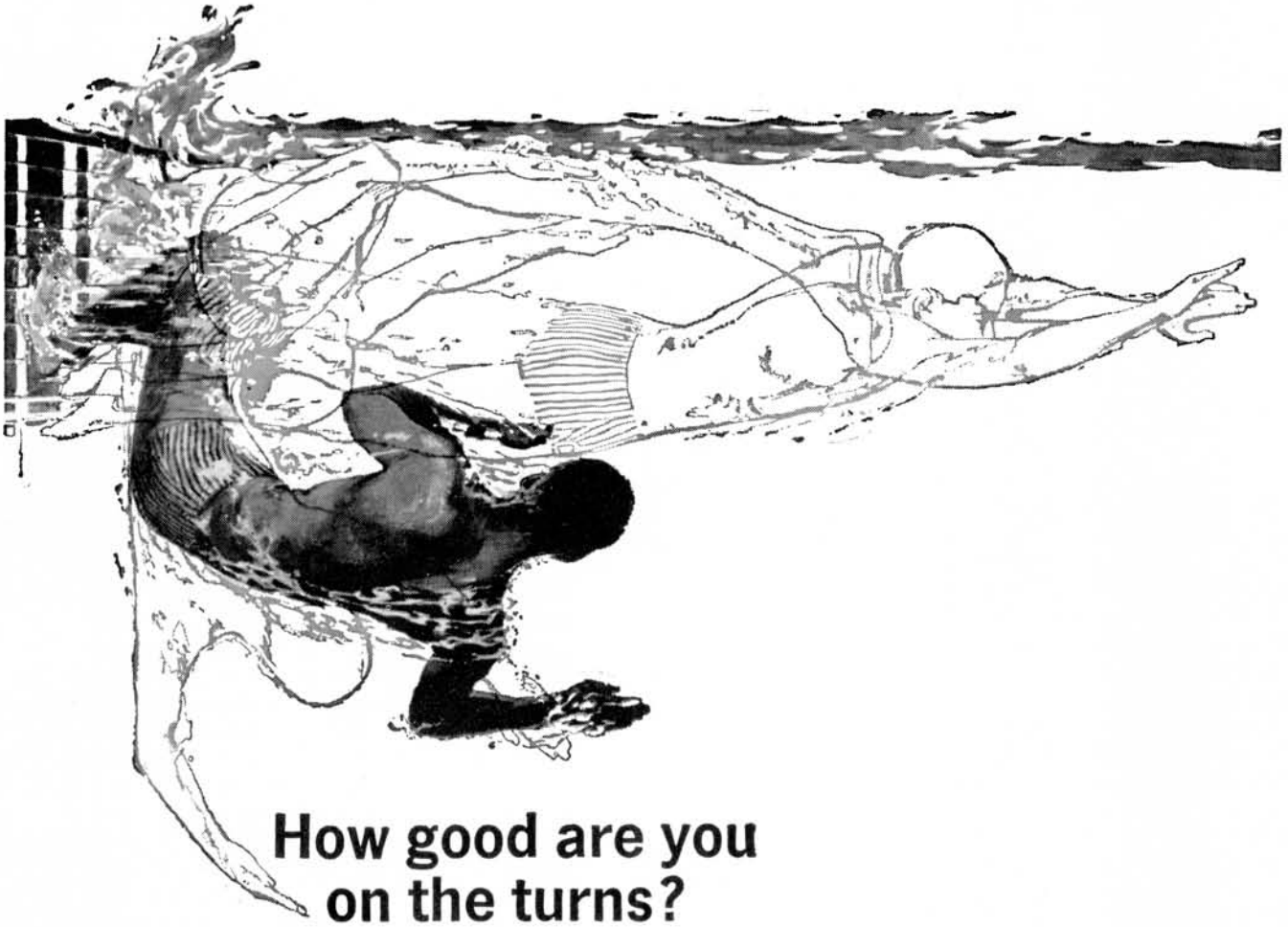
CAC:dh

"THE CREATIVE ENGINEER"

The creative, imaginative person is in demand in the field of engineering as well as every other profession or more generally, vocation. For the most part, one's occupation is considered a profession if it requires a higher than "average" degree of education, but I feel what is more important is that the professional is more concerned, or should be, with the work he is doing than the pay he receives. Near the turn of the century, it was Dr. Charles Steinmetz, an outstanding Research and Development Electrical Engineer for the General Electric Company, who said, "When a man thinks of the dollars he gets, he is not apt to get very much". Steinmetz is possibly typical of many professionals throughout history, but is the concern to do a good job for the job or man's sake, still the prime concern of the professional today?

The backbone of engineering, the Research and Development Engineer, should be one of the most creative, imaginative individuals in his profession. Generally, he is searching for new concepts, either abstract or applied, which demands search and research of the literature as well as his own mind. The product of his education prepares him to work out engineering problems and to effectively search the literature, but does not necessarily prepare him to create a problem to be solved which is manifested in invention or at least innovation. The depth to which he can search his mind is dependent to a large extent on his memory, and likely more important, the depth of his understanding in the course work he has and is pursuing.

The development, of a successful product, tangible or intangible, is greatly dependent on the effectiveness of search and research and "creative thinking". A nebulous area seems to exist between search—research and development where creativity bridges the gap to result in a unique solution to a particular problem or possibly a new concept. Many well-known scientists and engineers over the years have been quoted as saying, and I paraphrase, 'Imagination is more important than knowledge'. However, I feel that it must be made clear that, although imagination may be more important than knowledge, the effectiveness of imagination is dependent, to a large degree, on one's breadth and depth of knowledge. Everyone is born with the "gift" of imagination, to some degree or other, which is likely a quantitative attribute that may be directed, but not acquired. Therefore, if a decision had to be made as to where the emphasis should be, nurturing one's imagination or learning, I feel learning should be emphasized to build a highly desirable and necessary basis for imagination.



How good are you on the turns?

A strong stroke isn't enough to win in freestyle swimming. Experts say: "Watch the turns."

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Nuclear Power: The Zimmer Station

Technical and general aspects of a nuclear power plant-electrical generating station planned for the Southwest Ohio area.

Dick Jacobs EE,'73

It has been said that there is a direct relationship between the standard of living and the amount of energy used in a modern society. Such is certainly the case today in our society. There is growth in energy consumption from all aspects of the industrial, commercial and residential communities. Much concern has been expressed recently about the "energy crisis"; the need to meet the energy demands of our expanding society and to provide clean, safe methods of energy generation has brought about a new awareness of the quality and quantity of power necessary now and in the future. Consequently, electric power companies everywhere have had to adjust and plan for the growing needs of energy generation and distribution to provide for the requirements of our technical society.

In the southwest area of Ohio, the statistics show that energy requirements approximately double every ten years. An annual report from the Cincinnati Gas & Electric Company (C. G. & E.) shows that a total of 10,087 million kilowatt hours of electricity were consumed in the year 1971, whereas 5,046 million kilowatt hours were used in 1961. Yet a comparison of the number of customers for these years shows approximately 430,943 in 1961 and 499,797 in 1971 . . . thus the average usage per customer has been a main factor in this increased need for electrical energy (6,836 kilowatt hours per customer for 1971 versus 3,656 kwh per customer in 1961). At present, CG&E has five main electric power plants, four of the steam turbine type and one of the gas turbine variety. These plants serve an area of approximately 3,000 square miles throughout Southwest Ohio and Northern Kentucky. Although increases in power capacity are under construction at two of these stations, future power demands deem a new station necessary. This will be the Wm. H. Zimmer Nuclear Power Station.

The station is named after Mr. William H. Zimmer, former president and retired Chairman of the Board of the Cincinnati Gas and Electric Company. The plant will be located about 25 miles southeast of Cincinnati, along the Ohio River on a 600 acre site near Moscow, Ohio. The plant will be jointly owned by the Cincinnati Gas and Electric, Columbus and Southern Ohio Electric, and Dayton Power and Light Companies. The share of ownership of the above companies will be in the proportions of 40%, 28.5%, and 31.5%, respectively. Cincinnati Gas and Electric will have the largest share of ownership and will be responsible for the design, construction and operation of the plant.

This station will consist of a General Electric boiling water type Nuclear Reactor. This "boiling water" reactor is one of the most common and conventional types of system for nuclear energy conversion presently in use throughout the country. There are several other types of reactors, including the "pressurized water", "high-temperature, gas cooled", and "fast breeders." Heat energy is generated from a controlled nuclear fission reaction. This heat is used to boil water to high temperature steam (at an operating temperature of about 543 degrees Fahrenheit, a pressure of 985 psi). This steam is used to run conventional turbine generators. In a sense, a nuclear power plant operated much like a conventional fossil fuel plant, except that a clean, self-contained nuclear reaction is used to generate the heat needed to run turbines with steam. Yet the pollutive effects of the combustion of coal or petroleum products are absent.

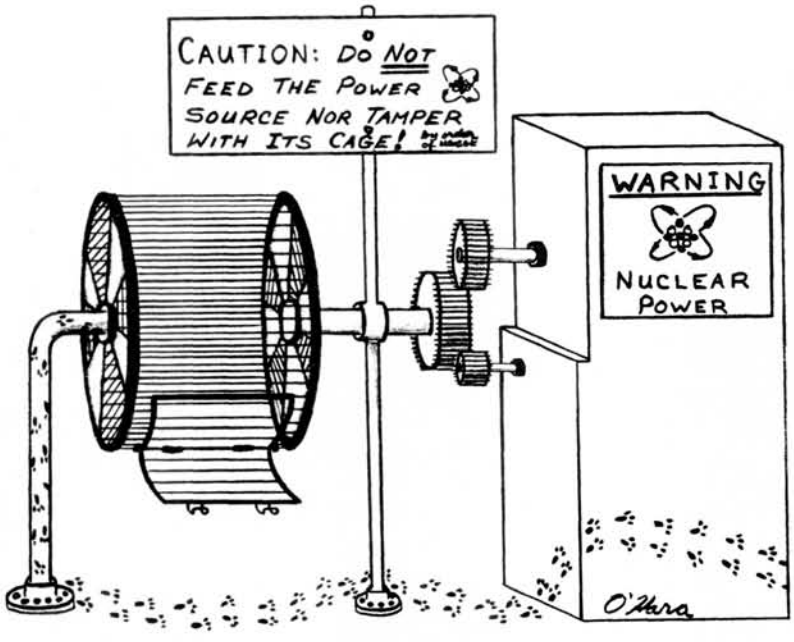
The reactor will use fuel pellets of Uranium contained in a core inside the reactor vessel. About 120 tons of the pellets will be used at a time, but it is noted that the fuel lasts for a long period of time (several years). Boron carbide rods in the reactor vessel control the nuclear fission process. The adjustment of these rods controls the amount of heat energy released. A huge, natural draft cooling tower of hyperbolic design will be used to recycle the condenser cooling water. This water never comes in contact with the reactor water, and is not radioactive. The tower will be 480 feet high and 385 feet in base diameter. About 450,000 gallons of water per minute will circulate through the tower. The water will trickle down the lattice structure of the tower and be cooled by the natural evaporation process. The cooling tower forms a closed-loop system with the steam-condenser and boiler and will not contribute thermal pollution to the Ohio River.

The initial cost of the fuel is about 24 million dollars. Although this initial cost is very high, the long run usuage represents a considerable savings over fossil fuels. Although the initial cost for nuclear plant construction is high, the long run investment is one of greater savings compared to conventional power plants. A great deal of the initial high cost is due to

the extreme degree of planning and safety that must go into a nuclear power plant. Although conventional fossil fuel plants certainly have many facilities built into them in case of failures, nuclear power stations must have even more safety and preventative measures . . . events of even remote possibility must be anticipated and controlled. A very high level of safety has been planned for in the CG&E nuclear power station in redundancy of power supplies and auxiliary systems, along with earthquake and flood protection.

The Zimmer Nuclear Power Station will have an electrical capacity of about 840 megawatts. The addition of this plant, along with planned additions to the present stations will help meet the energy needs of the Southwest Ohio area. The plant, with initial fuel, will cost about 315 million dollars and is planned for completion in 1977. Site preparation began in 1971, and it is hoped that actual construction will begin by fall of this year. Although initial plans have been approved by the Advisory Committee on Reactor Safeguards, the final construction permit by the A. E. C. has been delayed by the "Calvert Cliffs" decision in Washington, D. C. This is a federal court decision requiring the A. E. C. to make more extensive reviews of environmental aspects of all nuclear power stations.

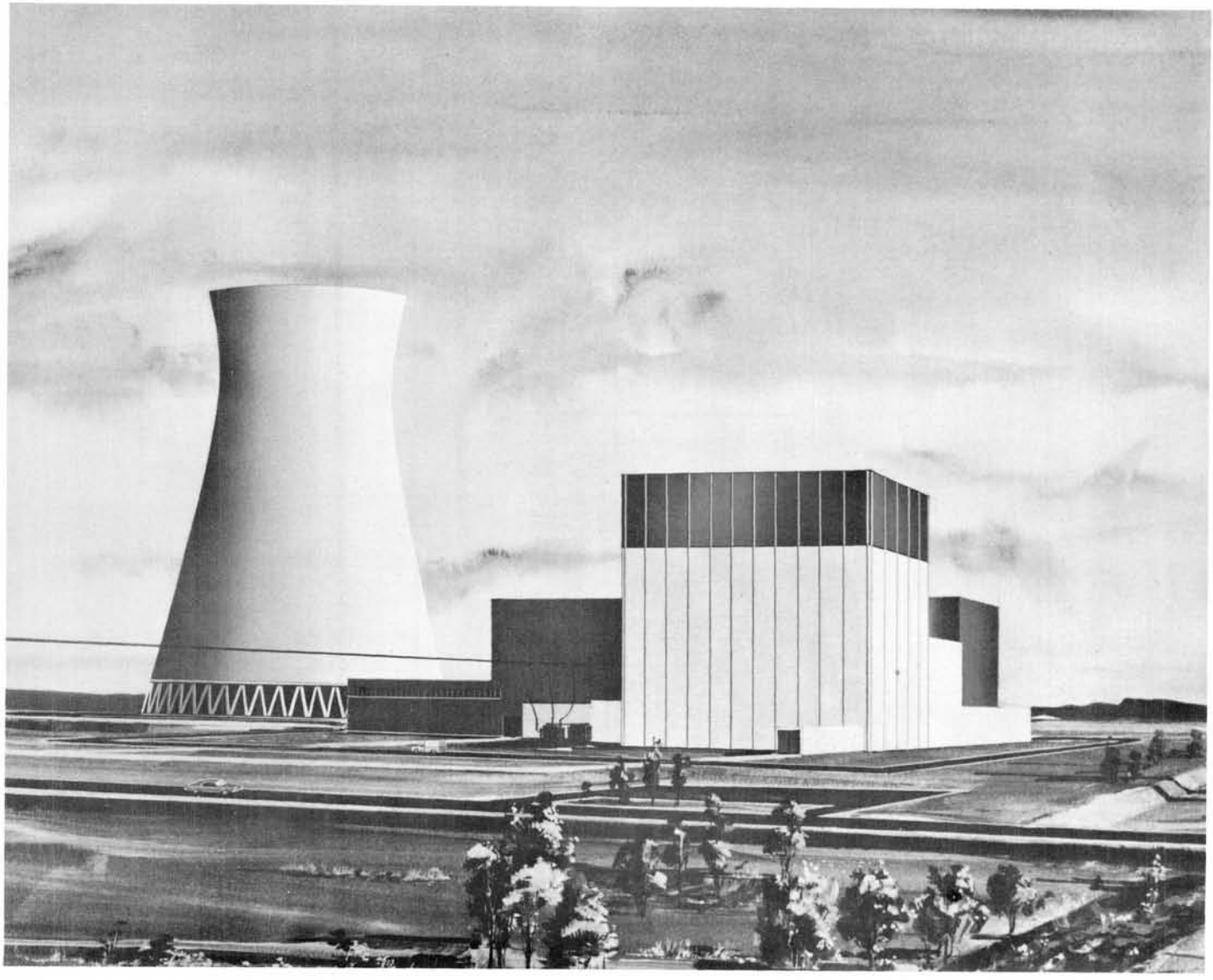
Much concern has been expressed recently about the impending problems of pollution. As the need for electrical energy expands, our society must develop and use cleaner, more efficient systems for energy con-



version. Such is the case with a nuclear power plant. There are popular "fears" of nuclear power, and ecology groups are demanding investigations of the possible radioactive and/or thermal pollution effects of nuclear power stations. These facets of concern have been cleared up by careful research, planning and development. First, there is no danger of a nuclear explosion in a power reactor. The reaction is a controlled fission of Uranium, kept in a vessel and restrained by control rods. Second, the radioactive wastes discharged from the plant will be well controlled, and all possible radioactive emissions will be kept down to within 1/100th of permissible limits. Thus there will be no danger of radioactive pollution. Finally, the issue of thermal pollution to the Ohio River water is bypassed by the cooling tower system and a "settling pond". The cooling tower actually aerates the water it uses. Although there will be "blow-down" from the tower, this non-radioactive water will go to a pond for settling before returning to the river. River water will be used to absorb heat from the turbine shafts and other rotating equipment, but this water will be returned to the river with very little more heat than when it is taken.

Two independent studies were recently made on possible thermal effects of power plants on the Ohio River. Neither found any evidence of harmful effects. One study was by a biological research team at Thomas More College. The study by Thomas More College was performed near the C. G. & E. Beckjord power station, a conventional coal-burning plant along the Ohio River, using run-of-river cooling. This study concluded that the Beckjord Station does not interfere with microbial life in the Ohio River, and that the Ohio River contained a very well balanced number of microscopic bacterial life essential to a "healthy" river. Considering the added feature of a cooling tower planned for the Zimmer plant, one can feel confident that the life forms in the Ohio River will not be threatened.

There are presently 23 nuclear power plants operating in America. There are an additional 54 being built and 52 planned or on order. One of these, the Zimmer Nuclear Power Station offers the promise of a safe, clean energy supply to meet the future requirements of our growing society.



BART – San Francisco's Rapid Transit

Rick Davies, EE '73

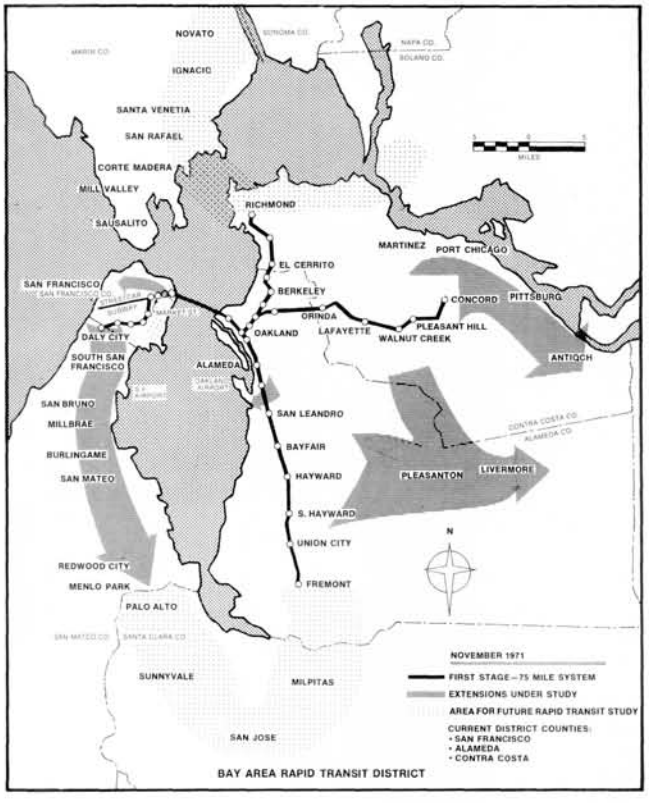
The need for improved transportation systems is steadily becoming more evident. Cities and associated urban areas are experiencing large-scale problems with congested traffic and the resulting air pollution. Expressways designed to handle this traffic can no longer keep up with the increasing number of cars and commuters everywhere experience frustration and time delay fighting the daily traffic jam-up.

One very promising answer to the need for improved transportation systems is the "rapid transit" presently being built in the San Francisco Bay Area. The objective of this system is to move more people faster and cheaper than they could possibly travel in their own cars, and to use less right of way than the expressways. This rapid transit system consists of high speed modern trains analogous to the subway systems of New York. The system will be called "Bay Area Rapid Transit", abbreviated "BART". BART will serve the San Francisco area through a network of subway, elevated and ground level track covering an area 15 miles north to Richmond, 30 miles south to Fremont and 25 miles east to Concord. Although this initial area is to go into service later this year, plans for expansion are under consideration.

Technical aspects of BART include a car with an advanced railroad undercarriage design combined with an aircraft type body. The train will operate at approximately 80 miles an hour, each car being powered by four 150 horse power electric motors from a 1000V DC third rail. The motors provide dynamic braking down to 4 miles an hour, after which aircraft type disc brakes take over. Auxiliary power for communications equipment, lighting, heating and air conditioning is provided by alternators. The undercarriage and suspension system makes for a smooth, luxurious ride. It is a two axle, center pivot type with a light weight frame and lateral shock absorbers with four air-bellow springs.

Many of the technical aspects of BART combine with aesthetic factors designed into the system. Compatibility with the community and environment figured heavily into the design. The streamlined aircraft-type structure of the cars was included to minimize the noise factor of the train at high speeds. Architects were instructed to individually design each of the stations to suit its neighborhood. The interior of the cars will be luxurious and comfortable, as convenient as any passenger car.

All movements of every train in the system are directed by a computer at a central control location. Equipment in the lead car of each train addresses and responds to commands from the computer through track circuits. The computer is set up to prevent any train from overtaking another, to protect against collisions and to prevent train operation if any vital system fails. The opening and closing of doors, acceleration and deceleration, stops, and dwell time are automatically controlled. A manual override is provided to give the train operator control in emergencies. The central control location also maintains supervision of all the stations.



The stations for BART are designed for convenience to the passenger. Spacious boarding areas, and wide aisles and escalators, will comfortably handle traffic during peak periods. Many of the stations are built underground to avoid disturbing the surrounding community.

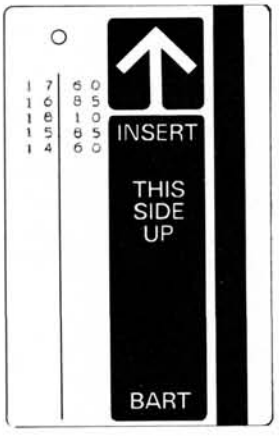
One important aspect of BART is its automatic fare collection feature. A passenger may insert the minimum fare into the gate or he may purchase a ticket up to twenty dollars in value from a vending machine. These tickets are used for multiple rides. The ticket is inserted into the fare gate where it is magnetically coded with time, date, and station of entry information. It is then returned as the gate opens. At his destination, the passenger again inserts his ticket in an exit gate. The fare is deducted and the ticket is returned with the remaining ticket value marked. If the ticket contains insufficient fare value, the gate will not open and a new ticket must be purchased to make up the deficiency.

Transportation experts from all over the world are keeping a close watch as BART nears operational service late this year. Many believe that it may well be a preview of rapid transit systems for other cities. John A. Volpe, U.S. Secretary of Transportation, has called BART "The finest transit system the U.S. has ever seen".

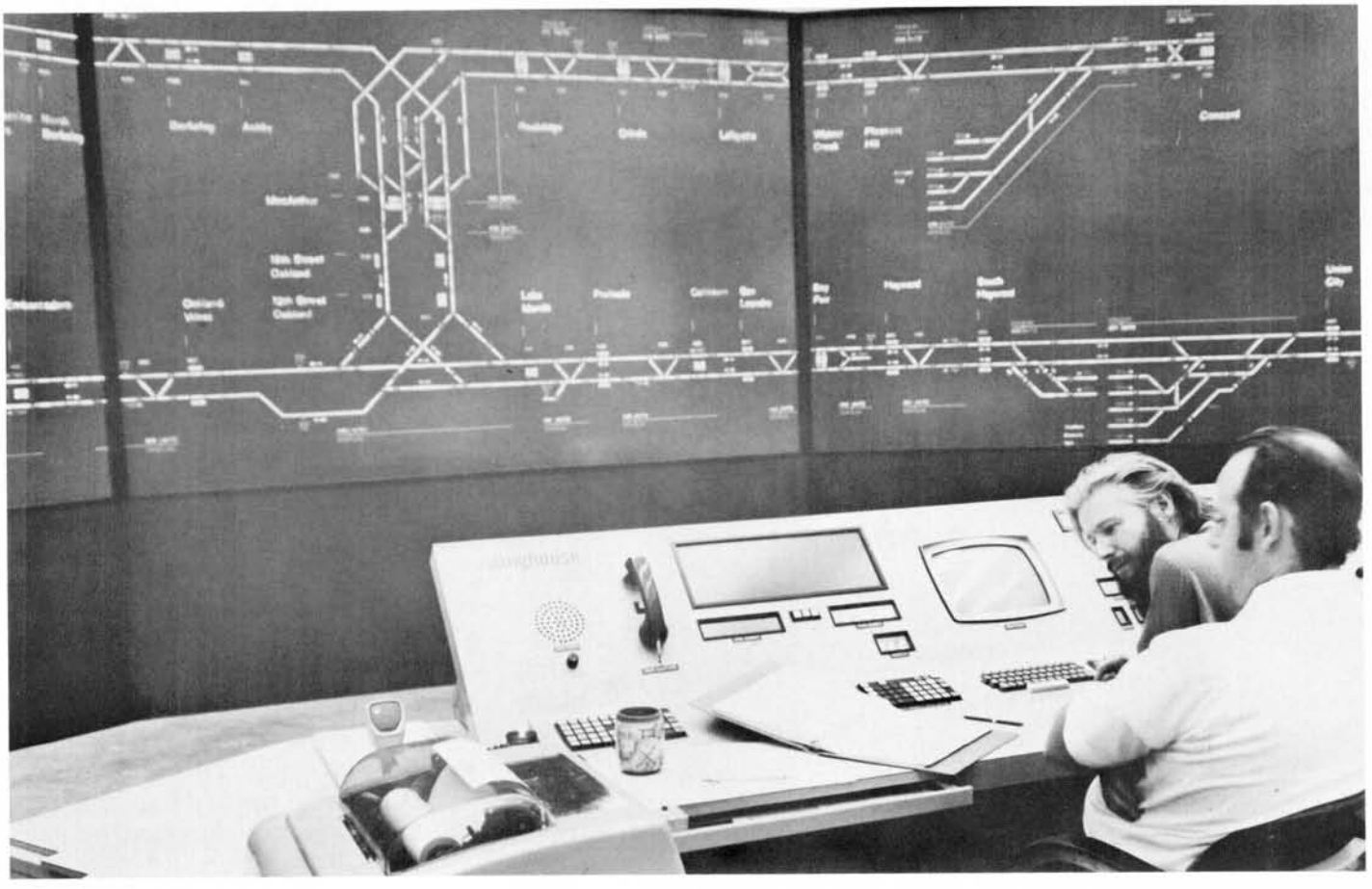
Eventually the BART system could expand to cover six counties. The result of BART will be cleaner air and smoother traffic flow . . . making jobs and recreation more accessible.

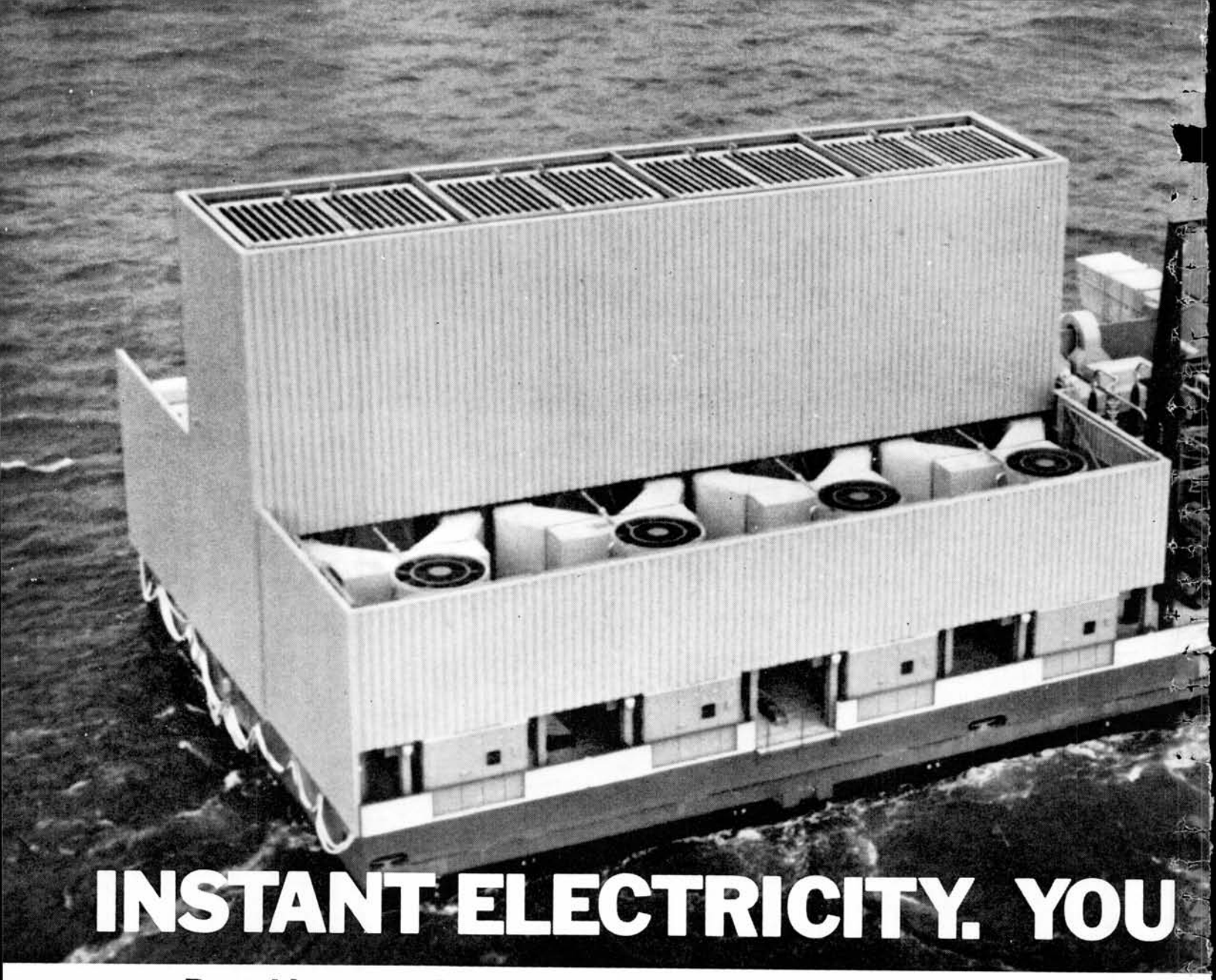
The BART revenue vehicle interior features carpeted floors, wide upholstered seats, tinted picture windows, full temperature control, and a revolutionary lighting system. Each car is capable of seating 72 passengers, and BART's carrying capacity is 30,000 seated passengers per hour on a single line in one direction.

Payment for use of BART is facilitated by use of vending machine-distubuted cards. The passenger inserts his card into the gate to gain entrance, and then re-inserts it into the gate at his destination. The fare is then automatically deducted from the value of the ticket.



The computer-controlled co-ordination of movements on the BART system are continuously monitored by dispatchers at this observation center. Fail-safe operation is therefore assured since the dispatcher has ultimate control of operations at all times.





INSTANT ELECTRICITY. YOU

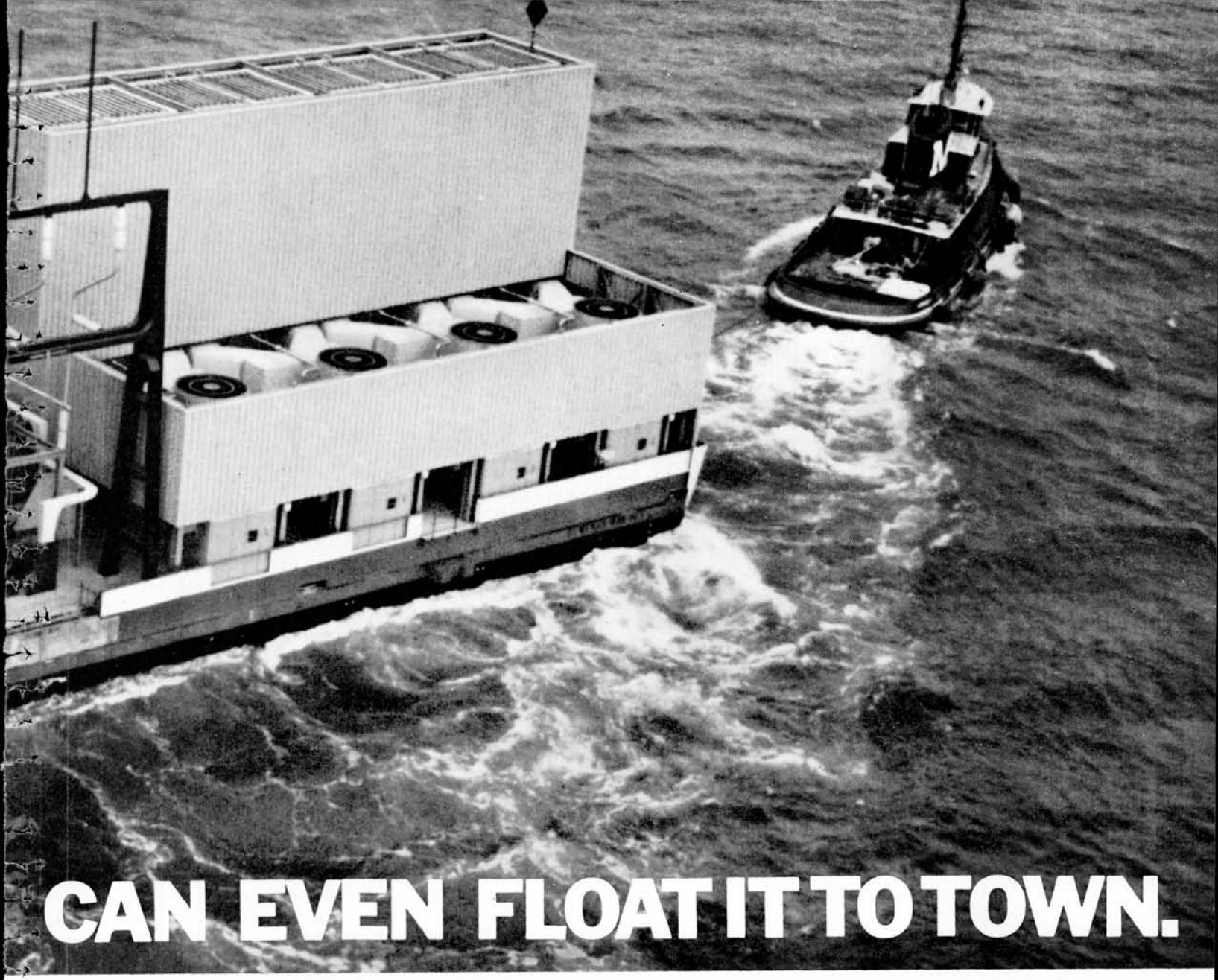
Portable gas turbine generators, mounted on barges and trucks, are being plugged into existing power networks to boost capacity. And nickel's helping make it happen.

One tool that more power companies are using in both their short- and long-range efforts to close the generating gap is a down-to-earth cousin of the jet aircraft engine, the gas turbine.

A typical turbine, hitched to a generator, can produce enough power to light a city of 25,000 people. (Above, *eight* turbines are ganged on one barge. Combined output: 156,000 kilowatts!)

The beauty of the turbine is that it can be bought and set up almost anywhere in a matter of weeks. And it can be turned on and off in mere *seconds*. Which makes it ideal for those muggy summer evenings when everybody gets home and hits the air-conditioner button at once.

Gas turbines have proved such a boon to utilities that sales of them are soaring. Last year, they actually accounted for more than *one fifth* of power companies' total new generating capacity.



CAN EVEN FLOAT IT TO TOWN.

At the volcanic heart of the turbines, where temperatures reach 1,800 degrees, only specially designed superalloys can be used. Almost all of these alloys contain a high proportion of *nickel*—up to 78 percent. Nickel is vital for the properties required for dependable turbine service. It helps to provide alloy stability and corrosion resistance.

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We assist dozens of different industries all over the world in the use of metals. We offer technical information. And the benefit of our experience. Often, Inco metallurgists are able to *anticipate* alloys that will be needed in the future, and to set about creating them.

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And that helps all around.

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INTERNATIONAL NICKEL HELPS.

Engine Charlie's

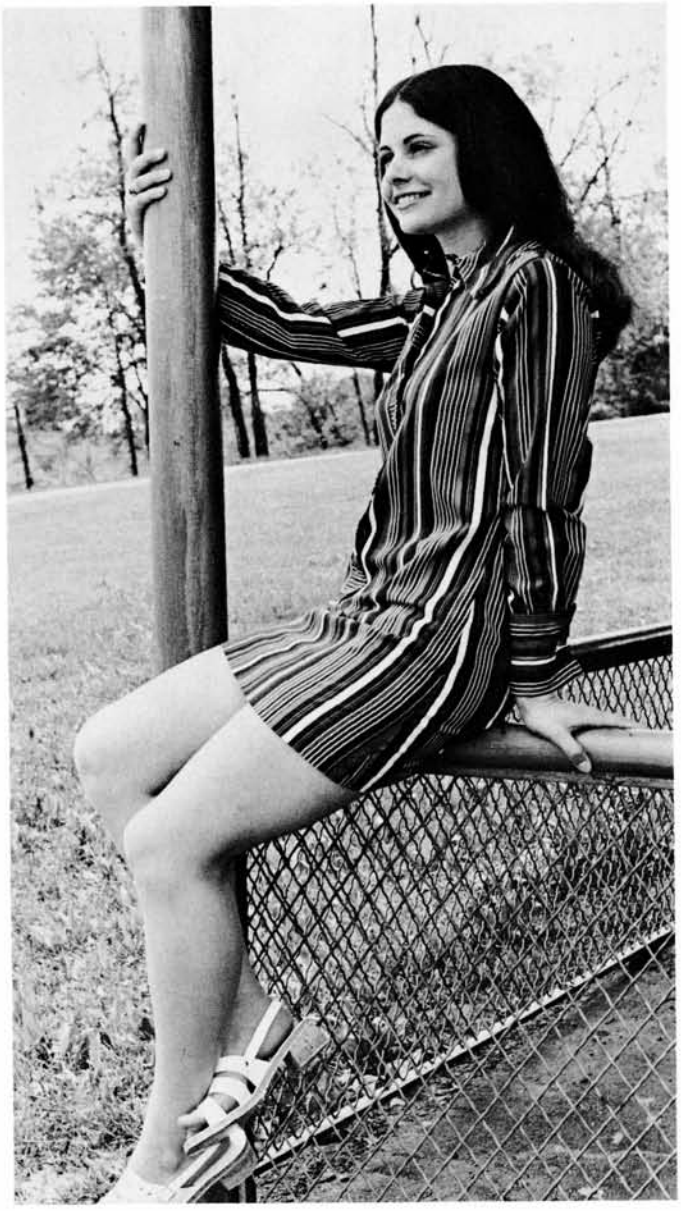
Photos by Bruce Lippard

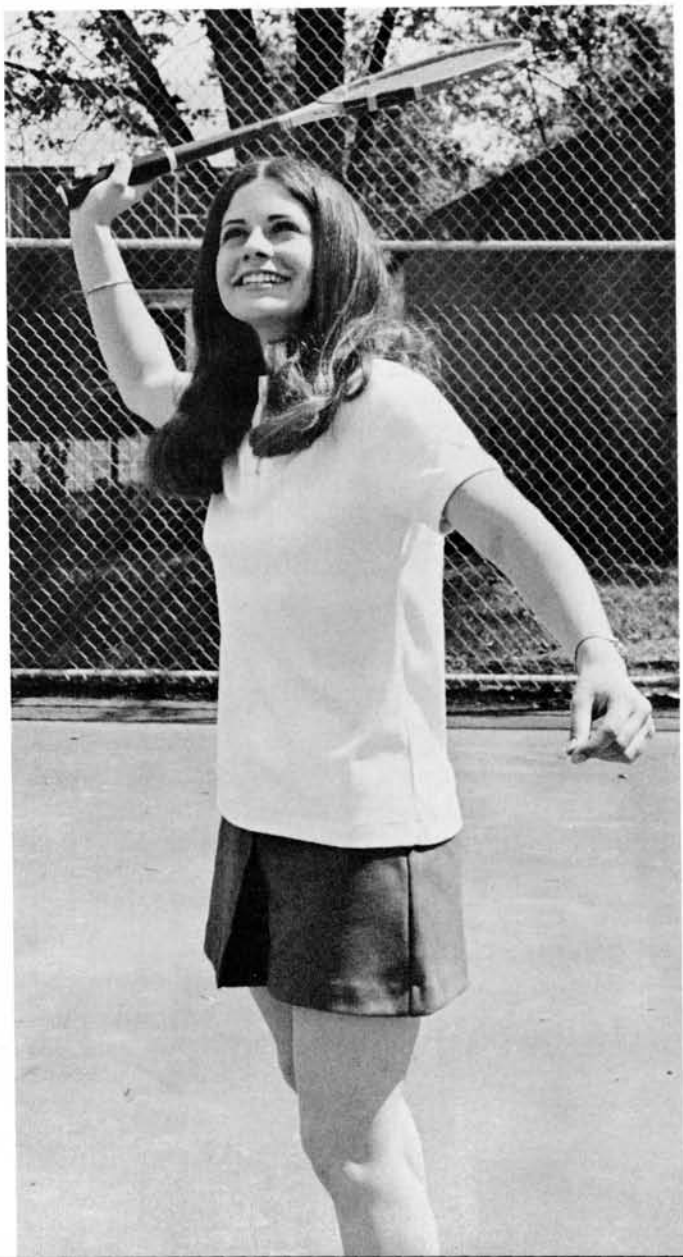
Spring Sensation

SUE TUERCK

Our Spring Miss is green-eyed, brunette Susan Tuerck, a sophomore in Arts and Sciences from Finneytown. As seen by her impressive list of activities, Sue has proven that brains and beauty can mix. In her first two years at U.C., majoring in Medical Technology, she has carried a full schedule of classes while working nights at Powel Crosley Jr. YMCA. Sue has been a consistent performer on the Dean's List and was honored by Alpha Lambda Delta, freshman academic honorary.

Sue's interests vary from tennis to medicine. She enjoys sewing, tennis, bicycle riding and is active in a physical fitness program at the "Y". But she says, "I've learned alot of psychology working at the "Y" the past four years. People are very interesting." Sue plans on working more with people her senior year while interning at Christ Hospital. Brighter days could lay ahead for Engine Charlie if he majors in bioengineering.





Man, Space Flight and Medicine

Charles A. Berry

Space flight is one of man's current and few remaining frontiers. This is particularly true of aerospace medicine where the excitement and the challenge of the unknown daily lead us to new observations about man and his ability to perform in and adapt to the peculiar, weightless world of space.

Man is made up of subsystems as is a spacecraft but, instead of an environmental control system, guidance system, or waste management system, etc., we have respiratory, cardiovascular, endocrine, nervous, genitourinary, gastrointestinal systems, etc. Nor are we as fortunate as our engineering counterparts because they can select " hi rel" (high-reliability screened) parts from known vendors, build the system to their specifications, test it to destruction, and determine a mean time to failure. This we cannot do. We cannot select vendors or the parts. We have no input to the specifications and the determination of mean time to failure is complex and quite out of the question. Nevertheless, certain important answers concerning man have been obtained from our flight experience.

The findings on our flight program to date have...indicated the wisdom in our observing changes in body systems and thus focusing our future flight experiments on those systems where change has been observed. It might seem logical from a scientific point of view to do a detailed survey of each of the body systems, but this would be both time-consuming and expensive with a resulting delay in obtaining the answers necessary for us carefully to evaluate man's capability to perform for long periods in the weightless environment. As a result of our current plan, we have developed a series of in-flight experiments to be flown on the Skylab, for missions of 28 and 56-day durations. Skylab allows us for the first time to measure the physiological response of the involved body systems while in the weightless environment and not just pre-and postflight. This focus on the involved systems should allow us to delineate and quantitate the physiologic adaptation of the body to the stresses of space flight and plan for man's involvement in long-duration flight.

These medical findings are interesting and have obvious implications to man's future activity in the space environment. This question is raised frequently, however: what about the mortals who live their lives on the surface of this planet Earth? Is there any benefit which will accrue to them as a result of man's efforts to explore the space frontier? The space medicine requirements which were necessary for assuring man's safe journey into and return from space have resulted in hardware and techniques of great value to terrestrial medicine. These applications may be viewed in the light of the original requirements.

The initial requirement is the selection of a crew capable of performing the mission required without undue physiologic or phsychologic effect. This led to observations on the effect of motivation of performance and adaptation and emphasis on the fact that the human machine is enormously capable of taking punishment and of adapting to new and demanding environments. The selection process also demonstrated the value of purely static examinations of the individual to perform at peak level in stressful situations. Another useful technique was a combination of background, psychologic, and psychiatric information in order to arrive at the best evaluation position concerning the individual's capabilities. These techniques obviously apply to terrestrial medicine wherever there is a need to select people for particularly demanding tasks.

Charles A. Berry, M. D., is Director for Life Sciences at the National Aeronautics and Space Administration in Washington, D.C. He received a BA degree from the University of California, Berkeley, and a Doctor of Medicine degree from the University of California Medical School, San Francisco. In 1956 Dr. Berry became Chief of the Department of Aviation Medicine at the School of Aviation Medicine at Randolph AFB, Texas, and was assigned to the Office of the Surgeon General, USAF, as Chief of Flight Medicine in 1959. In 1962 he was assigned as Chief, Center Medical Operations Office, at NASA's Manned Spacecraft Center in Houston, Tx., and became Director of Medical Research and Operations there in 1966. In this position he was responsible for planning, implementing and continually evaluating the medical effort of the center and for ensuring continuous coordinated medical support for the Apollo Program, Apollo Applications Program and the Advanced Manned Missions.

Once selected and retained, an artificial environment is needed to insure the health of the crewman in hostile space. The resulting hardware has been a series of environmental control systems — space suits, water-cooled undergarments, water and waste systems, etc. The terrestrial application of these items ranges from the use of the space suit helmet for pulmonary function testing of children, the water-cooled undergarment for cooling of firemen, race car drives, etc., to the reclamation of urine and purification of contaminated or potable water supplies for use of our terrestrial environment.

The need to monitor the physiologic function of our crewmen at distances of 240,000 miles while they were working led to the development of miniaturized, nonirritating and highly reliable sensors. Once the data are obtained, it is necessary to transmit it to earth. The development of such instrumentation led to a massive effort to create, miniaturize, and make reliable many types of bioinstrumentation which had not previouly existed. In fact, this additional requirement has caused the development of many items which are not yet being flown in space, but have excellent medical uses on the ground, such as the endoradio-sound for gastric PH, etc. Sprayon sensors have been developed for use in ambulances to call telemetering of an electrocardiogram back to an emergency room. The use of our sensors in cardiovascular and intensive care units has become widespread. The ability to monitor individuals at work and to telemeter the data to a central site for immediate viewing, or for storage and review, or even for recording on tape and later review, can place many of our medical decisions on a much firmer scientific basis. Answers to questions concerning the level of hypertension on an individual while he does a particular task and the effect of hypertensive drugs on the elevated blood pressure are possible through these techniques. The salient question in a post-coronary patient is what level of work he should be allowed to do. This can be determined on a direct physiological basis by monitoring the electrogram while the individual participates in his daily work activity. These techniques also offer the capability for remote telephone or television diagnosis in many areas of our own country and of the world where medical care is in short supply.

As soon as we were able to instrument man in such a way that data could be obtained from these great distances, huge masses of normal date were obtained by constant monitoring on the long-duration flights. This immediately led to the necessity to develop systems which would allow computer interpretation and tabulation of ECG, EEG, and other such data. These techniques are rapidly being used in many medical centers about the country, and indeed in central repositories, where individual practitioners may be connected by telephone. The large amount of data obtained and analyzed has led to a computer-stored data base on "normal" individuals which is probably unequalled anywhere. This normal data base may be utilized to define better the ranges of normality. Also, by its continued manipulation through our automatic handling systems, we may be able to find new ways to apply results of several evaluations to terrestrial medical problems. Our entire data system has been based upon the use of minicomputers in the local laboratory area. These minicomputers are connected to a larger central computer system for storage and dump of the material for the data base.

As each of our crewmen is used as his own control in determining the effects of space flight, it is essential that we know as much as possible about this "normal state". Each crewman has a large battery of clinical laboratory determinations made annually and then, depending on his participation in either flight or test activity, he may have this same series repeated at more frequent intervals. This has produced a large volume of laboratory information defining the "normal" for each of these individuals and, in the process, has provided a great deal of information concerning the definition of normality. The computer is used widely in this operation. There are circadian or time-of-day variations in most of the body's activities which are reflected in the values of laboratory determinations made at various times. Whereas, the variation in these values obtained at different times might not be of critical clinical significance in ill patients, it is of great importance to us as we try to determine the effects of space flight on man. In trying to define better these circadian differences and rhythms, their importance to clinical laboratory determinations may be better defined.

It has become very obvious that there can be values

which indicate significant alterations of body functions and still these values may be within the usually denoted normal limits. Curves plotting the values of such parameters as blood sugar, white blood cell count, etc., have proven of great value to us in determining preflight or postflight aberrations of physiological function in our crews. There is an increasing need for rapid answers to the various tests which the physician might request....

In a further attempt to reduce the number of procedures necessary, we have been developing hematologic, immunologic, and clinical biochemical screening procedures which emphasize mathematical interactions between laboratory variables, thereby minimizing the required analytical procedures without sacrificing any informational content. Some 47 laboratory tests were run on 100 individuals. A computer matrix was created with these 47 variables and it was possible to note that 20 of these gave the bulk of the information obtained. This list could be further optimized in such a way that 8 tests could provide 85 percent of the data produced by the 47 laboratory determinations. The tests were selected to obtain information on hydration status, humoral immunity, lipid metabolism, blood cell function, adrenal cortical function, liver status, and tissue damages. These techniques are being further refined so that our laboratory may be programed to run automatically a particular battery of laboratory determinations concerning a certain body area, such as the liver, should an indicator test prove to be out of normal limits. In fact, automatic programing of additional laboratory determinations would preclude the necessity for patients to return for further laboratory work and, also, would reduce or preclude additional time delay in providing the patient with an answer as to his condition.

In an effort to evaluate central nervous system function, particularly sleep inflight, a cap with new sponge electrodes has been developed. These electrodes will obtain an EEG of excellent quality without any special preparation of the scalp. This system also has been connected to a sleep analyzer which will scan the EEG tracing and print out digitally the amount of time spent in level 1, 2, 3, or 4 or rapid eye movement (REM) sleep. This device has great value in drug evaluations and for the use of anesthetists in surgical procedures. It also can be used in treating insomniacs and others experiencing sleep neuroses. Several of the devices have been made available to civilian hospitals, such as the Veterans Hospital in Oklahoma City, the Medical Branch of the University of Texas at Galveston, and the University of South Carolina Medical School. The electrode system allows us to obtain electroencencephalogram and an electro-oculogram, to better define the levels and quality of sleep.

Bed rest and water immersion have both been utilized extensively as 1 g analogs of the physiologic effects of weightlessness. They are not true analogs, but they do produce some of the same type, but not magnitude, of physiologic changes observed following exposure to the weightless environment. Bed rest has been utilized by physicians as a time-honored method of therapy since the beginning of the practice of medicine. In spite of this long usage, there has not been adequate knowledge concerning the effects of bed rest, both detrimental and beneficial, to the patient's condition. Our need to use this analog better to predict possible effects of the weightless environment has led to much better definition of changes in calcium balance, musculoskeletal integrity, blood volume changes and the effect of exercise and various other countermeasures in preventing these physiologic decrements. This has great importance to the many patients in who bed rest will be used as a means of therapy.

While evaluating the effect of space flight on the blood, we noted decrease in red blood cells. In studying the possible cause of this decrease in red cell mass, particular studies were made of the red blood cell membrane and much has been learned about its function and chemistry, which will be of value in the study of various anemias. The electron microprobe, which is principally an engineer's or physical scientist's tool, also has been used in determining the location of various elements in the red blood cell. In separating red and white cells, it was noted that neoplastic white cells had high levels of titanium and zinc, whereas the normal cells did not. This finding has been noted and passed on to a number of the large centers conducting research in cancer and other neoplastic diseases. Our flight results also have indicated that nitrogen, even in small amounts, appears to protect the red blood cell from the lysis occurring in the oxygen environment which may indicate some basic physiologic effect yet to be determined.

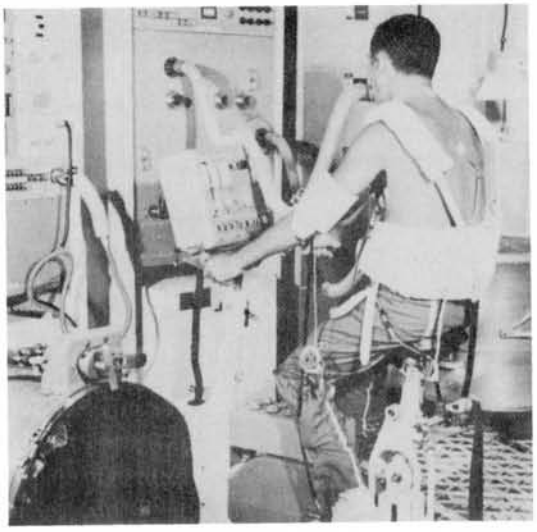
A small percentage of every blood sample drawn is preserved in our serum bank so that we may go back and check historically on either immunity levels or any other parameter involving a particular astronaut. This has proven to be an invaluable aid in such instances as the development of rubella in a backup crewman on Apollo 13. The value of such a serum bank and the epidemiologic investigation of disease is inestimable. Another instance of the value of our baseline data involved the finding of an 8000 white blood cell count on a crewman five days before the launch of Apollo 9. In a few hours, it was determined that the distribution of his cells was abnormal, showing a shift to the lymphocytic series and some eight hours later he had the symptoms and findings of an upper respiratory infection of viral origin. The 8000 white blood cell count is certainly within normal limits, but for this individual whose normal count was known to us as 4000, this doubled his white blood cell count. This development has led to a program looking further into the role of the lymphocyte as an early detector of disease. We have initiated studies of mice, innoculating them with various microbiologic agents.

We then studied the urine and the serum for specific antibodies, trace metals and amino acids, examined the tissues, and particularly looked at the lymphocytes with some new methods utilized in our laboratory. We have found that it is possible to the the microspectrophotometer and to actually quantitate the RNA and DNA in various portions of the lymphocyte. Indeed, by this method, one can draw a contour map of the lymphocyte. We also have been looking at the uptakes of radioactive thymidine and uridine. These are related to the DNA and RNA levels and these methods demonstrate some changes in ratios and distribution related to evidence of infection. Such methods for the early detection of disease obviously can have great import as we look at individuals doing specific jobs

where their presence is required. The ability to detect the disease before symptoms have been exhibited can be a powerful tool in this regard.

The preventative medicine program in operation for our crews alters their risk of disease, not just in the preflight period but during their entire career. The compilation of such disease information in a control population can prove of value as we adopt more and more preventive medicine programs in the population at large. In space medicine, we look upon the development of a disease in one of our crewmen, even though it be infectious, as a preventive medicine failure and try to find the cause of such a failure.

The necessity to study the microbiologic flora of man before and after missions as long as 12 days has shown some interesting changes in samplings of the throat, urine, and feces. We have seen evidence of overgrowth of opportunist organisms and are concerned about the possibility of microbiological shock on exposing crewmen to large doses of organisms after prolonged isolation in the microbiologically-controlled environment of the spacecraft. All these findings are of value as we consider such common occurrences as infections in patients who have had their immunities altered either through radio- or drug therapy.



In keeping the crews well during a mission, we have continued to be concerned about the development of toxic levels of minute amounts of materials contained in water or atmosphere of the spacecraft. Our crewmen are exposed for 24 hours a day to any substance in the environment, and therefore the standard acceptable levels has import to our study of pollution on Earth.

In addition to many valuable items coming from medical requirements created to support flight activity, a number of nonmedical space items with ground applications would have to be called serendipitous. The space helmet for conduct of pulmonary function testing in children has proven of great value, as has an electronic switch which may be operated by eye movement. The switch may be used to power almost anyhing and it has been coupled with a motorized walker chair originally planned for use in unmanned exploration on the lunar surface. These devices have been utilized with neurologically disabled patients of various sorts. A device used to simulate both zero g and $^1/_6$ g movement has found use in rehabilitation of stroke victims. Tiny motors which have been developed in the space program are rapidly finding varied uses within the medical community.

An area of great current interest is the multispectral scanning and sensing of earth from aircraft and spacecraft. While this has great importance to the study of pollution, water supplies, air, the finding of fish and many other such tiems, it also has great medical promise.

We are able to recognize certain vegetation from air or space by these scanning techniques. This vegetation may be connected with particular disease vectors. A recent example was the concern for St. Louis encephalitis carried by the Culex mosquito in the Houston, Texas, area. It was determined that this mosquito breeds in ditches fed by drainage from septic tanks and in streams where large amounts of urea were concentrated. Urea will flouresce and thus can be picked up by scanners. Streams with urea can be identified from the air and the area sprayed. Some 28 diseases are currently under study as to their vectors and reservoirs; we hope that direct attack may be made through the use of Earth-scanning methods.

The necessity to support manned space flight medically created a team effort allying the medical community with the engineering community in a most intimate manner. This relationship has at times been emotional, but both sides have learned a great deal. Production has been fruitful not only in mission results but in medical hardware, as well as spacecraft hardware to conduct these missions. Such a team concept and such an understanding is aboslutely necessary if we are to progress in medicine at the desired pace. This experience can and must be transferred directly to the private medicine sectors.

Many items of hardware techniques, and ideas have evolved through the necessity to support man in the space flight environment. This new technology and these new techniques must be applied to the practice of medicine here on Earth, for this practice must change. The ever-increasing demand for medical care without adequate increase in medical and paramedical personnel makes it mandatory that we utilize technology to help the physician in his task. It is certainly possible to do this and allow the physician time to spend with the patient and keep the all important human factor in medicine. At the same time, it is important to remember that the space program developments were not done solely to produce such fallouts.

All these developments were part of a technologic and scientific base which has to evolve if we were to achieve our goal in manned space flight. Such a driving force constantly pushing the country's science and technology ahead is vital if we are to survive as a nation and maintain our position as a prime world power.

Man's destiny, I feel, is indeed the stars: the technology and scientific base is the thrust to achieve that destiny. Apollo 15 provided the latest evidence. We placed the ladder. We now ask that you who follow should climb it.

Condensed from the February 1972
issue of *AIAA Student Journal*

News Briefs

Ed Hamilton, EE '73

Bob Keith, EE '73

Rick Davies, EE '73

DEAN BALDWIN RETIRING

Professor Bruce Baldwin will be retiring from the position of Assistant Dean of the College of Engineering on September 1, 1972, after 36 years with the University of Cincinnati. In addition to holding the job of assistant dean, where he has been primarily involved with supervising financial aid for the college and coordinating scheduling, Mr. Baldwin is a professor of mechanical engineering.

Dr. Carl Osterbrock, professor of electrical engineering, has been named to assume the responsibilities of Assistant Dean on September 1. Dr. Osterbrock is a graduate of the University of Cincinnati, the University of Illinois, and the University of Michigan. He has been a member of the EE faculty since 1956.

OFFICE FOR EFFECTIVE TEACHING AND LEARNING

At the beginning of Winter quarter, 1972, a proposal waspassed by the Educational Council to create an "Office for Effective Teaching and Learning", (OETL) within the College of Engineering. The specific responsibilities of the office will be to coordinate, promote, and direct teaching-learning effectiveness programs in the College. Not only will OETL provide direct aid to faculty and students trying to improve their teaching and learning skills respectively, but it will also provide a central office within the College to accept responsibility for accomplishments in the area of teaching-learning effectiveness. With a central office established, a year-round continuity for activities will be established, and an easy-access communication channel will be established for suggestions concerning new activities.

At the time of this writing, a director for OETL has just been named. He is Doctor Richard Chartoff, an Assistant Professor in the Chemical and Nuclear Engineering Department.

JUNIORS ATTEND AMERICAN POWER CONFERENCE

John Stevens (ME '73), Jim Elkin (EE '73), Terry Young (EE '73), and Don Snider (ME '73) attended the American Power Conference conducted by the Illinois Institute of Technology, during the week of April 20, 1972. Sponsored by the Cincinnati Gas and Electric Company, these students were sent to the conference in Chicago to learn about the latest developments in the power field, and to help them evaluate career opportunities in power engineering.

STATUS REPORT -- ABC-NO GRADE

As a result of a recommendation made in the Junior Faculty's Report on the Academic Climate, interest was generated in the ABC-No Grade concept. With the backing of the Engineering Tribunal, the concept was first submitted to the Educational Council of the College. The Educational Council, upon acceptance of the proposal, then named a committee to study implementation of the ABC-No Grade concept. At the present time, the committee is awaiting word on a University wide proposal, the ABCX grading system, in order to coordinate the Engineering College's grading system with the University wide grading system.

AEROS SEE APOLLO 16 LAUNCH

Most of the seniors and some of the graduate students in Aerospace Engineering were present for the launch of Apollo 16 on April 15 at Cape Kennedy, Florida. About 45 people in all made the trip, including some of the students' wives. Several of those who saw the launch said that it was a spectacular sight, well worth the trip to see it. They added that the next Apollo flight, which is to be the last scheduled mission, promises to be even more breathtaking, since the launch will occur after dark.

RACE CARS IN THE MECHANICAL DEPARTMENT

The Mechanical Engineering Deparment, in conjunction with $\pi T\Sigma$, the mechanical engineering honorary, sponsored a special design project in which students were to design and build ⅛ scale radio-controlled race cars. The project was open to senior mechanical engineers and was begun by them during the Winter Quarter. The eleven participating students divided into three groups with Dr. Max Brown as their advisor. The groups were given 3-channel radio equipment and $50 each to cover expenses. Most of the project funds were donated by the General Tool Company of Cincinnati. Students utilized the Mechanical Department's machine shop to make component parts for their cars because the cars required intricate design and machine work. The cars were Indianapolis open wheel types with wheel bases of about twelve inches and ground clearances of ⅜ inch. The engines had a displacement of .19 cubic cches, an output of .35 horsepower, and a 15000 RPM maximum limit. One group, in true racing style, completely modified their car's engine. The other two groups made 2-speed transmissions for their cars. Other ideas used were disk brakes and independent front wheel suspension using either the Indianapolis type or the twin I-beam type construction.

The cars were unveiled and demonstrated on April 28 in the U.C. Fieldhouse. Several courses were layed out, including an oval track, a figure eight track, and a drag strip. The cars performed very well, hitting speeds up to 50 mph without suffering too many crashes. The spectators thoroughly enjoyed the race and the free 32 gallons of beer donated by the Stroh's Brewery Company. The students received course credit for the project and returned the cars and all associated equipment to the Mechanical Department where it will be utilized for future projects.

GRADUATION 1972

Spring commencement will be held on June 4th, with Dr. Alvin Toffler giving the keynote address to the graduates. Summer commencement is planned for August 26th. This year's graduates total 5240, a substantial increase from last year's 4700.

The College of Engineering will give 506 degrees in 1972. Of these, 52% are Bachelor of Science degrees, 40% are Masters of Science degrees, and 8% are Doctor of Philosophy degrees. The table below gives a further breakdown of those graduating in the College.

Department	B.S.	M.S.	Ph.D.	Totals
Aerospace	41	34	8	83
Chemical	39	10	3	52
Nuclear	—	9	5	14
Civil & Environmental	31	67	10	108
Electrical	52	25	2	79
Mechanical	84	41	9	134
Metallurgical	15	12	4	31
Materials Science	—	5	—	5
Totals	262	203	41	506

Note: The figures shown include those graduating at both the spring and summer commencements.

COMMUNICATIONS GAP REVISITED

A plumber wrote to a government agency, saying he found that hydrochloric acid quickly opened drain pipes. Was this a good thing to use? A scientist at the agency replied that "The efficacy of hydrochloric acid is indisputable, but the corrosive residue is incompatible with metallic permanence." The plumber wrote back, thanking him for assurance that hydrochloric acid was all right. Disturbed by this turn of affairs, the scientist showed the letter to his boss—another scientist—who then wrote to the plumber: "We cannot assume responsibility for the production of toxic and noxious residue with hydrochloric acid and suggest you use an alternative procedure". The plumber wrote back that he agreed, hydrochloric acid worked fine. Greatly disturbed by this misunderstanding, the scientists took their problem to their boss. He wrote to the plumber: "Don't use hydrochloric acid. It eats hell out of the pipes".

THE JOB MARKET

Mr. Sam Sorilla, Associate Dean of Career Relations, is somewhat optimistic about the job trend outlook for new graduates. He says that this year's electrical and mechanical engineers have done fairly well in getting jobs but, chemical engineers have had a rather rough time. Engineers in other fields have had varied success. Average starting salaries have gone up, some to $884 per month. "Last year we saw the total number of college graduates needed in he job market fall off by 23%. This year it's projected that a 10% increase will be needed, so I think things are beginning to look up," says Mr. Sovilla.

The number of companies recruiting on campus has declined somewhat this year but not as much as at some other Ohio universities. "You have to remember that campus recruiting is not a true indicator of the current job situation because there are 6000 college graduates returning from the Service each month and there are many more graduates going to grad school," remarks Mr. Sovilla. "I'd like to say that new graduate engineers are in much better shape to get a job than are some of the older unemployed engineers, primarily because new graduates are familiar with the current state of the art and are more flexible in a job situation." Companies recruiting at U.C. seem to particularly like the qualities of the co-op student. "Frequently recruiters tell us that U.C. co-ops are some of the best prepared for the interview and for the job they seek," says Mr. Sovilla.

The current view is that the job market for engineers has hit bottom and is slowly improving. Mr. Sovilla feels that business has learned a valuable lesson in not over-hiring and over-committing itself. The U.S. Bureau of Labor Statistics sees engineers in balance with the supply and demand throughout the 1970's. "Engineers have a broad background and possess many of the qualities necessary for success, such as determination, an analytical approach, and flexibility. These things give me an optimistic outlook for engineers."concludes Mr. Sovilla.

KEN HOVER WINS HERMAN SCHNEIDER MEDAL

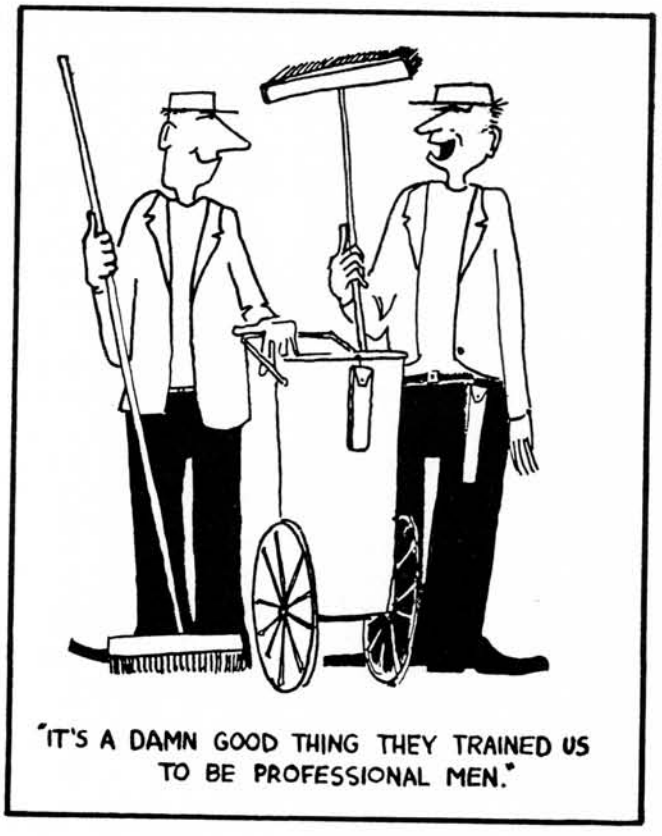
Each year the College of Engineering awards the Herman Schneider Medal to the senior who has been judged to have taken best advantage of the opportunities available to a student in co-operative education. Performance on the student's co-op assignment, recommendations from within the college, and grades are some of the criteria in selecting the winner of the medal.

This year, instead of recognizing one student, it was decided to select the winner of the Herman Schneider Medal from a group of seniors, one having been nominated from each department of the college. Those students nominated were:

Robert Anderson—AsE
Richard N. Burns—ChE
Kenneth C. Hover—CE
William Fox—EE
Randall J. Allemang—ME
Mike Labanow—Materials Science

The Medal was awarded to Kenneth Hover at the College of Engineering Alumnus Dinner on March 29, where all of the above students were honored.

Other awards, including the Senior Ring award, and a number of departmental awards will be presented on June 4 at the College of Engineering Recognition Program, at 3:30 PM in Zimmer Auditorium.



NEW PROFESSIONAL PRACTICE CALENDAR

On April 4, 1972, the Faculty adopted a new professional practice calendar upon the recommendation of the Engineering Tribunal, the Professional Practice Faculty, the Educational Council, and the Administrative Board of the College. The new calendar is as follows:

QUARTER / YEAR	SUMMER	AUTUMN	WINTER	SPRING
1st—Freshman		Study	Study	Study
2nd—Sophomore	Study/Unassigned	Practice/Study	Study/Practice	Practice/Study
3rd—Pre-Junior	Study/Practice	Practice/Study	Study/Practice	Practice/Study
4th—Junior	Study/Practice	Practice/Study	Study/Practice	Practice/Study
5th—Senior	Practice/Practice	Study	Study	Study

Under this new arrangement, the Professional Practice Program will be modified. The definition of Section I and Section II students will remain the same. Section I students will be in school during the Autumn and Spring quarters, and Section II students will be in school during the Winter and Summer quarters. However, the Professional Practice Program will *officially* start with the Winter/Spring block of the Sophomore year and will consist of *six* practice assignments. Although the official program consists of six assignments, it is possible, if the student is willing to study during the Summer quarter of the Sophomore year and if jobs are available, for the student to have an extra practice assignment during the Autumn quarter of the Sophomore year. However, the program will not be modified under any circumstance to permit the student to begin his *official* practice assignment in the Summer quarter of the Sophomore year.

How will this change affect present students? With the exception of the Class of 1973, who will *not* be affected by the new calendar, the various classes will undergo the following transitions:

Class of 1974—Although the official transition to the new Professional Practice calendar occurs during the Summer quarter, 1972, the students of this class will not notice any changes until the Summer quarter of their Senior year when it will be necessary for the Section II students to double section.

Class of 1975—As above, this class will not notice any changes until the Summer quarter of their Senior year when it will be necessary for Section II students to double section.

Class of 1976—The Sophomore year, 1972-73, is considered the transition period in which students will be initially placed on professional practice assignments during either the Summer/Autumn block of 1972 or the Winter/Spring block of 1973, depending upon the availability of appropriate practice assignments. Beyond this point, they will complete the curriculum according to the new calendar.

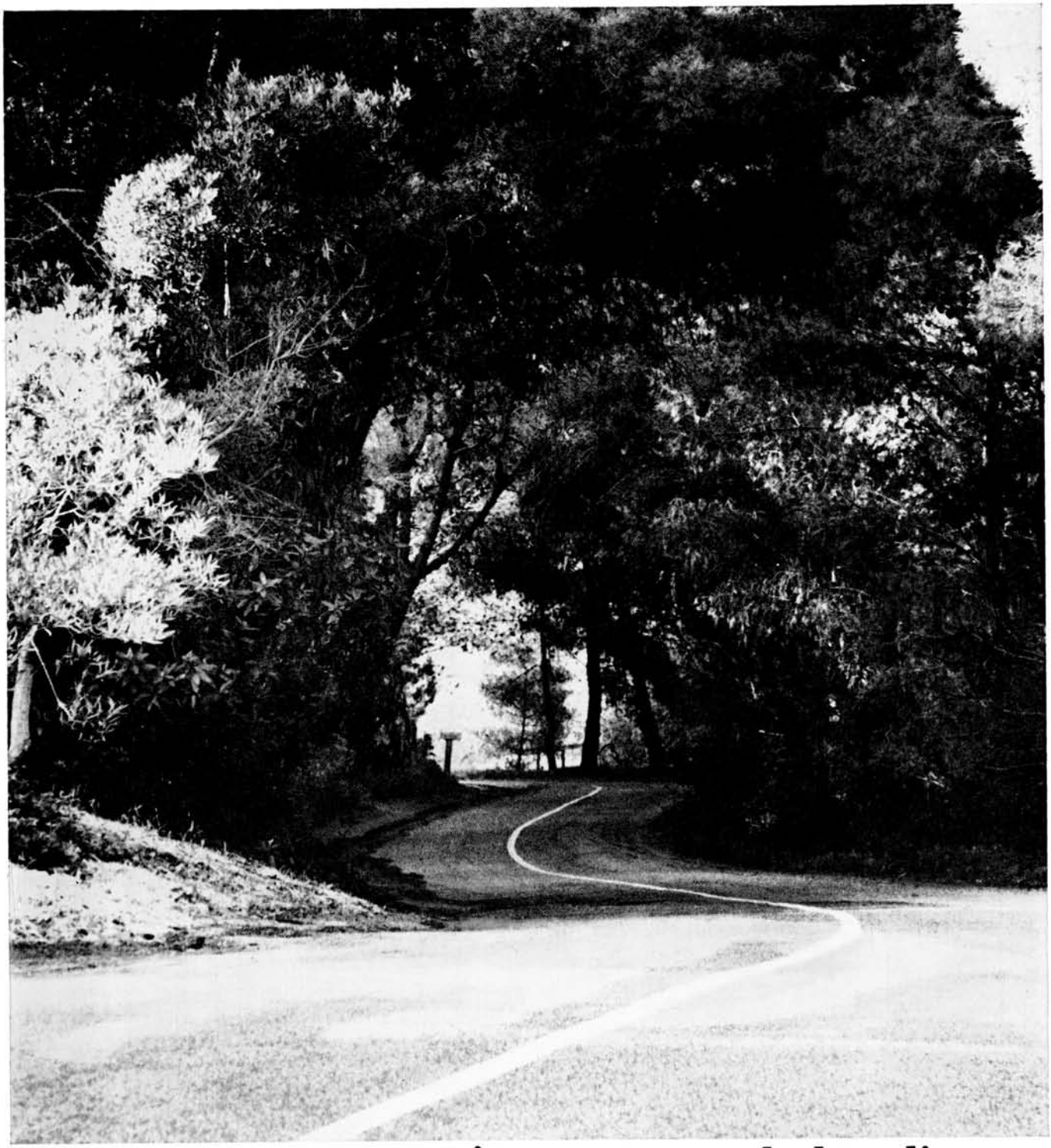
The introduction of the new professional practice calendar has many significant results. So called "disadvantages" may include the reduction from seven work sessions to six work sessions, and for Section II students, the necessity to work two consecutive quarters prior to their Senior year. However, the advantages of the new system tend to outweigh these disadvantages. The unassigned Summer quarter following the Freshman year not only permits trailer sections to overcome deficiencies, but also allows students to spend that summer working in unassigned activities, traveling, or studying. The double practice session preceding the Senior year offers the advantage of a long period on the job, thus permitting the student to become involved in more meaningful work. Finally, the new arrangement permits seniors to have an uninterrupted Senior year. Not only does this promote better class unity, but it also insures that *all* seniors will have equal opportunities to interview with different companies during the autumn and to take H/S and technical elective sequences.

For further information on the new professional practice calendar and how it affects you, contact the Office of Professional Development or your counselor.

Join The Staff

COOPERATIVE ENGINEER

730 Third Ave., N.Y., N.Y. 10017



As you can see, you can't see our new telephone lines.

They're underground.

We think America has enough eyesores, so wherever possible we're burying our new cable. And converting old aerial lines.

We already have over 50% of our lines underground. And before we're through we'll have about 92% buried.

We'll never reach 100% because in a few places it's practically impossible to get the cable underground. And in a few other places it's ridiculously expensive.

In the 15 years that we've been burying cable we've gone through hills and high water and turnpikes and mountains.

We've struck oil in Texas (a pipe in someone's backyard). And we've had to get a special repellent to keep gophers from eating the cable.

So if you still see a fair number of telephone poles around, bear with us. Our engineers are working as fast as they can to bury our lines.

And resurrect our scenery.

GTE

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That's a major engineering accomplishment. But that's not the reason it's important.

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