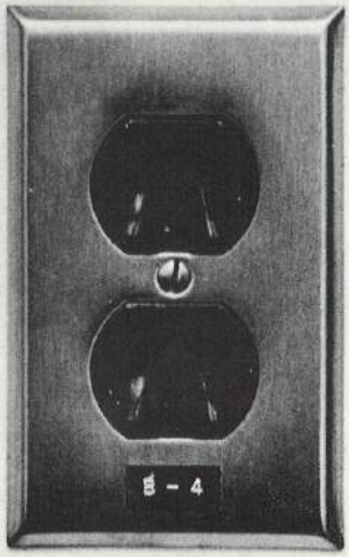
Rensselaer Engineer

APRIL 1975



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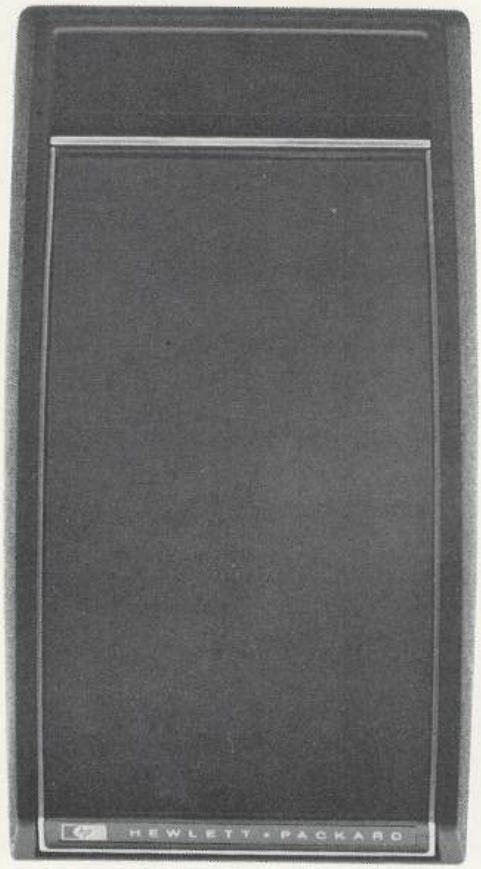

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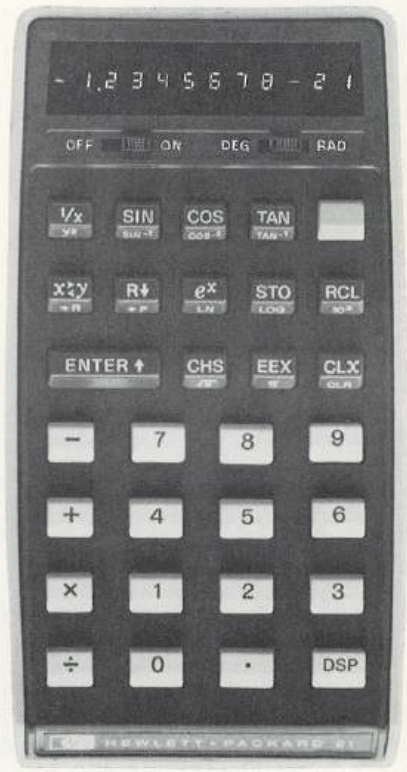

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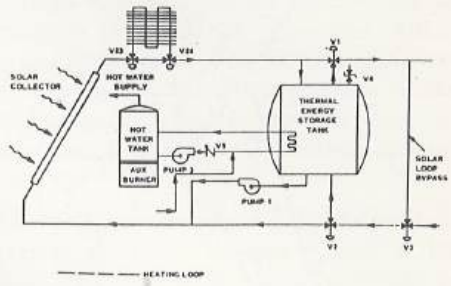

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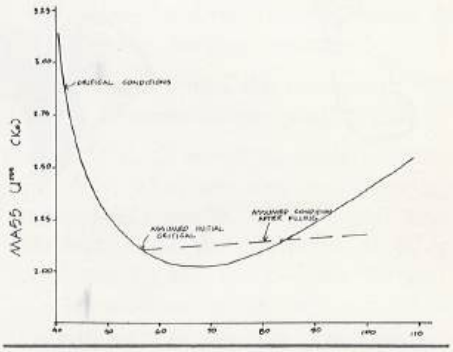

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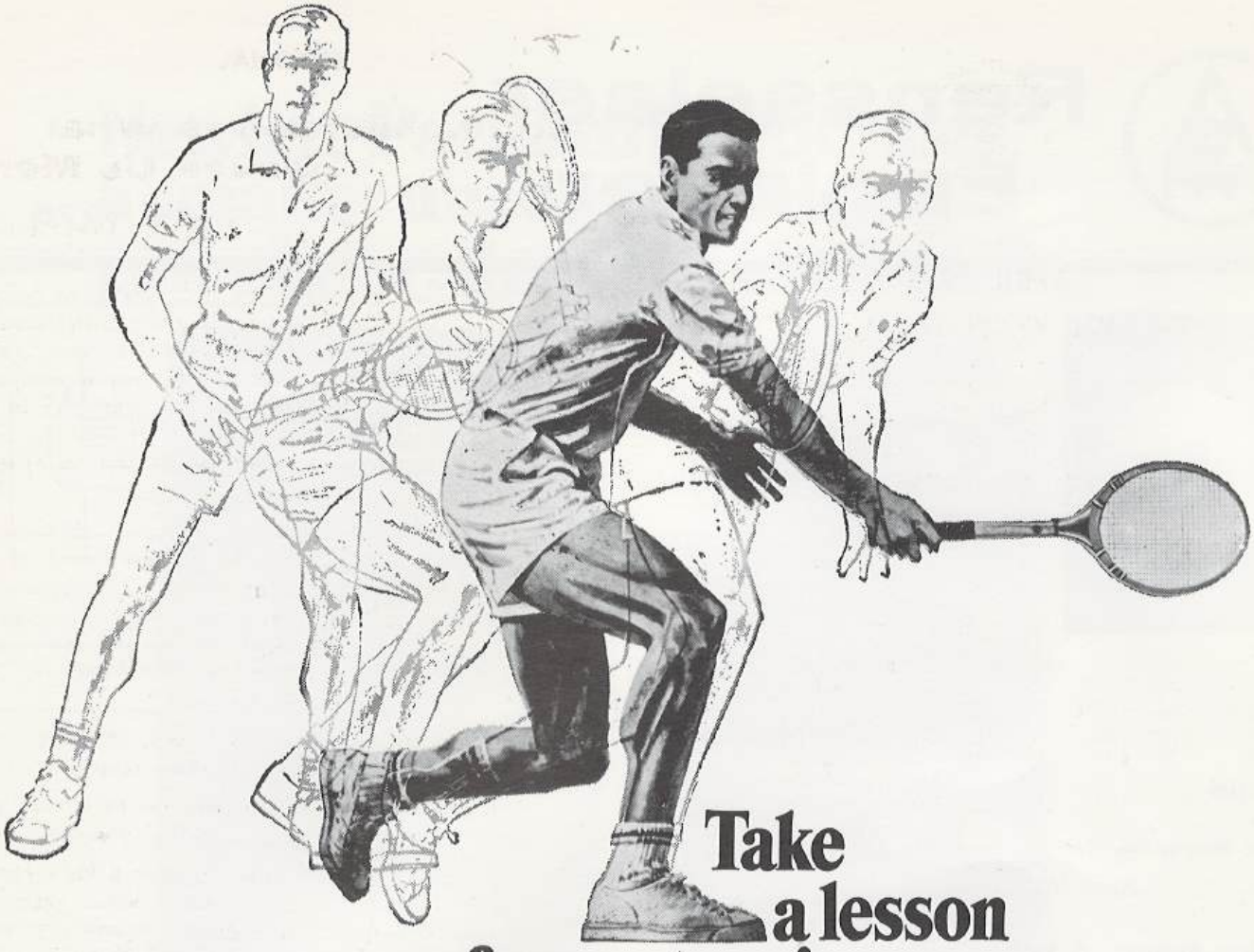

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EDITORIAL

"Communication Is What Makes Us Men"

— J. Robert Oppenheimer

"The speed of communication is wondrous to behold. It is also true that speed can multiply the distribution of information that we know to be untrue. The most sophisticated satellite has no conscience. The newest computer can merely compound, at speed, the oldest problem in the relations between human beings, and in the end the communicator will be confronted with the old problem of what to say and how to say it."

These sage words were spoken in 1964 by Edward R. Murrow in what turned out to be the last speech of his life. I think that even Mr. Murrow would be surprised to find out how true those words are today. The age of instantaneous communication is upon us and every man, woman and child of today must be able to communicate effectively or they will surely be buried.

People involved in science and engineering must be acutely aware of this situation for two reasons:

1. Engineers and scientists supplied the technology that made instantaneous communication possible.
2. The "state of the art" in all scientific fields is changing by quantum leaps; what was new two years ago is outmoded today. A scientist, of necessity, must continue his education, and the education of others in his field, even after he has finished his "formal" education. The most obvious means of communicating technical knowledge is through the technical journal and one need only look at an abstract journal to realize that scientists are being inundated by technical publications. A scientist, therefore, must be able to communicate and comprehend ideas in a clear and cogent manner, or he will fall behind and become obsolete.

Above and beyond technical publication, the practicing engineer is constantly being called on to communicate his ideas to laymen, i.e., management, finance and government personnel. If an engineer is unable to get his ideas across to a layman then his ideas fall into the category of "technical trivia", something we have enough of already.

In a conversation I had with Dr. P. M. DeRusso, Associate Dean of Curriculum of the School of Engineering, he stated that, more often than not, an engineer that can communicate well will be promoted before an engineer that displays only technical competence.

Given that this "communication crunch" exists, one must wonder what R.P.I. is doing to prepare its engineers for the outside world.

R.P.I., by its own definition, is a "technological university" that in the past has been an innovator in engineering education. Yet, in 1951, Livingston W. Houston, then president of R.P.I., foresaw the need for greater

(continued on page 5)

1975 ENGINEERING GRADUATES

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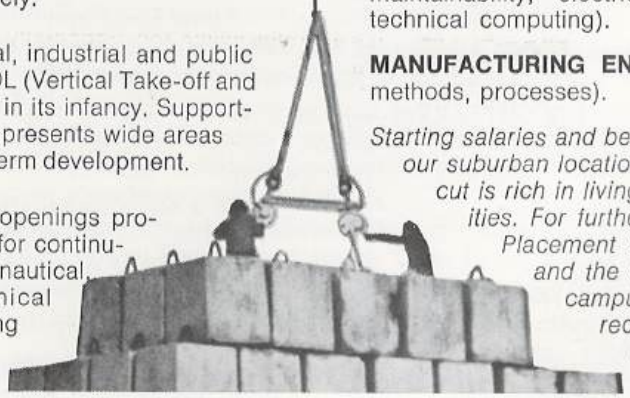

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Editorial (continued from page 3)

communicative skill when he said ". . . there is likely to be greater acceptance of the combined college course whereby the student spends a portion of his time at a college of liberal arts and another portion of his time at a college of engineering." This program never caught on since it would require the student to spend an extra year in school and to incur the expense of another year's tuition. R.P.I. did, however, develop a technical writing program that is respected throughout the United States. R.P.I. does not require their undergraduates to take any courses in technical writing or English composition.

Harvard University (average freshman verbal score: 700), a liberal arts institution, has a required twelve week expository writing course for all of its undergraduates. Harvard English professor Gwynne Evans states, "We try to teach them to write a simple, clear sentence that says what they mean and then arrange those sentences in some orderly fashion. Most of them don't know how to do that when they come here."

Approximately 50% of the freshman class at the University of California at Berkley (average freshman verbal score: 544), a liberal arts and engineering school, failed an English composition exam this fall. The students were required to enroll in a remedial English composition course to make up for their deficiency.

Rensselaer Polytechnic Institute (average freshman verbal score: 584), an engineering and science school, admits a freshman class with an average verbal score that is 20% lower than Harvard's and only 6% higher than Berkley's. R.P.I. does not require their undergraduates to take any courses in English composition or technical writing.

The time has come for R.P.I. to wake up and face the fact that if this school is going to continue turning out "the best and the brightest" then they are going to have to teach their students to communicate.

At this moment, the School of Engineering, together with the School of Humanities and Social Sciences, is investigating the possibility of adding a course in technical and professional communication to the existing pre-engineering requirements. This move is to be applauded and I would urge that the School of Engineering and the entire administration of R.P.I. waste no time in implementing this program for it is time, as one man said, to "cultivate our own garden."

PAUL CARROLL

Paul is one of the few students at R.P.I. currently in the 3-2 program. He will be receiving a B.A. from Colgate University and a B.S. in E.E. from R.P.I. this year. Although not a member of the editorial board, his views are totally supported by our editors.

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SOLAR SOONER

The Arab oil embargo and the energy crisis have finally forced us to realize how limited our sources of fossil fuels actually are. At the present rate we are using energy, the nation's electrical needs are expected to double in the next twenty years; we won't be able to produce the necessary fossil fuels. Based on this projection, the nation would need 300 power plants producing electricity. If oil is to be the source of energy, we would need 40 billion barrels per year; the United States produces about 3.5 billion. If coal is used, 900 million tons will be required; we now produce only 700 million tons. This is the coal that can be burnt without violating federal and state environmental regulations. It is obvious that alternatives must be found.

Right now it looks as if the best alternative is solar energy. There are a few other good bets for future energy sources such as nuclear power, especially the fast-breeder reactor. The main problem, however, is getting enough public support. Another possible alternative is the nuclear fusion reactor which is still in its early research stage. It is not expected to be commercially available until at least the 1990's. Geothermal power might also be a strong candidate but not for a few years to come.

The idea of harnessing solar power is not a new concept. It has only come into popularity during the last few years. There are signs of this sudden growth all over the country. Under the Solar Heating and Cooling Demonstration Act of 1974, 1,000 demonstration homes and office buildings are planned. In the state of Connecticut a housing development for the aged is planned, with solar energy as the main power source. In Boston, Minneapolis, Maryland, and Virginia, four schools have been built with supplemental solar heating systems. In Georgia, the first test of a total solar heating and cooling system replacing conventional systems is underway. In Valley Forge, Pennsylvania, a General Electric plant is using solar heating with 5,000 square feet of collectors on the roof.

The basic technology for harnessing solar energy has already been developed. The challenge: finding cheap and reliable systems.

The amount of energy deposited by the sun each day on this planet is stupendous. In terms of watts, the sun deposits about 1.73×10^{17} watts per day. This is 100,000 times the total capacity of presently installed electric power generators in the world. On the illuminated side of the earth, only 15 minutes are required for the sun to deposit what is equivalent to the energy consumed by people on earth in one year. In reference to the United States, the average solar energy that falls on Lake Erie is greater than the total energy we consume in one twenty-four hour period.

Collecting solar heat is extremely simple in principle. Putting your hand on a piece of metal that has been lying in the sun will confirm this fact. If the object is colored dull black, it will collect about 95% of the solar energy that falls on it. At the same time, however, the object collects visible light and converts it to heat which is then emitted in the form of infra-red rays. Heat is also lost to surrounding air through convection. A state of equilibrium is soon reached with the object losing heat as fast as it is absorbed.

The obvious engineering problem presented is designing an ideal collector that absorbs heat rapidly but is a poor radiator. High temperatures can then be reached. The concentrated heat can then be collected and utilized by a gas or liquid power system.

There are several basic methods of converting solar energy into electrical energy. One is heat concentration in which solar heat is collected and used to boil water or some other substance, which is then used to turn a turbine that generates electric power. Several research projects use this approach.

ENERGY

THAN WE THINK?

ANNE WILKES

Another method is direct conversion. In this method, specific materials must be used. These materials, silicon is one, are semiconductors that absorb photons of light and then generate a small electric potential.

There are several systems that use variations of one type of, or more than one, conversion method. In 1974 the National Science Foundation sponsored a study on solar heating and cooling of buildings. As a result of this study, four systems were found to be more desirable than others. The first is heating with liquid-to-air heat exchangers coupled with absorption air conditioners modified for solar operation. Another is heating with liquid-to-air exchangers coupled with conventional vapor compression air conditioners. A third are heat pumps assisted by solar energy in the heating mode and operated either conventionally or in an off-peak manner for cooling. Finally,

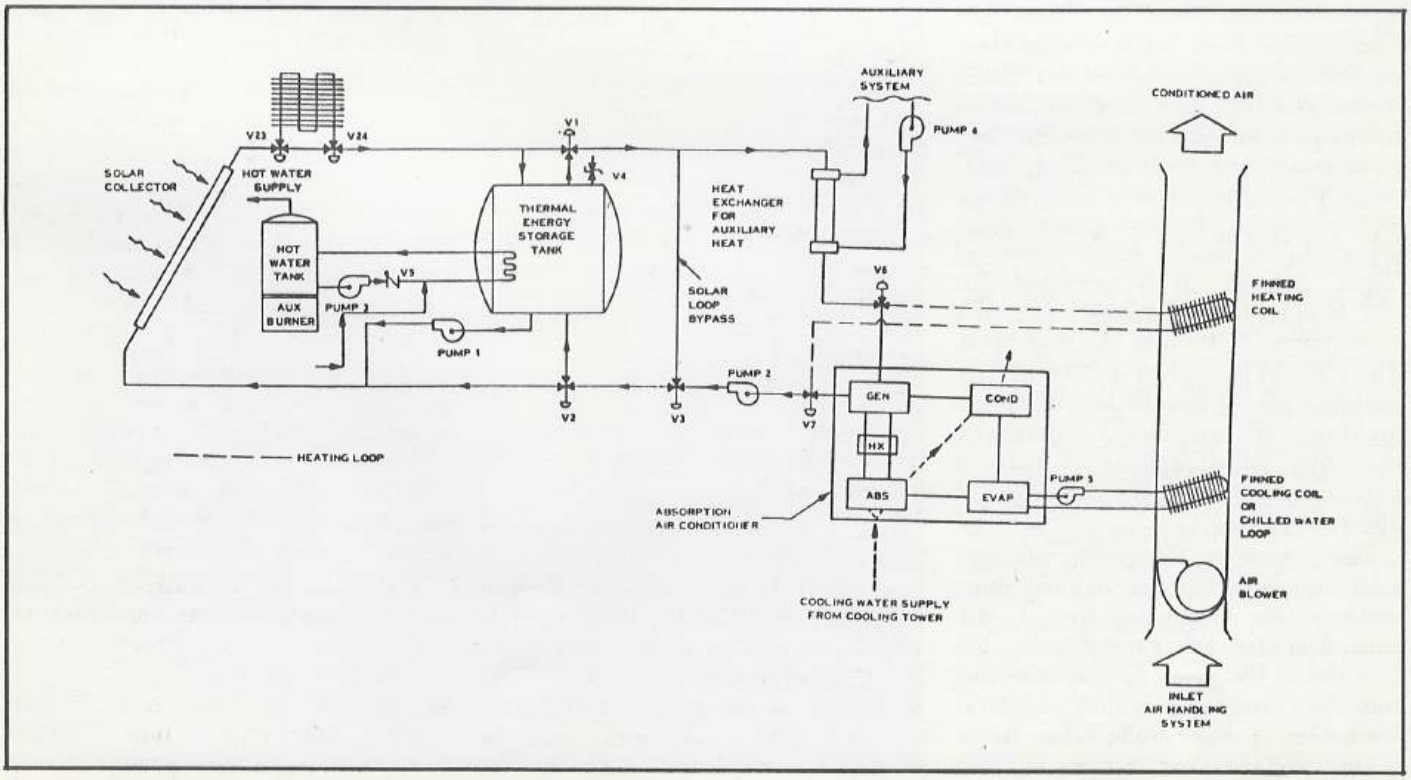

Figure 1. Typical Solar Heating and Cooling System Schematic.

heating with liquid-to-air heat exchangers and cooling with vapor compression air conditioners driven by Rankine cycle engines designed for operation with solar energy.

Under certain conditions these systems can be cost effective on a life-cycle basis. This means the amount of money required for installation and maintenance as well as the costs of fuel over its lifetime. If a system is cost effective, it saves money in the long run, and sometimes in the short run. Even when cost effectiveness for solar systems is marginal, the amount of energy conserved is substantial.

An important design variable is the ratio of solar collector area to roof area. As this ratio increases the amount of energy conserved also increases. But a point is reached where the cost of the added collector may exceed the value of the fuel saved at projected prices. The cost effectiveness of solar air conditioning depends upon the development of equipment optimized for this purpose rather than current equipment designed to use conventional resources.

The possibility of utilizing solar energy is limited most by money and imagination. Nearly every possible source has been considered.

One of the first large scale projects was presented by a husband and wife team, Alan and Marjorie Meinel. The Meinel plan is to build a vast array of "solar farms" across the southwestern deserts. These farms will collect heat, use it to generate steam and run power-generating turbines. Their long-range plan is to create a $1x10^6$ megawatt generating facility in a corridor along the Colorado River north of Yuma, Arizona. It is estimated that this would supply the entire country's power demands through the year 2000. There would be a great deal of leftover heat, but Meinel has the answer to that problem. He proposes to desalinate over fifty billion gallons of water a day, enough to provide a population of 120 million.

The biggest problem with collecting solar heat is building enough collecting surface. One engineering firm, J. Hilbret Anderson of Pennsylvania, has brought up the possibility of collecting solar heat using the world's oceans as the collectors. The Gulf Stream alone is estimated to collect 75 times as much power as the United States now uses. Any power conversion device operates not only on absolute heat but also on the heat differences between two sources. In the Anderson plan the difference would be between the warm surface waters and colder waters at the bottom.

The possibility of using satellites of some sort in space to utilize solar energy has been considered also. Peter Glaser of Arthur D. Little of Cambridge, Massachusetts, has a plan which would convert sunlight directly into electricity, without going through an intermediate heating stage.

His plan is to build a huge array of solar cells that would be in synchronous orbit around the earth, collect sunlight, and convert it directly to DC power. Each satellite would be a five mile square made up of solar cells and hooked to another cell by a two-mile long transmission line. The transmission line is hooked to a transmitting antenna a mile square. The receiving antenna on the earth is to be 36 square miles and is expected to produce about 5000 megawatts. But the problem is that it is astronomical in its costs too.

Research projects are now being conducted at many laboratories and colleges. A project conducted by Rensselaer Polytechnic Institute is in the development of solar heating panels. Conceived and directed by Matthew Cohen, a fifth-year, civil engineering and management major at RPI, the group consists of students and faculty members. The other students in the group are Jerry DeSantis, a fourth-year civil engineering major; Dennis Ross, a fifth-year architect student; Paul Klinger, a senior management major; and also Joseph Serdalowski, and Craig Skevington. Their advisor is Dr. Arthur A. Burr, former dean of the RPI School of Engineering. Walter Kroner of RPI's Center for Architectural Research is codirector with Dean Burr. Advanced Cooler Manufacturer and Fink Associates are also part of the team.

In October, their first solar panel was constructed. It was simple in design consisting of a 4′ x 4′ box with a glass cover and black surface poster board. Its testing was done on a simple scale with the surface, cover plate and ambient temperatures recorded on a multi-channel micromax.

In January the panel was moved to the Ricketts Building on campus. The duct work was installed but the glass panel was destroyed before sufficient data could be taken. The team spent about a month constructing a new panel and air quantifier.

The air panel is simple in concept and design. Air is the transfer medium and is drawn through instead of blown through. The vanes constructed will channel the air flow away from cover and toward the insulation with reflective foil built into it.

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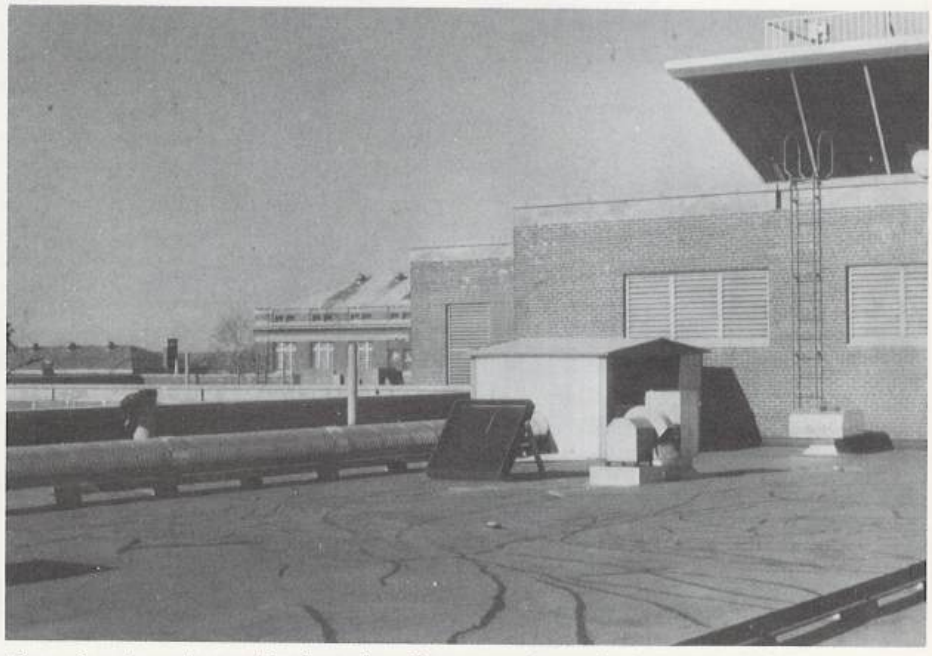

Figure 2. An early model of an air collector on the roof of the Science Center.

Nuclear Energy: A Public Concern

JOHN CASCONE

Nuclear reactors as a viable source of energy remain a polemic issue; nevertheless, 53 commercial reactors are in operation, 73 are under construction, and 107 are in the planning stages. Nuclear reactors exist and will proliferate in spite of opposition. Consequently, my concern here is not to dwell on what has already been done, but to consider the public's position with respect to the future.

At this point there is no doubt that the U.S. supply of oil and natural gas is limited; indeed, they are in imminent danger of depletion. The reliance on imported fuels has only compounded the problem. Needless to say, alternative sources of energy are necessary to meet the current and future demands of the consumer. Uranium is one of those alternatives.

The light water reactor (LWR) has reached center stage in attempts to solve the energy problem. Since its inception, in 1954, the fission reactor has undergone technological advances that make it one of the cleanest and presumably safest producers of energy to date. The profuse literature now available to the public dealing with the operation and production of the fission reactor has managed to ease the conscience of many ambivalent minds, while the adamant opposer is slowly being forced to accept the inexorable reality.

I would like to direct my attention to that literature and particularly to the consciousness that is developing as a result of it. In the past, substantial information about nuclear reactors was not readily available to the masses. One of the reasons for this was that there was no pressing demand for it. From 1954 to 1962 reactors were built in New York, Massachusetts, and Illinois with virtually no opposition, much to the satisfaction of the AEC and private utilities. The only significant exception was the Bodega Bay site in California.

Between 1957 and 1962, Pacific Gas and Electric Company (PG&E) furtively planned to build a nuclear plant at Bodega Bay, known to many Americans as the setting for Alfred Hitchcock's movie, "The Birds". To residents of the area, Bodega Bay is looked on as one of the few unspoiled sites. Thus, in 1962, under the auspices of David Personen, 2,000 citizens united to halt PG&E's plans. The initial objection to the plant was based on aesthetic values; the AEC could not respond to that argument, claiming that it was not within its jurisdiction. Meanwhile, PG&E continued according to plans and began breaking ground.

After two years of heated debates, the organization headed by Personen finally argued that Bodega Bay was situated on the San Andreas Fault, and that, contrary to PG&E's investigation, the Bodega site did not have a solid granite base but one composed of clay, silt, and sand. The probability of a major reactor catastrophe as a result of an earthquake thus became a very real consideration. To this the AEC responded, and in October of 1964 the Commission officially reported that the Bodega site was not suitable for a nuclear power plant. Consequently, PG&E cancelled the project.

With respect to the Bodega Bay incident, there are two things to consider: 1) the role that the AEC played as an administrative agency, and 2) the discretion of the power company involved. The Atomic Energy Commission was established by Congress in 1954 as a regulatory agency in charge of licensing, construction, and operation of nuclear power plants. The AEC's primary concern in performing its functions, however, was radiation, and it did not feel required to consider any other environmental effects. The AEC's narrow perception of the powers delegated to it was the main reason why it took two years for the people of Bodega Bay to stop the PG&E project. Obviously, the AEC was not ready to deal with public opposition or participation concerning nuclear power, nor was the AEC quick to ameliorate the situation.

The discretion, or rather lack of it, on the part of the Pacific Gas and Electric Company was clearly evidenced by their determination to build a nuclear plant on a site as precarious as Bodega Bay. The question is, can the public sit back and rely on the major utilities and regulatory agencies to make all the right decisions? The answer is unequivocally, no. The problem is one of perspective. What is right for a major power company may not be right for the public. To put this in economic terms, what is profitable for a large utility may not be practical for the citizenry.

Bodega Bay can be considered the harbinger of conflicts to come. The public demand for participation in the decisions on licensing power plants increased with each new reactor, while the AEC and the utilities continued to neglect the public interest. Thus, a major confrontation between the public and the promoters of nuclear energy was inevitable.

A Landmark Case

In 1967, Baltimore Gas and Electric Company (BG&E) declared their intentions to build a power plant at Calvert Cliffs, Maryland. The residents of the area had virtually no say in the matter, so early in 1969 they organized to form the Chesapeake Environmental Protection Association. The controversy that ensued resulted in a major breakthrough for the public.

The citizens of Calvert Cliffs objected to the installation of high tension wires; to tall, unsightly utility towers; and to thermal pollution. Three conservation groups took the agency to court in the

mid-1970's, but once again the AEC responded by saying that the above considerations were not within its jurisdiction. The Commission insisted that it had the power to judge only those questions involving health, safety and national security pertaining to the actual construction of the plant.

But in 1969 Congress passed the National Environmental Protection Act (NEPA) which was signed by Richard Nixon on January 1, 1970. With this new legislation all federal agencies were required to prepare detailed environmental impact statements on all projects "of substantial governmental involvement." The Atomic Energy Commission, however, did not recognize the urgency of that legislation. As a result, in July, 1971, the U.S. Court of Appeals for the District of Columbia set the AEC straight. The Court declared that, with the enactment of NEPA, the AEC was indeed responsible for considering all environmental factors, including thermal pollution and even siting. Clearly, the AEC could demand strict pollution controls even beyond those imposed by other federal, state, and local agencies. With this unequivocal delegation of power, no longer could the AEC blatantly escape public participation at licensing hearings. Unfortunately for the Commission, the AEC may have been too slow in recognizing its responsibility to consider the public interest.

The AEC Is Abolished

On January 19, 1975, the Atomic Energy Commission was abolished and replaced by two coordinating agencies: The Energy Research and Development Administration (EDRA), and the Nuclear Regulatory Commission (NRC). Both agencies will work closely with the Federal Energy Administration, the Environmental Protection Agency, and the Energy Resources Council. ERDA, as a research and development organization, is involved in programs including fossil, nuclear, solar, geothermal, and other advanced energy sources, as well as environment and safety, conservation, and national security applications.

The NRC, as a regulatory agency, has a function similar to its predecessor, the AEC: "to (help) make the nation self-sufficient in energy, to advance the goals of restoring, protecting and enhancing environmental quality, and to assure public health and safety." In establishing the NRC, however, Congress emphasized that the recognition of nuclear power is to be done in the public interest; a distinction which, though it may not solve all the problems, it is a positive step, showing that the NRC is clearly aware of its responsibility to protect the public interest. How successful the agency will be in evaluating where the public interest lies remains to be seen.

Knowing what the public interest is regarding nuclear power does not necessarily have to be an enigma, and it should not be exclusively a concern of the NRC's. For a realistic approach to solving the nation's energy needs, all those directly and indirectly involved with nuclear power must open up the channels of communication. This not only involves the NRC, but the utilities, universities, manufacturers, designers, and the legislature as well. And the information disclosed must be comprehensive in scope. Limited information that is contrived to support the biases of those respective concerns will not benefit anyone, but will only create additional problems in the long run.

Society is tired of having decisions which seriously affect the lives of every individual made by a handful of people who congregate in smoke-filled rooms in attempts to protect their vested interests. Evoking a "crisis mentality" (notorious during the Nixon administration) to expedite a project in lieu of controversy has reached the level of absurdity. One can cry "wolf" just so often before his audience turns a deaf ear.

It is, of course, possible that the people directly involved with nuclear power feel that the general public is not qualified to participate in the decision-making process. But that kind of argument cannot hold when one recalls the "qualified" individuals who directed the planning for the Bodega Bay site in 1962. Those people concerned about nuclear energy are qualified to respond to the information given them. Their responses, however, can only be as logical and as accurate as the information they receive. If they have been misinformed, then their opinions will reflect their sources of information. False information may ultimately be rebutted, which may then lead to a long confusing debate. This is not to say that all controversies can be easily resolved or prevented merely by being open and honest to the public, but it does suggest that this kind of communication will result in fewer controversies. Projects that should be implemented might not suffer prolonged waiting periods because of unreasonable opposition, and projects that are unreliable can be discarded prior to unnecessary monetary losses.

With the establishment of ERDA and the NRC it appears that the current stage is set for open communication. Even some of the utilities recognize the necessity of restoring public confidence. The attempt to restore public faith is evidenced by the current widespread dissemination of literature on nuclear energy. Because much of this information is published by promoters in the field, it reveals an inherent optimism, which is to be expected. Nevertheless, the information is quite comprehensive, and the reader can easily ignore the optimistic tone and attempt to be independently objective.

However, most of the literature now circulating deals primarily with the fission reactor: the pressurized water reactor (PWR), and the boiling water reactor (BWR). This is not unusual since the fission reactor is, at the moment, the only commercial source of nuclear power in the U.S. But substantial information regarding prospective sources of energy is also necessary. Already there is concern about the limited supply of low cost Uranium 235, which is the essential fissionable isotope in the light water reactor. Consequently, extensive research and experimentation is being done with the Liquid Metal Fast Breeder Reactor (LMFBR) which uses the inexhaustable Plutonium 239 isotope.

The considerable amount of attention given to nuclear energy makes its imperative that the public be cognizant, not only of the present stages of nuclear development, but of the potential stages as well. Only from this awareness can public participation have any significant value. Knowing about the fission reactor is necessary, but finding out about it "post facto" can be disconcerting. The fact is that the fission reactor has been commercially operant since 1954 and not until 1971, with the Calvert

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There could be as many as 20 million of them out there.

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Why? Simple economics: It often cost more to transport and process a hulk than it was worth.

But now, junked cars are moving faster than ever. Higher demand for steel and growing concern for conservation have made steel scrap look better and better.

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It can make new steel using 100% scrap. It's cleaner than other furnaces and it uses less energy.

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It's only one of our many contributions to the steel industry.

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Today, something we do will touch your life.

Labor Relations at RPI

Two Viewpoints:

Faculty versus Administration

Last year, the faculty of the Polytechnic Institute of New York and the New York Institute of Technology voted, in separate actions, to strike for changes in administrative policy on salary, tenure, and work load. In both cases, the bargaining agent was a local chapter of the American Association of University Professors (AAUP). While successful negotiations averted the strikes, such recourse demonstrated the serious nature that faculty-administrative relations can assume.

The AAUP chapter here at Rensselaer decided to seek certification as the faculty's collective bargaining unit a year ago this spring. The administration refused to recognize the chapter's petition and is opposing the organizing effort. At present, the matter is before the National Labor Relations Board (NLRB) in Washington, D. C., with no immediate decision promised. Nevertheless whatever is decided at Rensselaer will seriously affect the future of faculty collective bargaining on campuses across the country.

THE FACULTY VIEWPOINT

Dr. William B. Brower, Jr., is an Associate Professor of Aeronautical Engineering in the Department of Mechanical Engineering, Aeronautical Engineering, and Mechanics at RPI. A member of the RPI faculty since 1952, Dr. Brower currently teaches fluid mechanics and has research interests in high speed ground transportation systems. Dr. Brower is Vice-President of the RPI Chapter of the American Association of University Professors and is chairman of the Committee on Collective Bargaining.

Current efforts in collective bargaining at RPI reflect a national trend as well as local problems. Nationally, many Boards of Trustees are attempting to impose industrial concepts on universities, particularly the concept of cost effectiveness. Carl Thomsen, Officer of the Board of Texas Instruments, as well as Chairman of the RPI Board, recently made a vigorous attack on the concept of tenure which has been one of the cornerstones of university tradition. He indicated that he believes many industrial concepts can be applied to the university without modification. Faculty reaction is that this indicates a very limited understanding of the essence of an institution of higher learning.

Over the past several years the RPI administration has introduced several policies consistent with the cost-effectiveness concept. Many faculty object to these policies insofar as no real attempt is made to evaluate their effect on the quality of the educational program.

Pension

Space available does not permit full explanation of the pension issue. However, most faculty (including many of those who oppose collective bargaining) feel that the Institute has broken a series of commitments, made over a period of years (in numerous official documents on the plan and reconfirmed in countless oral statements by officers of the Institute) to match employee contributions to the pension fund. Instead, it unilaterally reduced its own contributions and has used the difference (about $500,000) to pay operating expenses. This means, in effect, that the surplus accumulated will not be used to increase benefits for retirees as was done in the past. Most faculty believe that in withholding these funds, the Institute has abandoned a moral (and some faculty believe, a legal) obligation to its employees.

It has come as an equally rude awakening to the faculty to learn that the pension plan is embodied in a contract between the Institute and the

insurance company, under which the faculty are not principal parties. Officers of the Institute have stated that there is no legal barrier even to the termination of the plan by the Institute, so long as obligations previously incurred are honored. This has allowed the Institute to modify the plan without consultation of those affected.

Compensation

On compensation (salaries plus fringe benefits) the Institute has traditionally been competitive at the assistant professor level. Compared with the prestige schools we are substantially behind at the professor level. In fact, as confirmed by a memorandum of Dr. Loewy, we are behind even the average engineering school for full professors. Not surprisingly, Institute literature does not suggest that we are in any way merely average, let alone below.

More significant, however, was the reaction to a recently adopted policy introduced by the School of Engineering to reward *productive* faculty and to leave *unproductive* faculty with zero, or a nominal raise. Most perceive that what is meant by "productive" are faculty who bring in sponsored research. Unsponsored research, or teaching quality, is thought to have little or no value in the rewards system. In a year of double-digit inflation, this lack of equity (in contrast to *equality*, which is not an AAUP goal) has outraged many and has resulted in an extraordinary loss of confidence in the administration.

The Institute's belated recognition that there is a faculty-administration communications gap resulted in an unprecedented series of meetings at which Drs. Grosh and Loewy met with faculty and librarians in groups of about five. This would require over 75 meetings to cover the entire faculty and library groups. My limited feedback is that answers to the crucial questions raised at these meetings were not forthcoming. In short, conversation is not necessarily equivalent to communication.

The following is in brief response to other questions bearing on the subject of collective bargaining and its potential consequences:

Tenure

It is becoming more difficult to acquire tenure at RPI. This has created a morale problem among the untenured staff.

Dismissal of Tenured Personnel

This possibility has not surfaced up to now.

Teaching Loads and Class Size

Teaching loads are creeping up. Over the last five years the class sizes have increased, as have the number of sections per faculty member. Additionally, the available number of teaching assistants has sharply decreased. These factors have a significant effect on the program, as the instructor tends to spread himself even thinner. This could be a major item in negotiating a collective bargaining agreement.

Effect of Tuition

Tuition at RPI, though set officially by the Board of Trustees, is actually fixed by the marketplace. Over the past 30 years our tuition has usually been slightly less than that of the major Ivy League schools. It is unrealistic to believe that collective bargaining will change that pattern.

Compensation of Faculty with Research Grants

Most faculty believe that the principal (and perhaps the only) way to reach the highest range in the salary spectrum is to be highly productive (meaning to charge a large fraction of one's salary against a research contract). But there are other activities vital to the life of a university which are equally meritorious. It is questioned if this principle is adequately recognized on this campus.

Exclusion of Sponsored Researchers from Bargaining Unit

The action of excluding researchers ("charged-out" faculty) from participating in the RPI bargaining unit is opposed not only by the AAUP but by the Faculty Council. The probability is high that the issue is spurious, since the NLRB has previously ruled that such researchers may *not* be excluded. The concept of a bargaining unit as some amorphorous group with faculty drifting in and out, depending on whether or not the individual has a research contract, has little merit, in my opinion.

Lack of Experience in Bargaining

It is not inevitable that inexperience of the Institute and of the faculty in collective bargaining must result in a dangerous confrontation. After all, both sides have intelligent people and experienced advisors. More to the point is the question, "Will both sides approach the bargaining table in good faith?"

Similarity to Situation at PINY

The basic problems at Polytechnic Institute of New York are quite different than at RPI. The main similarity is the expressed desire on the part of the faculties for collective action. Some opponents of collective bargaining blame the faculty for PINY's plight, and grimly predict its early demise. On the other hand, the faculty there, through the collective bargaining process, take credit for working a plan for an orderly (though painful) retrenchment, and for forcing the Institute to overhaul an inefficient and inept administrative structure.

THE ADMINISTRATION'S VIEWPOINT

In August, 1974, Barry A. Taylor became the Director of Personnel and Employee Relations at RPI. Employed by RPI in 1968 as an Assistant Professor in the School of Management and Director of Management Development Programs, he became Assistant to the Vice President of Student Affairs in 1972. Mr. Taylor, who previously served on the Executive Committee of the Faculty Council for two years, was

also a member of the Faculty Council's Salary and Fringe Benefits Committee for four years and Chairman of a joint ad hoc committee on early retirement.

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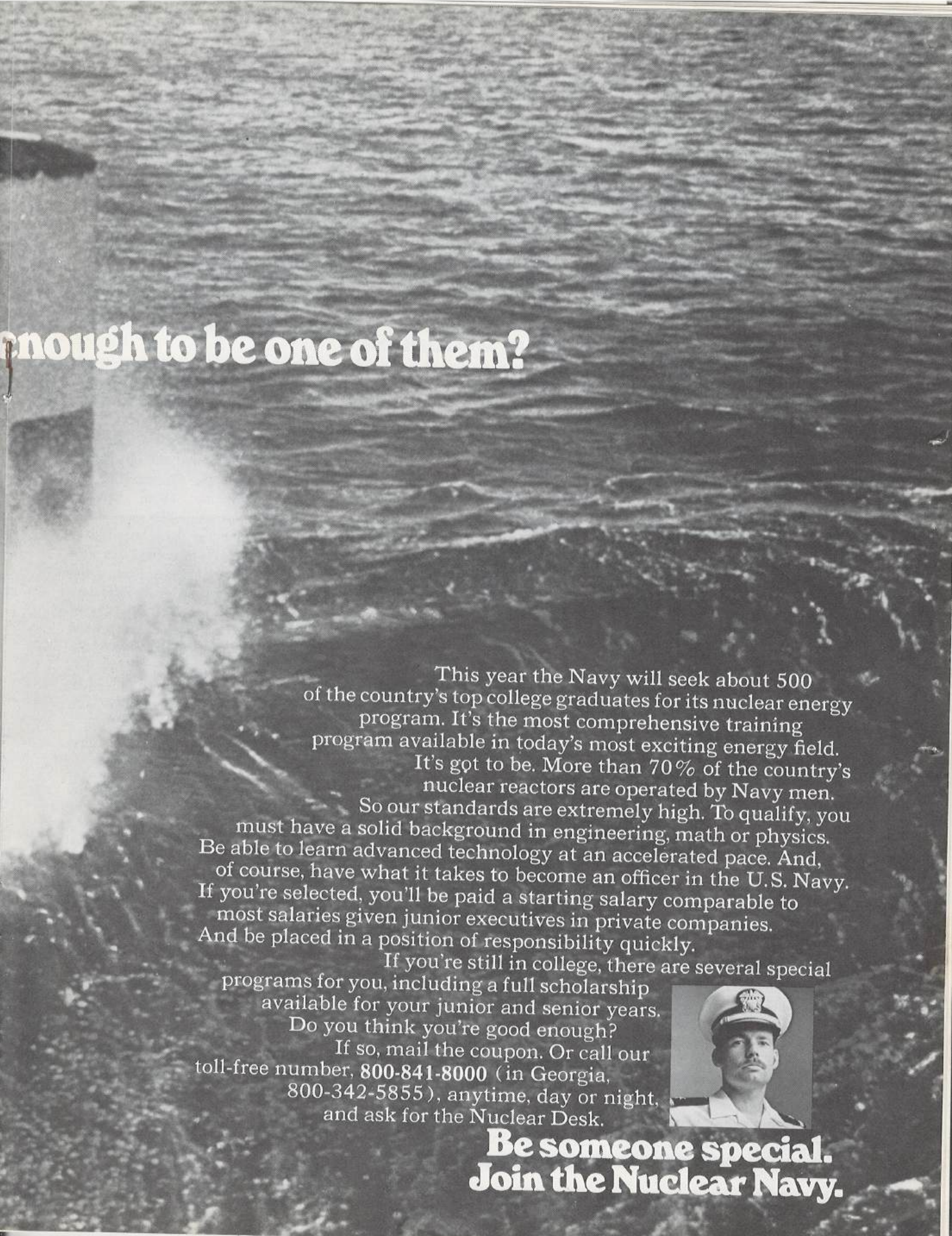
The Nuclear 500. Are you good
651


nough to be one of them?
This year the Navy will seek about 500 of the country's top college graduates for its nuclear energy program. It's the most comprehensive training program available in today's most exciting energy field.
It's got to be. More than 70% of the country's nuclear reactors are operated by Navy men.
So our standards are extremely high. To qualify, you must have a solid background in engineering, math or physics. Be able to learn advanced technology at an accelerated pace. And, of course, have what it takes to become an officer in the U.S. Navy.
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Criticality Accidents: Administrative Failure

WILLIAM M. CONLON

As with many unusual ways to die, the criticality accident is a source of morbid curiosity. And as often happens when death is discussed we often ignore the possibility that we could become the victims of such accidents. However, this psychological defense should not obscure our awareness of this danger, particularly in view of the fact that these accidents have often arisen in the past "from an unusual and complex set of circumstances."[4]

In examining the accident reports in literature I was struck by one trend — the accidents were caused not by equipment failure, but by the failure of administrative controls of nuclear safety. This has importance both for the health physicists and engineers responsible for the safety of others, and for the individuals whose safety is directly endangered. For the former, the moral question becomes: should equipment be designed and operations structured so that no reasonable action can cause an incident; or is the designer also responsible for the unreasonable, that is, the inattentive worker or mislabelled chemical? We are told that we are responsible for our own safety. Unspoken remains the phrase: and the safety of others. The moral issue here is: to what extent should a worker allow the "unreasonable" actions of others, or even the designer who failed to foresee this unreasonableness, influence his safety?

It is our duty to eliminate, as much as possible, the possibility of these accidents occurring. In the case of fuel processing, criticality control is based on one or more limitations of volume, geometry, mass or concentration of Uranium solutions. Often this is achieved by restricting the size of the vessel containing the fissile material to a so-called "safe" geometry, i.e. five inches in diameter or less. Part of the control is administrative — operators in the process prevent the fissile material from approaching a critical condition. This method sometimes fails, as at the Oak Ridge Y-12 facility, Los Alamos, and Wood River Junction. Failure of administrative controls also resulted in a criticality accident in a research reactor at the Boris Kidric Institute.

GLOSSARY

criticality
: steady state neutron population in the reactor.

prompt criticality
: the neutron chain reaction is maintained by neutrons produced instantaneously in fission. The neutron population diverges, increasing every second by approximately a factor of 'e'.

dollar
: a measure of the extent to which the reactor is controlled by delayed as opposed to prompt neutrons. $1 of reactivity corresponds to a prompt critical condition.

excursion
: a very rapid and unintentional increase in the power level of the reactor.

void fraction
: the ratio of the volume of vapor to the total volume of a liquid-vapor mixture. Voids tend to lessen the reactivity of the system and protect against 'runaway' accidents.

safe geometry
: a configuration in which it is impossible to sustain a chain reaction due to the leakage of neutrons from the container.

rem
: a basic unit of radiation exposure related to the amount and density of energy deposition in tissue by radiation.

Oak Ridge Y-12 Accident (1, 2)

An accidental critical excursion at the Oak Ridge Y-12 Plant occurred on June 16, 1958 in a U-235 salvage area. Prior to the accident, the 5-inch diameter geometrically safe pipes were filled with water from a 55-gallon drum, checked for leaks, and the water drained back. During concurrent operations in another area, a Uranium solution was transferred into one of the pipes which had just been tested.

The solution of 50 grams/liter of 90% enriched U-235 was drained into the 21.75 inch diameter drum. At a height of 23.45 cm of solution, the 2.10 kg of U-235 attained prompt criticality. During the ensuing power excursion the density decreased due to

gas dissociation, driving the reaction subcritical. As the gas vented, the system again became prompt critical, this cycling continuing for 2.8 minutes. Boiling followed, and for the next 17 minutes the reaction was controlled on delayed neutrons by the void fraction, until the flow of water reduced the concentration below critical (see figures). A total of 1.3 x 10^{18} fissions occurred with an energy release of 11 kilowatt-hours. The maximum dose equivalent received was under 500 rem.

According to the official inquiry, the following administrative controls were violated:

"Process liquids are never transferred from a geometrically 'safe' container to a geometrically 'unsafe' container."

"Unsafe containers used to collect dilute liquids contain a charge of Cadmium nitrate" to absorb neutrons.

Boris Kidric Institute (3)

At the Boris Kidric Institute in Yugoslavia, a criticality accident involving a zero power reactor occurred on October 15, 1958. The natural Uranium fueled, heavy water moderated reactor was controlled by the moderator level. Safety equipment consisted of the operator's control key, two cadmium safety rods, flux monitors coupled to audible alarms, and an automatic shutdown circuit which was not connected to the safety rods.

At the time of the accident, all monitors and safety circuits were turned off. An uncontrolled rise of the moderator level resulted in a supercriticality in which six persons received heavy doses (one fatal). During the ten minute excursion, which was recorded by a radiation monitor 540 meters away, there were 2.4 x 18^{18} fissions.

The degree to which nuclear safety depended on administrative control is evident from these conclusions from the official inquiry:

"1. None of the normally used instruments for dosimetry, alarm and automatic safety were turned on.

2. The radiation monitoring equipment and the automatic release of the safety rods were neither designed nor constructed as an interlock system so that it was possible to put the reactor

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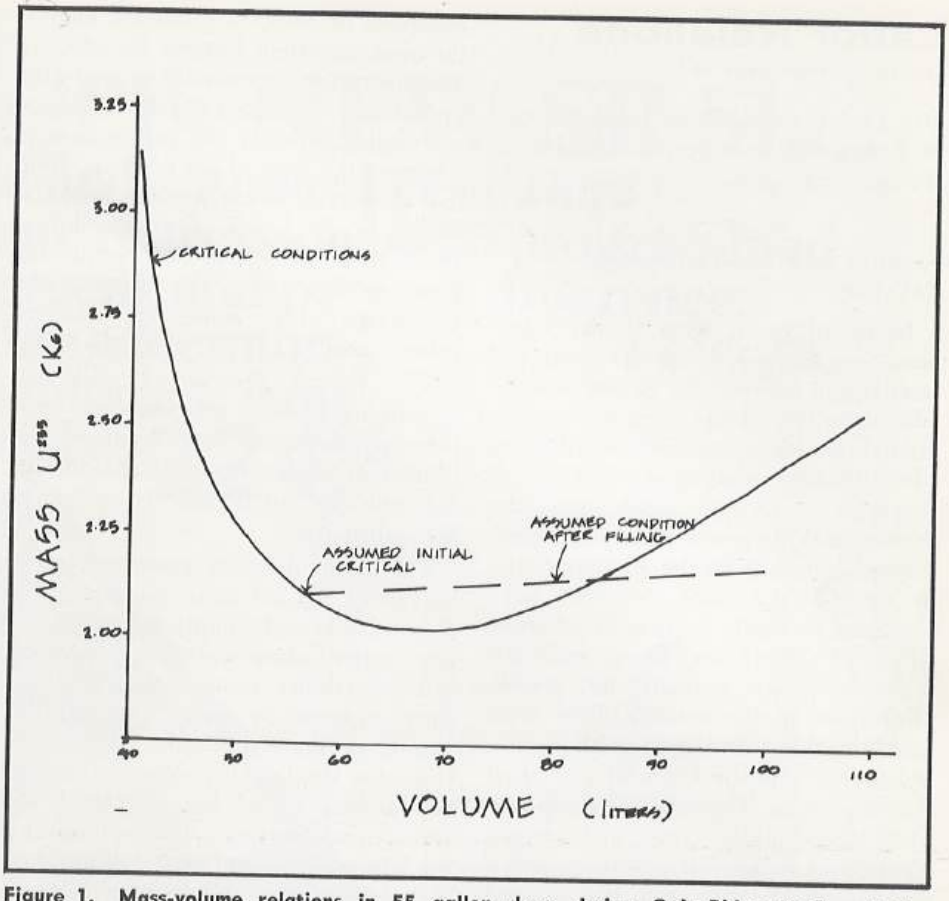

Figure 1. Mass-volume relations in 55 gallon drum during Oak Ridge Y-12 radiation excursion.

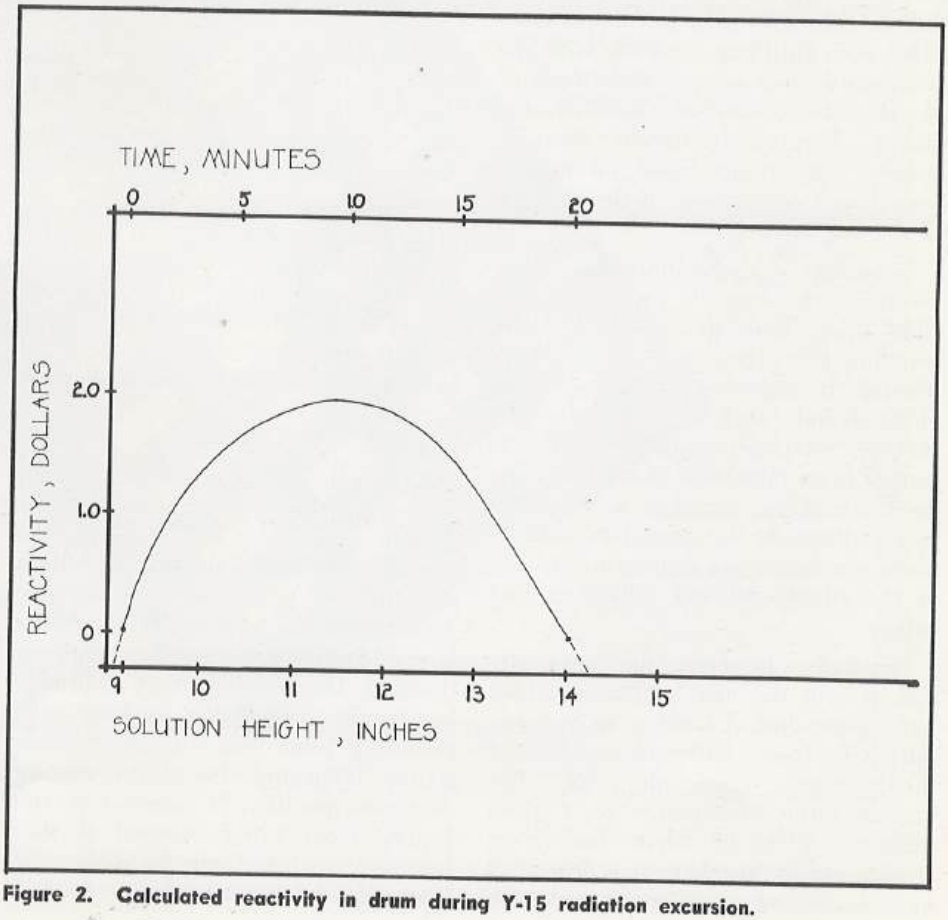

Figure 2. Calculated reactivity in drum during Y-15 radiation excursion.

Labor Relations

(continued from page 15)

Mr. Taylor continues to teach courses in Labor Relations for the School of Management.

Faculty and Administration Relations

In recent years, some faculty members have expressed concern over the relationship between the faculty and the administration. These concerns center around the apparent inaccessibility of administrators, what appears to be resistance to faculty input into the decision-making process, and insufficient communication from the administration to the faculty. Such concerns have combined to create feelings of mistrust. RPI's administration, along with administrators in virtually all private institutions in the country, have been faced in the recent past with a preoccupation with the financial aspects of the university. The enactment of new financial controls and management practices at RPI, while necessary in this new financial environment, has imposed additional strains on relations with the faculty. Although some faculty contend that the administration is "unapproachable" and unwilling to work with the faculty, this does not reflect the feelings of the administration towards the faculty. The administration views a healthy relationship based on mutual respect as a cornerstone of the strength of the Institute.

Rensselaer is an institution of higher learning, interpreted in the widest possible sense. With its diverse and demanding disciplines and all the complicated management situations, both physical and fiscal, of a modern university, complete student or faculty control is too unwieldy to carry out the decision-making process successfully. Hence, there is the need for those to make administrative decisions, with all of the advantages and difficulties this brings.

Hopefully, however, the university will remain the one institution which has a great deal of freedom in carrying out its business. Different members of the academic community can offer various forms of expertise on a given question. Financial advice may come from a faculty member, or a dean may have something to offer on academic questions or research problems. One of the most important features for effective administration is flexibility and the opportunity for give and take. This, by no means, removes the administrator, whatever the level of his position, from the obligation of making the final decision in his area of responsibility. While RPI's present procedures are far from perfect, they do contain the ingredients for achieving effective management.

The formal process of collective bargaining is both unnecessarily complicated and can well dissipate the limited practical resources and the all too precious intellectual resources of the university.

The major difficulty presented to the university by collective bargaining is the formality and rigidity imposed upon the entire decision-making process. Little flexibility results from the contracts customarily agreed to and the nature of the bargaining process accentuates the line between faculty and administration and the associated adversary relationship. The opportunity for informal give and take is diminished and the freedom to take advantage of fortuitous circumstances seriously impaired. Reports from other deans working under collective bargaining agreements indicate that a large fraction of their time is occupied in handling formal grievance procedures, with opportunities for effective academic leadership reduced commensurately.

Despite the problems which may exist with our present form of administration, it would appear that the possibilities of improvement hold much more promise than the constraints produced by a collective bargaining agreement.

Tenure

With job opportunities for faculty decreasing throughout the country, it is only natural for faculty to be concerned with financial security. Many have equated tenure with job security. Actually, tenure was never intended to guarantee faculty a position until retirement. Tenure is a method of protecting faculty from being discharged for espousing ideas that trustees, administrators, influential alumni, or even students, do not like. It does not prevent faculty from being released if their jobs are abolished, or for being discharged for "just cause."

At RPI, the granting of tenure is not based on a quota system. It is conferred only after receiving and reviewing the recommendations from the senior faculty in the department, the department chairman, the faculty promotion and tenure committee, the dean of the school and the Provost.

With a union representing the faculty, though, promotions and tenure may be based solely upon seniority. Virtually all unions insist on a contractual layoff, bumping and recall system based on seniority, which preserves the jobs of the more senior men and women. The system, as we know it, of promotion based on talent, achievement and potential would be lost.

Salaries

The RPI administration is aware that inequities exist in the present faculty salary structure and it has been attempting to correct this situation. Few, if any, private institutions have been able to keep abreast of the cost of living. A recent survey by the Association of Independent Engineering Colleges (AIEC) showing average compensation for the 1974-75 academic year indicated that the average compensation for RPI professors in the schools of engineering and science were $915 less than the average compensation for the 1974-75 academic year of the engineering and science faculty at 15 other colleges which participated in the survey. Furthermore, RPI associate professors were $38 less and assistant professors, $15 less. Since that survey was taken, RPI has announced that faculty salary increases for the 1975-76 academic year will average approximately 8 percent. This is in addition to the 2 percent increase given to the faculty on December 1, 1974. Furthermore, RPI increased its contribution to the health plan from 25 percent to 50 percent, effective January 1.

It is questionable whether more money for faculty salaries could be generated by collective bargaining. RPI does not have a reserve that can be tapped for faculty salaries. We rely primarily upon tuition and gifts as our major sources of income. RPI is limited in the extent to which it can raise tuition, since excessive increases would result in declining enrollment. Increases in faculty compensation in

(continued on page 20)

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Deg/rad mode selection	yes	yes
Decimal degrees—deg-min-sec	yes	yes
Polar-rectangular conversion	yes	yes
y^x	yes	yes
e^x	yes	yes
10^x	yes	yes
x^2	yes	yes
$\sqrt{x}$	yes	yes
$\sqrt[x]{y}$	yes	no
1/x	yes	yes
x!	yes	yes
Exchange x with y	yes	yes
Metric conversion constants	13	3
% and Δ%	yes	yes
Mean and standard deviation	yes	yes
Linear regression	yes	no
Trend line analysis	yes	no
Slope and intercept	yes	no
Store and recall	yes	yes
Σ to memory	yes	yes
Product to memory	yes	yes
Random number generator	yes	no
Automatic permutation	yes	no
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Digits accuracy	13	10
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Labor Relations

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the light of limited total university income beyond some point, would have to be at the expense of the budgets supporting some other area of the university such as classroom or laboratory facilities, library materials, support services, etc.

It is well known that collective bargaining tends to treat all categories of employees alike and put major emphasis on across the board compensation increases. Under these conditions, a reward system based upon merit, which has always been the policy at RPI, would severely suffer and existing inequities would tend to be preserved. Salaries would be primarily based upon rank, degree and years of service, not upon ability. Such a system within a school like RPI could lead to mediocrity and would certainly frustrate those striving to have inequities reduced or eliminated. This would make it more difficult to preserve or to establish the "steeples of excellence" necessary to the survival of a private university in the present and forseeable future. If merit is not rewarded, it is also difficult to attract or retain the better professors who are inclined to go to a university where their talents can be properly rewarded.

Rewarding Faculty with Sponsored Research

Salary increase for faculty at RPI are based on merit. When evaluating faculty for salary and position changes, the performance of each faculty member is reviewed, with due consideration of his or her experience, based on the person's teaching, research or other scholarly activity, and service to the university.

Presently, fewer than half of Rensselaer's faculty are engaged in sponsored research. Those who are, contribute to the entire university community by providing additional funds to help offset the fixed operating costs of the institution. Furthermore, through their research activities, new fields of study are opened for students and RPI's name and prestige are enhanced. This makes RPI more competitive in attracting students and better able to attract other faculty with similarly vital scholarly interests.

Sponsored research, especially at a technological university such as RPI, is essential, and because faculty who attract external funding are valuable to RPI, it is right and proper that they be rewarded. The level of sponsored research, however, is not the only criterion upon which salary increases are based.

Pension Plan

In recent years, the RPI pension plan has developed into a major issue at RPI. The faculty has become increasingly suspicious of the motives of the administration in the management of the plan, and when it was revealed that the Institute had reduced its contribution to the plan during the contract year ending September 30, 1974, most felt that their worst fears had been confirmed. Following this revelation, the faculty position hardened, and charges of broken faith were immediately forthcoming.

What are the reasons for reducing the Institute contributions?

First, the RPI plan is a fixed benefit plan in which each member earns a fixed amount of pension each year depending upon the member's base salary. The fixed amount is guaranteed, regardless of the earning of the money in the fund. As a result, RPI is required to contribute each year a sum of money which, in addition to the employee's contribution, will purchase the guaranteed fixed pension benefit. This amount can be more or less than the employee's contribution and will vary as the earnings of the fund vary. In fact, including RPI's last contribution over the past ten years, the Institute has contributed over $265,000 more than the members contributed.

Secondly, in November, 1974, President Grosh announced to the faculty that consideration was being given to changing the pension plan. An eight-member joint committee of faculty and exempt personnel was formed to review pension plan alternatives in April, 1975. The five faculty members appointed had been suggested by the chairman of the faculty council after informal consultation with several members of the council. (Simultaneously, a similar committee of non-exempt personnel was formed for the same purpose). One possible change under consideration by the faculty and exempt personnel committee is to offer members the option of stopping all contributions to the present fixed benefit plan and have all future contributions made to a money purchase (fixed contribution) plan such as TIAA-CREF. A variation of this option might involve transfer of funds from the old to the new plan, but this entails penalties, since Bankers Life would be forced to sell securities to acquire the cash for the transfer. Because of this and because the IRS required that RPI not use surpluses to increase member benefits (as a condition for preserving the tax-exempt status of contributions), the Institute decided to contribute no more than was required to provide the guaranteed benefits. It should be emphasized that this decision has had absolutely no effect on any member's pension benefits. The benefits, as spelled out in the pension plan handbook, are fixed, fully guaranteed, and fully funded to date.

Excluding Faculty with Grants from the Bargaining Unit

It has only been since 1970 that the NLRB has reversed its long-standing position and assumed jurisdiction over over employees, including faculty, in private colleges and universities with income of $1,000,000 per year or more. Therefore, the precedents set by past Board actions have not been sufficient to establish uniform guidelines as to which academic groups would be appropriately included or excluded from a collective bargaining unit.

Supervisors are routinely excluded from belonging to the same bargaining unit as those subject to their supervision. RPI's administration has, therefore, asked the NLRB to determine whether certain fiscal and supervisory functions of faculty in charge of research projects are sufficient to place those individuals in the category of supervisors.

Unfamiliarity with Collective Bargaining Practices

In a situation such as that at RPI, where people familiar with collective bargaining are in short supply, both parties — administration and faculty — are usually forced to hire labor relation experts to handle their contract negotiations and other formal procedures associated with collective bargaining. Besides the obvious costs involved, there are other disadvantages in

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Fraternities at R.P.I.

MICHAEL BIRRER and BRIAN BOTTORFF

The social fraternities which have become so popular on American college campuses today were very influential in the history of many educational institutions, including their student governments and their community relations. Although fraternities in the early 19th century originally began as "secret societies" couched in ritual, the establishment of such on the RPI campus was perhaps the first organized initiative taken by students to try to meet their non-educational needs such as recreation, adequate housing, and comraderie. In addition to providing a group-living type of atmosphere and a means of active participation, fraternities established a framework which permitted many social activities to be offered to their members. Most organizations perpetuate themselves through continuing memberships; RPI fraternities are not the exception. In the past they have been very involved in community activities and charities throughout the Troy area.

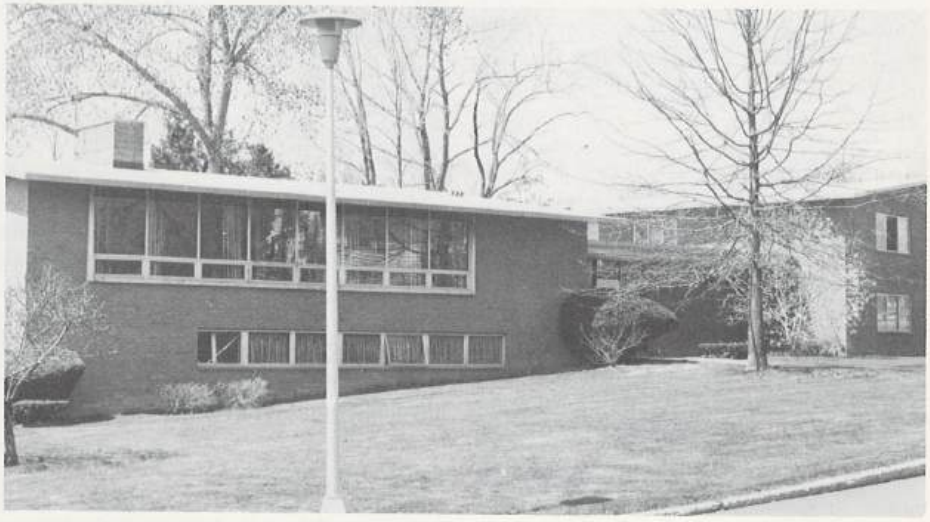
In recent years numerous incidents concerning fraternities on college campuses throughout the nation have come into the public eye, and with them perhaps a close scrutiny of those "Greek" societies that date back early into American history and its educational institutions. These incidents, in conjunctions with the historical connotation of "secret societies," their social exclusiveness, and their ritualistic nature, have perhaps unfairly, cast a shadow on fraternities in general and the fraternity systems at many American colleges.

Although "secret societies" at Rensselaer date back to 1853, organized fraternities in the modern sense began in 1864 with the founding of the Alpha Chapter of Theta Xi, the first national fraternity founded at a technical school and still the oldest fraternity in existence at the Institute. Three more social fraternities were soon established and were recorded in the 1865 *Transit*, the first published student yearbook of RPI. More fraternities evolved during the next 50 years, but it was not until 1912 that a large number of them began to acquire houses. At this time, the Rensselaer student body numbered approximately 500.

The Institute, which had previously left the lodging of student up to individual arrangements with private boarding houses, began to develop its own inadequate dormitory system just after 1915. Fraternities at this time housed approximately 50 percent of the student body.

Between 1900 and 1938 the number of Rensselaer fraternities grew from 8 to 23 chapters and during this period the first attempt to organize non-fraternity students into a type of "Commons Club" was made. Their effort was unsuccessful, as were subsequent efforts, until the formation of the Independent Council in 1962, which still serves the interests of the non-fraternity students. The Independent Council's "Greek" counterpart, the Interfraternity Council, was established in 1918 and acts as a governing body for all of the Rensselaer fraternities. It not only regulates their conduct but provides an organizational medium to improve, and meet the needs of, the overall fraternity system of the school. Both Councils are directly responsible to the Student Senate, the legislative unit of Rensselaer's student government.

The strength and survival of fraternities and the fraternity system at RPI may be attributed somewhat, to the Institute's historical and financial "non-involvement" policy. Unlike a few schools, which financially supported fraternities and went so far as building



Diversification of Fraternity Architecture — Left, Castle (Pi Kappa Phi): Right, Phi Kappa Tau.

the traditional "fraternity row" complexes, the Institute has not become financially involved with their fraternities, nor have they forced them out of existence as many Ivy League schools have. The only exception to this policy was their involvement in the so-called "60-40 Plan" during the late 1940's, in which each of five fraternities paid 40% of the cost of a new house and the Institute absorbed the remaining 60%. Only three of the five houses remain active on campus today.

There are 24 fraternities existing today at RPI and perhaps the word that best describes them is diversified. Their geographical locations range from the rather distant Pawling Avenue all the way to downtown Troy and over to Hoosick Street. There are only four that are located on the Rensselaer Campus but in general, most of the houses off campus can be easily reached by the bus routes. The type of housing varies from modern designed structures to ones that are a 100 years old, including one which looks like a castle and another that has a swimming pool. The capacities of these buildings range from a high of 55 people to well below 30, and indeed the membership of the fraternities fluctuates greatly between these two extremes. The average size of a house at Rensselaer is about 30 to 35 "brothers" and these "brothers" do by no means possess the same characteristics. There is no "typical fraternity man." Perhaps the most obvious reason for rejecting this notion is the fact that men are not the only sex involved. Women have become members of a couple of houses at Rensselaer and in fact, one has four coed members. There are also a large number of minority students who are "brothers." Further, many members of RPI athletic teams and many of its "high cum" students are members of fraternities. Thus, a particular house may attract a certain type of person, but overall, no single word can be used to describe the members of Rensselaer's fraternity system.

Community Service in Action.

Opposing this sense of diversity is a loose type of unity displayed in several ways by the fraternity system. As stated previously, every house at RPI is represented on the Interfraternity Council (IFC) which is an important link between the fraternities and the Institute. The IFC allows the houses to decide together on policies and actions that will affect them. The fraternities also participate in a extensive intramural sports program and have a highly organized freshman "rush" program.

Furthermore, many of the business and financial aspects of the houses are handled by the Fraternity Management Association (FMA) which is an independent non-profit organization run by the students providing numerous services to its fraternity members, i.e., purchase of food and other commodities. In a recent statement from Associate Dean of Students, Carl Westerdahl, he called the FMA, "one of the best such organizations in the country." Thus, although there might be the traditional rivalry between houses, there is also a sense of "togetherness" in the RPI fraternity system.

A interesting and important question about our fraternities is, why do people join them, or rather, what do they offer their members? One obvious answer is that they supply housing during the upperclass years. But it has to be more, for there are many other alternatives to fraternity life if one is looking only for a place to stay, i.e., dorm, apartment, etc., and yet, large numbers of people every year choose fraternity life. Perhaps a solution to this dilemma is to be found in a passage from a recent IFC publication concerning rushing. It states, "a fraternity is far from a band of men who are characterized as social brothers . . . At Rensselaer, a fraternity can most accurately be characterized as an experience . . ." *An experience:* for many many people it appears primarily as a social one; this is the main reason why so many students each year join fraternities at Rensselaer. In a fraternity, there is an atmosphere highly conducive to meeting and conversing with people. This is an extremely attractive offer, especially at RPI with its cold, scientific aspects so characteristic of technical schools. This is summed up in a recent Alumni publication which stated: "Fraternities provide our students with a great many opportunities for social development which would otherwise be unavailable." Further, it is said that fraternities offer a feeling of brotherhood, or a sense of belonging which can not be found in any dorm or apartment. In a sense, a fraternity is a "bit of the real world" with its people and problems. This quality of being real," in some cases, tends to prepare the individual for the world he must face after RPI. In a quote from the latest Rensselaer Alumni Bulletin, "as reported by Rensselaer's Placement Office, when RPI men of equal academic backgrounds compete for a job more often than not the fraternity man is employed."

At this point, although it is obvious that fraternities offer their members numerous advantages, one might be inclined to ask if they contribute anything to the school or to the campus as a whole. Of course there are several rather obvious methods of contribution. For example, approximately thirty percent of the student body is housed by fraternities and this does indeed ease the present housing crisis at RPI. Also, since the houses offer so many benefits or, better yet, advantages to their members, they are indirectly (since their members are students) helping the school. However, the effect of fraternities goes much further than this. Our system of fraternities offer entertainment and a social medium to the entire student body via their band parties, cocktail parties, etc. It is easy to imagine what RPI would be like

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Someone New in RPI Administration: Dean of Women

Engineer Interview: Sandra Gull

Editor's Note: Sandy Gull was appointed Dean of Women and Assistant Dean of Students this past year.

Question: Do you think that a Dean of Women is necessary at R.P.I.?

Dean Gull: The official position that I have is Assistant Dean of Students. Cindy Soja, the woman who had the job before me was called Coordinator of Women's Affairs, and I get the impression that the job was primarily based towards working with women students. The way I perceive my job is that it is a general administrative position with all that is involved: disciplinary duties as well as a concentration in working with women students. So, I'm in favor of this job in terms of an Associate Dean of Students with that area of concentration, because I feel that the women students here need someone to work with them full time.

Question: With regard to working with the women students — do you have any goals in mind for the immediate future?

Dean Gull: I think that there are a number of things that must be done here. When I first came here, I saw a fragmentation of women's interests. The women are physically spread out on and off campus. There seems to be no general group feeling. There is a little bit of identity, but not much. It seems that the sense of identity women have is more often what they are not, rather than what they are. In other words they are coeds or an addition to R.P.I. instead of female students. I think that is one of the things that has to change. What I'd like to see is a rise in group identity. Once we get that done, then we can take a look at the problems that affect them and then we can act as a group to solve the problems. However, as long as feelings of isolationism are still around, things are going to stay just the way they are.

Assistant Dean Sandra Gull

Question: In that case, you would consider The Society of Women Engineers to be a step in the right direction?

Dean Gull: Exactly. I think that is a very good way to get people involved. What you are doing is appealing to a practical kind of interest that a lot of people have. If I were a student, I would be willing to go to a meeting because that would be a good way to make contacts with people in my professional field, while making friends at the same time.

Question: What about women of other majors?

Dean Gull: I think that the Society of Women Engineers, because it is a nationally based organization, has given us a template to follow. We can say since the Society of Women Engineers has worked, let's try something in another area. As soon as people get excited about this kind of thing, there is no end to what the women students can do.

Question: What other activities would you like to initiate in order to foster a group feeling among the women at R.P.I.?

Dean Gull: Typically, in the last couple of years there has been a big sister-little sister program at R.P.I. I think it is a shame it hasn't worked out, because in terms of survival, a freshman should know what type of courses to take and the type of problems she is going to be up against in the classroom. It seems that fraternities offer this to their members. What we need is to foster a similar support system. I would like to see this program initiated again based on assigning juniors and seniors to freshmen who have the same major.

Question: What do you have in mind for next year?

Dean Gull: What I idealize about next year, and how we are going to start, is through a series of informal meetings for the first two weeks. In the beginning of the year there is a lot of energy and people are looking forward to meeting others.

I would like to have successful professional individuals come here for small informal discussions. In that type of atmosphere you can get a sense of the person.

When we do have a speaker it should be an atmosphere where people can easily walk up and ask questions. By the questions asked, we can get an idea of what interests the students have to further involve additional speakers.

I am ready to plan a flurry of issues and activities for next semester. If five students come or if fifty-five come, it will be O.K. It will be the type of situation where you'll know something will be accomplished. Whether it's a

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Interview

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film festival or a discussion, there are going to be activities available. I think we can humanize this place if we change the programming a bit from the band party type of entertainment to something a little more humanistic. Maybe we can help people answer such questions as "What am I going to do when I get out of here?" and "What is it going to be like in the real world?"

Question: What other problems do women face at R.P.I.?

Dean Gull: The social climate at R.P.I. is a major problem. Because women are a minority they face tough adjustments especially as freshmen. For example, in the initial few weeks the women are sought after and they don't know what to do with all of the extra attention. Six weeks later this situation disappears and they don't know what they've done wrong.

I think that the negative attitudes toward Sage women are also a problem. Since the women here at R.P.I. are in a minority situation they tend to believe what the R.P.I. men have told them (about Sage women) instead of checking it out for themselves. In order to eliminate these preconceived notions we should try bridge building on a small scale. Planning a film festival or having discussions together might be a possible solution. Again, I'd like to emphasize that using other women for support while you are here is important because once you leave it takes a lot more effort to make contacts.

Question: Are the admission standards different for women?

Dean Gull: No. The criteria used are exactly the same.

Question: Gradewise, do women do better than men at R.P.I.?

Dean Gull: As a whole, this seems to be the case. Nationally, this is true as well.

Question: Any other thoughts about women?

Dean Gull: I think it is a great time to be a woman. Job opportunities are finally opening up and peoples attitudes are changing. It is as though womankind is finally reaching its maturity — breaking out of awkward adolescence into adulthood. Women aren't afraid of risking their femininity anymore. □

Public Concern

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Cliffs case, did the acknowledgement of public participation reach any significant level. The attempt now to restore public faith by defining the processes of the fission reactor seems to be an attempt to heal an old but tender wound. That attempt may take quite some time considering that a very strong controversy still exists regarding high level radioactive wastes. At present we are committed to 600 years of storing irradiated wastes, and though a means for containing this material has been proposed, an official policy has not been set.

So while the fission reactor remains the focal point, around the corner looms the breeder reactor. If all goes well, by as early as the 1980's the Fast Breeder will be contributing its supply of energy. But only "if all goes well," and by whose standards? The liquid metal fast breeder reactor (LMFBR) relies on Plutonium 239, which is the most lethal element known to man. The Plutonium isotope is popular because it is an inexhaustible source of energy. At this point, however, the disadvantages connected with plutonium far outweigh the advantages. Not only is the isotope extremely toxic, but it has a half life of more than 24,000 years. The present commitment to store high-level radioactive wastes for 600 years is merely a fortnight when compared to the long-lived toxicity of plutonium. In addition, there are the routine problems of handling, shipping, and fabrication of large quantities of plutonium.

In the reactor itself there are also numerous problems, but the major one concerns the cooling system. In a breeder reactor the fission energy is produced in a very compact volume which necessitates a very efficient coolant to carry off the energy. Liquid sodium is the chosen coolant because it can carry great quantities of heat with no rise in pressure. The problem, however, is that liquid sodium reacts violently with water, releasing hydrogen gas which is highly explosive. Strict preventive measures must therefore exist to insure that the radioactive liquid sodium is shielded from the water. There are additional risks associated with the LMFBR but they are beyond the scope of this article.

The poignant issues here are whether the public can be assured that breeders using plutonium will not become commercially operant in undue haste, and indeed not at all if they do not prove to be safer than other options. Some promoters in the nuclear field agree that the fast breeder must "stand on its own", that the safeguards must prove to be highly effective, and that if the fast breeder does not in fact meet all safety standards, it should not be put into commercial operation. This kind of rationale is practical and encouraging; nevertheless, in January, 1975, the Atomic Energy Commission submitted to ERDA a summary sheet on the proposed final environmental statement on the LMFBR that was not so encouraging. Regarding the LMFBR, the AEC expressed its optimism as follows: "It is further concluded that fully developed LMFBR industry will be able to meet environmental quality and safety standards, will not have a significant adverse environmental impact, and that the advantages of developing the LMFBR as an alternative energy option far outweight the attendant disadvantages." In its report, the AEC looked to the early 1990's as the time when the LMFBR industry will develop. By the 1990's the AEC's prognosis may be proven a reality. However, in light of the current problems related to plutonium, the optimism expressed by the AEC is premature and merely enforces the need to proceed with caution.

Nuclear power is clearly not the only source of energy extant, and it should not be considered a panacea. Imperative at this point is the need for legislation to define a national energy policy that will be practical and conservative in assessing the nation's energy needs. Consideration must be given to all possible energy sources in an attempt to meet those needs, and the public interest should play a major role in helping to evaluate the course of action. The need for public participation must be emphasized if those directly involved with nuclear power are sincere in their commitment to act within the public interest. There is no way to discern "public interest" without an active public voice. Participation by the public also enables people to carefully and objectively watch and question the discretionary procedures performed by the agencies and utilities that are responsible for implementing an energy program. □

Criticality

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in operation even if such equipment was removed or turned off."

Los Alamos Criticality Accident (4)

The Los Alamos criticality accident occurred on December 30, 1958 at a plutonium reprocessing plant. During this time an inventory was being conducted and the plutonium content of residual materials in the process vessels was to be evaluated. Plutonium rich solids were washed from two other vessels containing aqueous and organic solutions. The aqueous portion was removed and the remaining forty gallons containing Tributyl phosphate (TBP) were transferred to the 225 gallon, 38 inch diameter solvent treating vessel in which the accident occurred. Nitric acid was used to remove the solids, which were drained into the vessel. Air spraying to finish cleaning the first vessel caused a mixing which resulted in the solids being absorbed in the TBP phase.

At this point 40 g of Plutonium were dissolved in 87.4 gallons of aqueous solution, 3.27 kg were dissolved in 42.2 gallons of solvent, and the remaining 60 grams were suspended throughout. The 8 inch thick solvent layer was approximately $5 subcritical, only 1/4 inch too thin. As the stirrer was turned on, the aqueous solution was forced up along the wall, causing the TBP layer to thicken. This configuration was supercritical, emitting a burst of approximately 1.5×10^{17} fissions, before being terminated by the turbulence induced by the burst. Continued operation of the stirrer diluted the Plutonium concentration, maintaining subcriticality.

The burst of neutrons displaced the tank 3/8 inch at its supports. The operator, who was knocked off a step ladder, received a fatal dose of 12,000 $\pm$ 50%. The AEC investigating committee blamed the operator for not following the instructions of his supervisor, clearly a failure of administrative control.

Wood River Junction (5)

The last accident to be discussed occurred at Wood River Junction, Rhode Island on July 24, 1964, in a new plant designed to process salvable fissile material. As in the previous fuel processing accidents, this one happened during an unusual, non-routine operation.

The operator mistook a geometrically safe bottle of uranyl nitrate crystals and saturated solution for trichloroethane contaminated slightly with Uranium. The Uranium contents were poured into a geometrically unsafe 18 inch diameter tank, reaching a critical configuration. In the ensuing excursion, some of the liquid was ejected from the container, and this combined with the action of a stirrer maintained subcriticality. Later when the stirrer was turned off, a second excursion took place, which was terminated by gross settling of the precipitate.

The operator received a fatal dose of 46,000 rads to the pelvic area and 14,000 rads to the head. The review committee recommended more rigid administrative control, better identification of fissile materials and better indoctrination of plant personnel.

Conclusions

I do not wish to assert that administrative control of nuclear safety is

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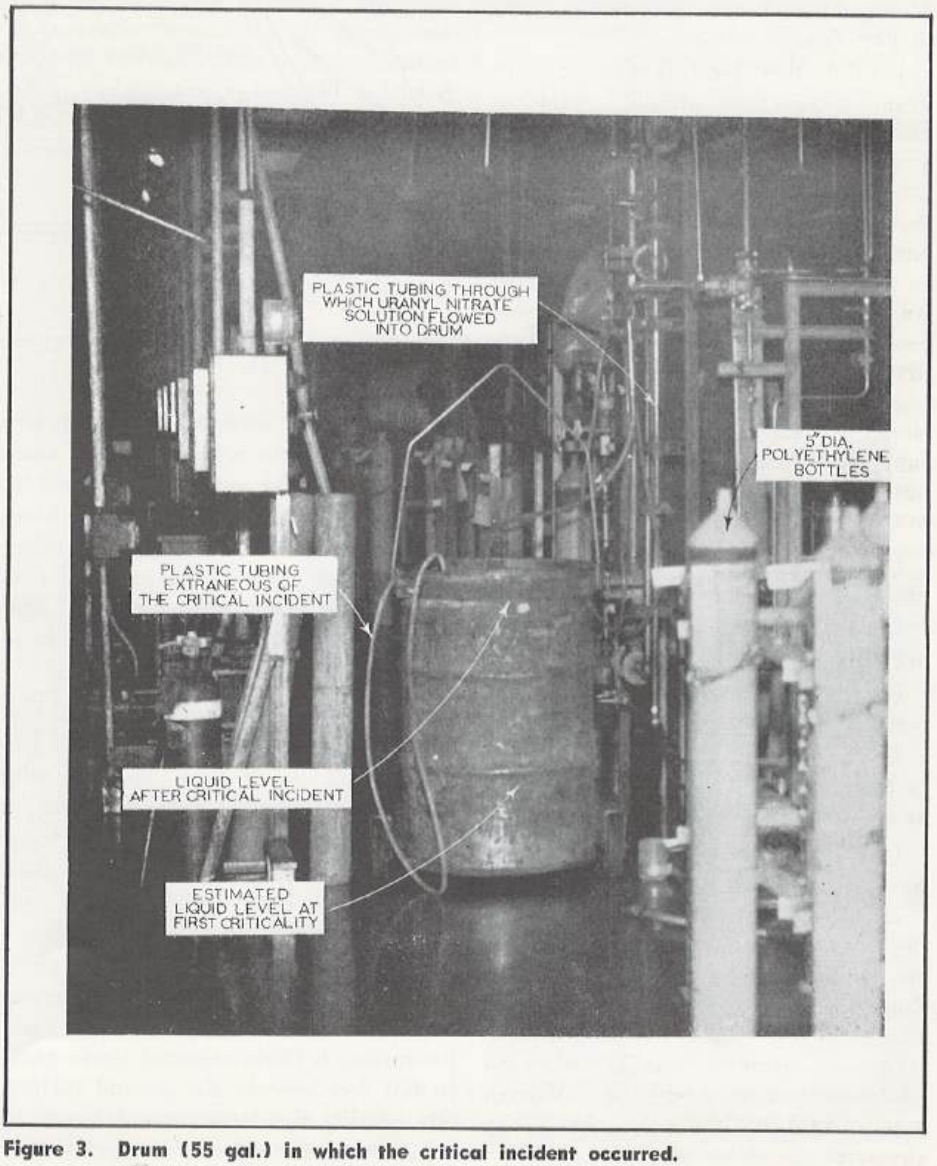

Figure 3. Drum (55 gal.) in which the critical incident occurred.

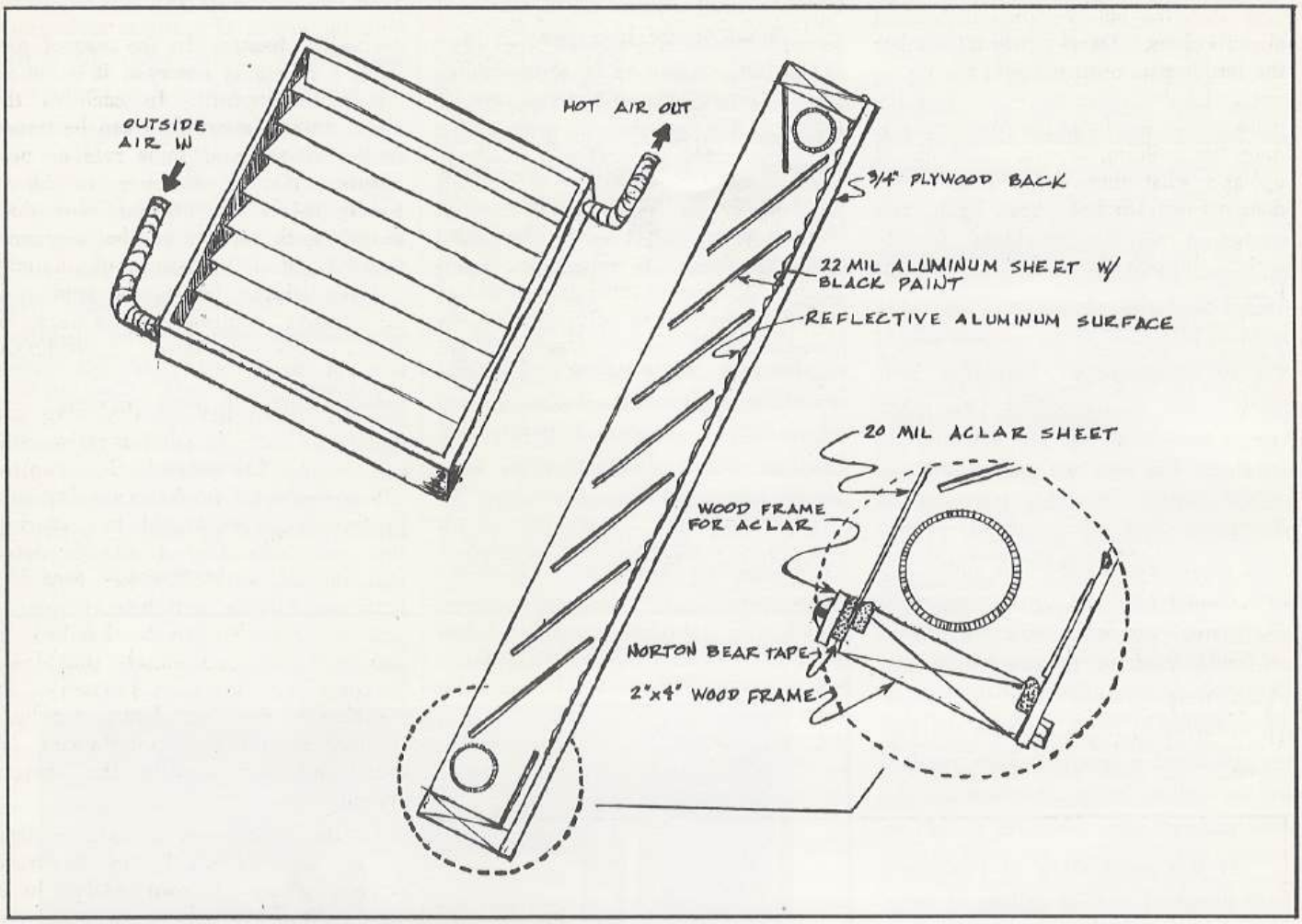

Figure 3. Block Diagram of the air collector (see also figure 4).

The air quantifier consists of a fan, a thermostat and rotometer and control valve. These provide readings on temperature and velocity of the incoming air.

Figure 4. Mat Cohen — one of the designers of this air collector.

An idea put forth by the group is a window collector with adjustable vanes which could be opened or closed as needed. They would be painted black on one side and white on the other. With a mechanical linkage similar to a venetian blind, this unit can have three modes: solar collection, shade or transparent.

In the still well on the southwest corner of the Ricketts Building, a laboratory is being built to test solar panels. Complete instrumentation is being installed to check flow rate, temperature, insulation and pressure drop as well as heat exchange rates for various components.

The group is also working on a geothermal heat exchanger. This project is based on the principle that the earth maintains a fairly constant temperature a few feet beneath the ground surface. By passing the intake and exhaust air of a house through the heat exchanger it is hoped that it will be possible to preheat the air that enters a building. One of the problems with this is when the ground freezes to the point where it cannot transfer heat to the pipe of the system as fast as heat is removed.

While collecting energy through a subsystem is the most important aspect of energy production, it is also extremely important that energy be conserved through strict regulation of air flow through a building. Advance Cooler Manufacturing of Clifton Park, N. Y., has designed their new plant as a monolithically insulated building. The building traps the air inside and does not breathe as most buildings do. The new factory does not use any major heating or cooling systems but relies almost entirely on the "flywheel" effect of temperature and humidity control. This means opening the building when the environment offers comfort and shifting to a closed down mode when the elements threaten. In the Advance

Cooler plant the heat absorbing mass inside the building is used to exchange heat with the outside when it is most advantageous. During warm weather the building is opened up in the morning to let the cooler air in, cooling the mass inside the building. When this is done the building is once again closed up and what increase in temperature does occur from body heat, lights, and energy from the machines is absorbed through the cooler mass of the building.

This combination of solar heating, cooling systems, and tight air flow control, shows great promise.

Aside from conservation of energy, there are a number of good reasons to go along with solar energy. One of the best reasons is the reduced amount of pollution. If the realization of the projected market value is reached by the year 2000, there would be a reduction of over 430,000 tons of air emissions. The amount of solid waste would be reduced by 20 million tons. Radioactive air and water discharge would be reduced by over 1 million curies and solid wastes by over 670 million curies.

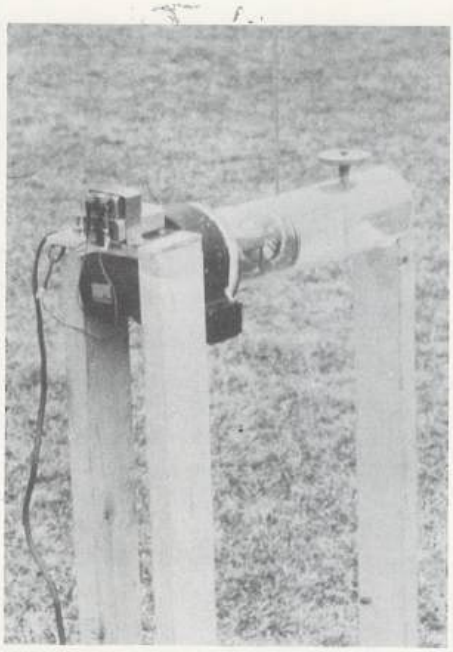

Figure 5. The Air Quantifier now in use.

When one takes a look at the facts, it is almost impossible to oppose solar energy. It is safe, clean, and unlimited. Full development, however, depends upon new construction methods and a change in our present attitudes toward the world and its resources.

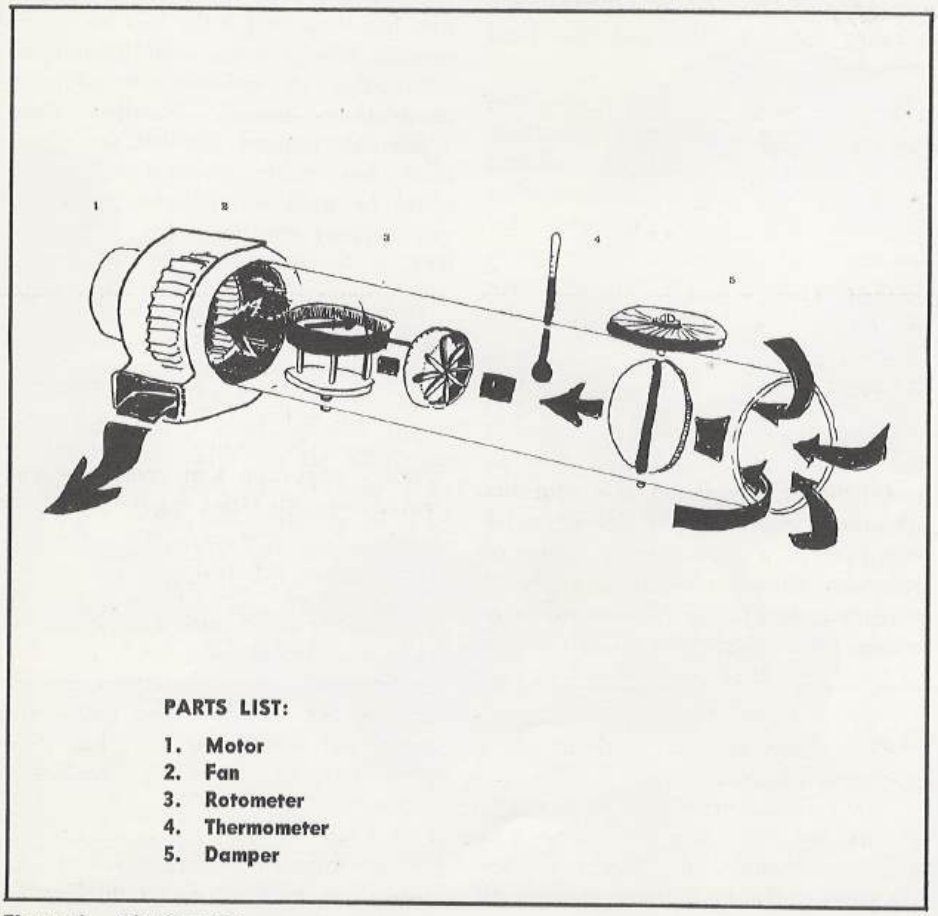

Figure 6. Air Quantifier.

Criticality

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in itself a hazard. In the case of preventing criticality however, it is not an adequate safeguard. In each of the above cases, the accident can be traced to the violation of some rule or procedure. Having someone to blame hardly solves the problem, nor does designing the system so that accidents can happen only because of administrative failure. Of course some administrative controls may always be required on economic or technical grounds.

The answer lies in designing the system so that the administrative controls cannot be violated. One control which could be implemented for fuel processing plants would be ensuring that only vessels of a safe geometry are allowed in the process area. If fuels of various enrichments and/or concentrations are to be handled in one area, then all vessels should be designed for the safest geometry. In the case of the Boris Kidric incident, the obvious solution is interlocking the monitoring system with the control system.

In the context of a safe nuclear design, an individual can be truly responsible for his own safety. In a design which is only administratively safe, an individual must take a risk which he cannot estimate. Perhaps, if you believe Murphy's Law, "In the course of human events, if anything can go wrong, it will go wrong," administrative control is not a means of preventing an accident, but a means of guaranteeing one.

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Labor Relations

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employing people largely inexperienced in academic matters to handle their collective bargaining. Regardless of competence, such non-academics cannot be expected to fully understand the campus situation; they are unfamiliar with many of the problems peculiar to a particular university, in this case RPI. There is also the danger that these outsiders with their traditionally legalistic approach to negotiations may be more concerned with the contract language than with the intent of the negotiated agreement. At times, these outsiders who will be making decisions directly affecting the RPI community, may not be available to administer the negotiated agreement. Potentially more injurious to both sides is the probability that these outsiders will reach agreement among themselves on certain issues before the principals directly affected are fully consulted.

STRIKES

Last January, a strike nearly materialized at the Polytechnic Institute of New York, a situation which tended to raise the question about the possibility of a strike at RPI in the event of unionization. Fortunately, RPI is not in the same situation as Polytechnic Institute of New York, where in order to secure state funding, it was necessary to reduce the number of faculty positions substantially.

In contrast to public institutions of learning, where strikes are prohibited by law, unions at private universities are not restricted from striking.

In any union situation, a strike is always a possibility. Without a doubt, a strike would have serious consequences to the education mission of the institute.

When RPI accepts a student's tuition money, it guarantees to that student an opportunity to obtain a quality education. A strike would have the effect of negating this opportunity. It is a situation which would not only be detrimental to students presently enrolled, but would erode RPI's competitive edge in attracting future students and its stature among other leading private institutions. □

Fraternities

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on the weekends without the fraternities around — certainly rather uneventful. In general they seem to make Rensselaer a more enjoyable place for many of its students which is good for everyone involved — RPI, the students and the fraternities.

Many of the houses do community service which establishes respect not only for the fraternity system but also for RPI. Christmas parties for disadvantaged children, supporting a Korean child, the Heart Fund, Blood Mobile, supporting a Troy youth hockey team, Cancer Drives, and repairing a playground for retarded children are just a few of the activities fraternities have participated in. In doing such work the fraternities not only gain a feeling of satisfaction but also help to consolidate a better relationship between RPI and the local community.

A direct contribution of fraternities at RPI is the Annual Phonathon. This fund raising drive is conducted by the Rensselaer Alumni organization and each house "mans the phones" for one night. During the past five years, fraternities have collected approximately 300,000 dollars for RPI and each year a certain amount of this is put aside for the fraternities for their own use. So far this year, about 80,000 dollars have accumulated. It was decided that this money will be used to construct a new wing for the infirmary. Finally, it is interesting to note that in a recent study, 56% of fraternity alumni contributed to RPI as compared to 36% of non-fraternity alumni. This is indeed an impressive statistic, one which certainly benefits RPI.

Of course, this relationship between Rensselaer and its fraternities is not one-way. There are several ways in which the school can and will aid the houses on campus. The first that has been mentioned is the 60-40 Plan which although no longer in existence, at one time assisted several fraternities in need. However, this is contrary to RPI policy. It seems that financial assistance to fraternities would diminish their much needed independence. Recently, the Institute has found new ways in which to assist the fraternities. In an interview with Dean Westerdahl, it was pointed out that there are several areas in which the school could concentrate. First, RPI could offer its many specialists in management, law, etc., as consultants for free service to fraternities. Secondly, a program of education concerning fraternity management and development might be offered. In fact, a course by this name was conducted during the January term this year. Thirdly, it has been suggested that a "Fraternity Service Award" program, which in essence would honor one alumnus from each house, the one who has supported it the best be implemented. This program would include an entire day of activities including a recognition dinner. Finally, Dean Westerdahl pointed out that the school itself has many publications which could be used to publicize, or better yet, support the fraternity system at RPI.

In conclusion, one can see that the fraternities of RPI are a unique blend of diversity and unity possessing a great heritage that promises them bright futures. Indeed, it would seem that with all the fraternities have to offer not only to their members but RPI in general, that they are truly irreplaceable and through continued support from the Institute, the fraternities of RPI can only continue to improve. □

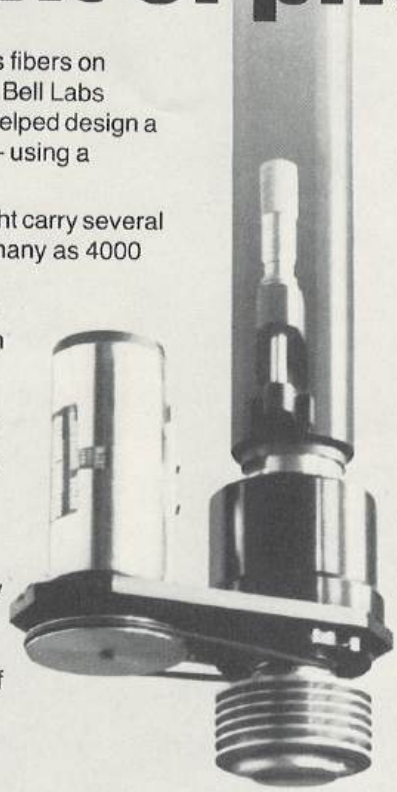
Advertisers' Index

Ray Jaeger wants to make light of phone calls...

by sending them through tiny glass fibers on beams of light pulses. To this end, Bell Labs ceramic scientist Ray Jaeger has helped design a new system to make such fibers — using a powerful carbon dioxide laser.

In the future, one hair-thin fiber might carry several phone calls within big cities or as many as 4000 long-distance calls. But many problems must still be solved. Ray tackled one of them — the problem of today's glass fibers, which contain impurities that absorb and weaken light beams. One impurity source is the conventional heaters used to melt glass rods that are drawn into fibers.

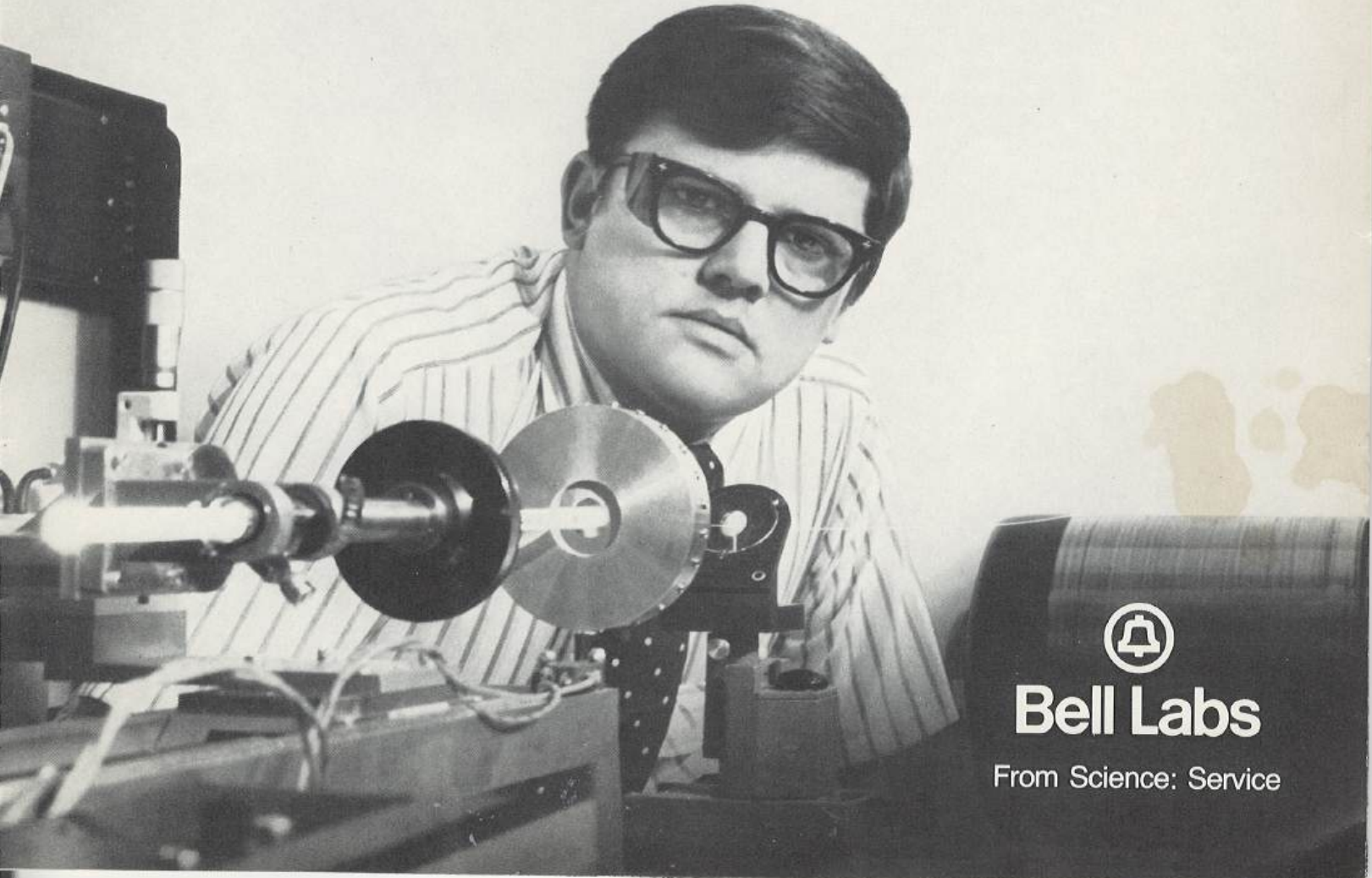
Ray had to find a "clean" heat source that also would be precisely controllable, to assure uniform diameter throughout a mile-long fiber. Using his broad knowledge of ceramic materials — he's a 1967 ceramic science Ph.D. from Rutgers — Ray studied many heat sources. But he finally explored a new approach: melt the glass rod with a carbon dioxide laser.



To make fibers, Ray had to devise a way of focusing the laser beam uniformly around the rod's circumference. He solved this major problem with a rotating lens and reflectors, to form a doughnut of radiation around the rod. Now Western Electric engineers are studying variations of such a laser system to develop the most practical manufacturing procedure.

To make optical communications useful, other Bell Labs scientists are working on ways of splicing glass fibers. And on better, cheaper, longer-lasting light sources and efficient ways of getting calls on and off light beams.

Although today's communications systems are more than adequate, someday there will be a need for the added versatility and capacity of optical systems. And the Bell System will be ready because of Ray and others like him.



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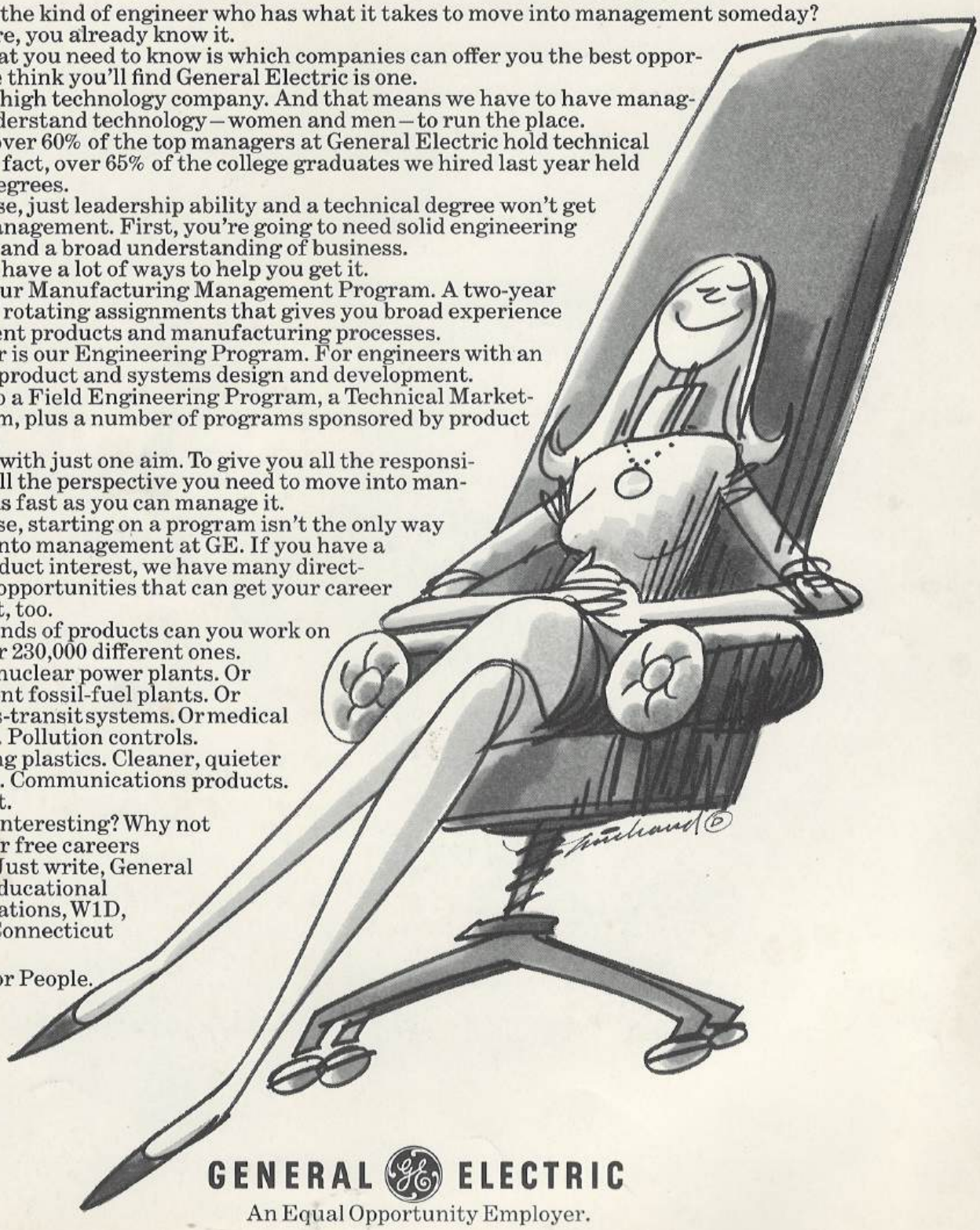

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