TECHNOLOGY and SOCIETY

IEEE

CONTRIBUTED PAPERS, REPORTS, REVIEWS, AND CORRESPONDENCE OF THE COMMITTEE ON SOCIAL IMPLICATIONS OF TECHNOLOGY

EDITOR: NORMAN BALABANIAN **VOL. 7, NO. 26 JUNE 1979 (USPS 321-090)**

CSIT HONORS VIRGINIA EDGERTON

Presents 1979 Award for Outstanding Service in the Public Interest

Virginia Edgerton receiving the 1979 CSIT Award from Steve Unger, Acting Chairman of CSIT at ELECTRO/'79 in New York, April 24, 1979.

IN THIS ISSUE

CSIT Awards Fund Urgently Needs Donations

A tax-exempt account has been established within the IEEE Foundation to receive donations to the CSIT Awards Program. Donations to this account will be used to fund the cash award (750 dollars per awardee) that goes with the *CSIT Award for Outstanding Service in the Public Interest.* Donations to support this award are urgently needed and are tax-deductible. Please be sure to make checks payable to:

IEEE Foundation Inc., Account no. 325.3

and send to:

IEEE Foundation, Inc.
345 East 47th Street
New York, NY 10017

A covering letter, stating that the donation is in support of the CSIT Awards Program should be included.

The *CSIT Award for Outstanding Service in the Public Interest* is intended to honor engineers who act to protect the public interest—particularly when such actions are taken despite personal risk. Readers are encouraged to direct any questions or comments about the CSIT Awards Program to the CSIT Awards Committee Chairperson: J. S. Kaufman, Bell Telephone Labs, Holmdel, NJ 07747; phone (201) 949-5241.

[Ed. note: The awards to the three BART engineers were funded through this awards program. The funds were provided through a single generous donation by an IEEE member who wishes to remain anonymous.]

IEEE TECHNOLOGY AND SOCIETY is published quarterly by the Committee on Social Implications of Technology of the Institute of Electrical and Electronics Engineer, Inc. Headquarters: 345 East 47th Street, New York, NY 10017. Subscription price: $2.00 per year, IEEE members only.

VIRGINIA EDGERTON

Award for Outstanding Service in the Public Interest Presented

J. F. Lindsey

The presentation of the Second CSIT–IEEE Award for Outstanding Service in the Public Interest took place at Electro '79 on April 24 in New York City. The recipient was Virginia Edgerton. The award consists of a certificate and $750 and is intended to recognize engineers who have, in the course of their professional duties, acted to protect the public interest, particularly where such action is taken despite personal risk.

The award session was chaired by Jeff Bogumil, a CSIT member, who introduced the speakers and also read a letter from Robert Saunders, IEEE President at the time of the investigation of the case. The speakers included IEEE President Jerome J. Suran, Executive Vice President Leo Young, past CSIT Chairman Malvern Benjamin, IEEE Member Conduct Committee (MCC) Chairman James Fairman, and current CSIT Chairman Stephen Unger, who made the award presentation.

In his remarks, President Suran noted that he would rather be making an award for a technical contribution rather than an award honoring an IEEE member for an act of personal courage. The present occasion, he said, is not a happy one, in that the act of courage we are honoring have not had happy consequences for Virginia Edgerton. It reflects adversely on our society where we hope individuals can exercise their social responsibility without fear of reprisal. He emphasized that IEEE was not assessing the correctness of Ms. Edgerton's technical judgment in the matter. If Edison and Von Neumann could be wrong in their technical judgment, Suran said, so could Edgerton. In fact, more than ever before, engineers need a degree of humility in their work, since the complexity of technological systems makes it impossible to guarantee 100 percent safety or certainty of operation. Suran expressed the hope that all engineers would feel free to exercise their professional and ethical responsibilities without consequences that would justify a medal and that, therefore, the IEEE would not be called upon very often to make awards of this nature.

Dr. Leo Young expressed the opinion that the presentation of the Award was significant for two reasons. First, members of the Institute may require courage to act in controversial situations, and second, the Institute is recognizing one particular act of courage. He stated that IEEE members must speak up on issues of public concern, and member's right to speak directly to the public after pursuing all available internal channels.

Chairman James Fairman, of the Member Conduct Committee, observed that CSIT had been instrumental in the development of this committee as a result of the pioneering investigative work on both the present case and the case of the BART engineers who had been the first recipients of the CSIT award.

Before presenting the award, current CSIT Chairman, Stephen Unger, said that the Institute should not consider the case completed since there is no evidence available that the technical problem raised has yet been studied or resolved. Moreover, Miss Edgerton has not yet received any apology. An invitation to Mayor Koch of New York City to attend the ceremony was answered by an Assistant who made no reference to the problem, despite specific references to it in the letter of invitation.

Dr. Unger then presented the Award to Virginia Edgerton. In her response, Ms. Edgerton said she dedicated the Award to all IEEE members who are going through an experience similar to hers but are not receiving any award. It represents a pledge by IEEE to our fellow men to protect them from equipment malfunction. She urged engineers not to be docile technicians and suggested three ground rules for engineering ethics: First, engineers will not do a particular job just because they are ordered to do so. Second, the deliberate design of malfunctioning equipment such that it can kill or harm is a crime, and ordering an engineering to do so is also a crime. Third, a person who commits this crime can be jailed.

The background information concerning the circumstances which led to the Award are as follows:

Virginia Edgerton, in her position as Senior Information Scientist in the employ of the Criminal Justice Coordinating Council of the City of New York, encountered a situation in May, 1977 that she judged might degrade the response time of SPRINT, the city's police car dispatching system. Should such a slowdown occur, the delay in responding to emergency calls would, over a period of time, almost certainly result in lives being lost.

The basic problem was whether the computer on which SPRINT was running could also handle a second system, PROMIS, a data processing system for prosecutors. Ms. Edgerton, who was involved in the installation of PROMIS, saw that no investigation had been made to determine if the increased load might slow down the operation of SPRINT. When she called this to the attention of Project Director, Sarwar A. Kashmeri, who was her immediate supervisor, he rejected out of hand her proposal that a careful study be made of the problem. After repeated efforts to pursuade him, and after he refused to consider a memorandum that she wrote on the subject, she sent copies to the membership of the Criminal Justice Coordinating Committee (CJCC), which constituted the next level of supervision. Mr. Kashmeri then (June 21, 1979) peremptorily discharged her on grounds of insubordination.

[The author is Assistant Dean in Engineering and Computer Sciences, Concordia University, Montreal, Quebec, Canada. H4B 1R6.]

Robert M. Morgenthau, USCC Chairman, went unanswered. Ms. Edgerton applied to the IEEE for advice and assistance. She was referred to CSIT's Working Group on Ethics and Employment Practice. A committee consisting of R. J. Bogumil, J. S. Kaufman and S. H. Unger (Chairman) carefully investigated the case, concluding that Ms. Edgerton had been unprofessionally treated and that her "action (at considerable personal sacrifice) was in the highest tradition of professionalism, in engineering." Subsequently, the matter was referred to the newly-founded IEEE Member Conduct Committee, chaired by J. F. Fairman, Jr., which reviewed the matter and further endorsed Ms. Edgerton's conduct. Their report was approved by the Executive Committee of the IEEE Board of Directors last fall and released for publication. This was support for IEEE members placed in jeopardy by their adherence to the IEEE Code of Ethics. Both reports appear in full in issue No. 22 of TECHNOLOGY and SOCIETY (published by CSIT), and a summary appears in the December, 1978 issue of *The Institute.*

There have since occurred several changes in the management of the PROMIS project (Mr. Kashmeri is no longer employed by the city) and it is not clear as to whether that system will ultimately share the same computer with SPRINT.

The first IEEE CSIT Award for Outstanding Service in the Public Interest was presented last year at WESCON to Max Blankenzee, Robert Bruder, and Holger Hjortsvang for their efforts, as engineers in the BART system, to protect the public safety.

ENGINEERING JOB STABILITY AND ECONOMIC CONVERSION

SEYMOUR MELMAN

There are two classes of reasons that compel attention to the idea of conversion from a military to a civilian economy—not as a moral speculation, but as a realistic prospect.

The first consideration is that, within the military economy itself, there are characteristically shifts of emphasis—among weapons, among the services—and these shifts of emphasis take place in an environment that has certain special characteristics. For example, in the aerospace industry, as ordinarily understood, there prevails to the recent moment about 55 percent unused industrial capacity, where that refers to physical plant, equipment, and the presumably available work force. This means that, even within the framework of a military planned outlay for the fiscal year 1980 in the order of $125.8 billion, it may be anticipated that there will be substantial blocks of unsued capacity within the aerospace industry. Accordingly, shifts of contracts, shifts of requirements, and the like can be carried out with ease by the Department of Defense. But those shifts, while appearing to be within the framework of an aggregate large military expenditure, nevertheless impose severe hardships on particular localities and on particular firms; in a moment I will illustrate that in some fine detail with respect to the events that accompanied the cancellation of the B-1 bomber program.

There's a second kind of consideration that compels prudent attention to the idea of conversion from a military to a civilian economy, and that is that such conversion is probably indispensable to coping with two sets of national economic problems, and with one military problem.

The economic problems are, first of all, the condition of depletion—that is to say—technological deterioration finally resulting in the economic non-competitiveness that prevails today in many U.S. industries. At the core of this condition is the fact that even a country as large and as rich as ours still has a finite stock of technical brains and hands and a finite stock of the set of resources which, taken together, we ordinarily call capital. The consequence is that, when civilian industries in substantial numbers are denied these resources, it starts to show after awhile. It is observable in such effects as: 50 percent of the shoes manufactured for men's use in the United States now being manufactured *abroad;* 20 percent of the steel industry products made *abroad;* 20 percent of the automobiles made components made *abraod.* I don't think you can buy a cassette recorder made in the USA at any price. I don't know of the existence of a factory making radios in the United States—they're gone! We used to take students to visit the Emerson Radio Company in lower Manhattan; then it moved to New Jersey; and then it disappeared. It is also a fact that a considerable proportion of electronic equipment and other instrumentation used in scientific laboratories was once a great American specialty, as in the case of electron microscopes. I don't believe you will find,

---

[Text of a talk delivered in Farmingdale, NY, May 17, 1979, at a joint meeting of the IEEE Long Island Section and AIAA. The session was organized by Stan Roth, chairman of the L. I. Section's Professional Activities Committee, and Steve Yaros, chairman of AIAA's Career Environment Committee.

Dr. Seymour Melman is Professor of Industrial Engineering at Columbia University and he is co-chairman of SANE. He has written numerous books, including Our Depleted Society *(1965),* Pentagon Capitalism *(1970), and* The War Economy of the United States *(1971). His most recent article, "Beating Swords Into Subways," appeared in* The New York Times Magazine *in November 1978. Dr. Melman's main areas of concern are the impacts of American militarism on world peace and on America's industrial productivity.]*

in any research laboratory you may enter, an electron microscope of recent vintage that is made in the USA.

So it is not quite the case that we have done high technology across the board and the lesser activity in production has been left to other countries. In fact, our terms of trade with Japan are rather peculiar in terms of that expectation. Thus 80 percent of our exports to Japan consist of soybeans, wheat, corn, timber, coal, while their exports to the United States consist of the familiar set of smart, well-designed optics, electronics, vehicles, household durables, kitchenware, and the like. Indeed the present pattern really looks like that of the trade relationship between an industrialized country and an underdeveloped society, in which the United States appears in the unenviable position of the latter. This fact was rubbed in at an industrial meeting two years ago where, over drinks, a Japanese visitor suggested to one of the American colleagues, "Why don't you people concentrate on the things that you're good at—like agriculture, extraction, and forestry—and leave manufacturing to us?" And why not? The "why not" of course is that, in order to live, a community must produce.

The second kind of economic problem is how to deal with the present unpleasantness called inflation. In a study at Columbia University entitled "Inflation Under Cost Pass-along Management," Dr. Byung Hong demonstrated with statistical precision that the overwhelming part of the price variation of manufactured goods from 1966 to 1976, quarterly data, could be accounted for in terms of the changing conditions of cost within manufacturing firms, which were concurrent with the dramatic drop in the rate of productivity growth in U.S. manufacturing industry as a whole. In consequence of which, U.S. firms were no longer able to minimize cost, lacking the cost-offsetting capability given by productivity growth; and so they moved as though in concert from cost minimizing to *cost pass-along*. And so cost increases plus a profit margin were added to price, and as that pattern took hold very widely, as it did within manufacturing, it produced a rate of price increase to the unpleasant degree that we call inflation—that is to say, the rate of price increase exceeded the savings bank rate of interest.

This inflation mechanism cannot be dealt with, except by sharply increasing the rate of productivity growth. During the period studied, the United States and its manufacturing firms experienced the lowest rate of productivity growth in their history, and the period 1965 to the present day has seen U.S. industry with an annual rate of productivity growth that is the lowest of any western industrial country. A reversal of this process is indispensable for any coping with an inflation process.

There's another kind of consideration that necessarily will call attention to a requirement for economic conversion, and that is: There may very well be international agreements that would curb—not to say reverse—the arms race. And this possibility would be addressed in some foreseeable future owing to a set of considerations not presently discussed—but bound to be increasingly discussed—namely, that there are *limits* to military power. Thus, with nuclear weapons and delivery systems available to quantity, no one knows how to *specify* a condition of military advantage, let alone how to actually design, produce, and wield it. Whatever else may be said about these considerations, this much can be put in a very modest way: There is with assurance no science that allows us to exclude the prospect of these considerations from looming in importance.

Accordingly, I want to turn to bits of experience that shed light on our capability and our incapability to do this process called *economic conversion*—meaning the redirection of resources, human skills, equipment, plant, land, and the like to produce civilian—as contrasted to military—products. A year-and-a-half ago, in the course of preparing an article subsequently done for *The New York Times Magazine,* I visited a number of military industry plants. One of them was the Los Angeles Division facilities, outside the L. A. Airport, operated by Rockwell International, which facilities were the headquarters for the B-1 bomber project.

On the day in June when President Carter announced for the first time that the project would be terminated, there were 5000 production workers, 5000 engineers, and 4000 administrative staff of all sorts employed in those facilities. It was a further characteristic of that set of operations that no party involved—not the management, not the engineers, not the production workers, not the unions, none of these bodies—had ever considered the possibility of being required to think about doing anything other than the B-1 bomber. That resulted in a remarkable set of disorderly conditions following upon the announcement of termination of the contract. For example, persons arriving at the plant to take up employment were greeted with the advice that the invitation was cancelled. Persons who had already been formally employed were immediately in propsect of layoff. Several persons who literally were loading up the family goods in the van in the midwest somewhere received hurried telephone calls advising them that the employment in prospect was off.

There were no proposals, no plans, no prospects for any other work in those facilities. In discussing this, the management stated to me that the absence of plans for any alternative work was a matter *of principle.* That is to say, *in principle* they would not do such planning. To my question "why?", they answered: "Because we wish this division to be in the service of the Department of Defense. We are accustomed to dealing with the Department of Defense, and if any work should come to the firm of a civilian sort, we wish that to be allotted to a civilian-oriented division of the firm. We are oriented to serving the Department of Defense." And indeed comparable statements were made to me by engineers and by production workers and by their union officers.

The managers were in an especially interesting position because the unit was allotted a contract termination set of grants, which one estimate at the time had it amounting to about $700 million, and that's a comfortable going-away present or change-of-plans present; that is, you can do something with that kind of money by way of wrapping up the existing tools and equipment and residual raw materials, and putting aside a kitty with which to sustain a cadre of managerial staff. And indeed, as I examined the data and the plans, it emerged that there was an inverse relationship regarding layoffs; that is to say, the management, fewest in number, also had the lowest *proportion* of layoffs; the engineers and production workers, greatest in number, had the greatest proportion of layoffs, the effort apparently being made to retain a cadre of only 10 to 20 percent in the case of engineers and production workers. The production workers, for their part, also had no plans for doing anything else. In fact, the very idea of thinking about an alternative activity had never occurred.

Among the engineers exactly the same was true, but here I should detail some other characteristics. I interviewed a number of these men and wrote essentially short professional biographies from the information that they gave me. The characteristic pattern looked like this: 20 to 25 years experience in aerospace engineering; average number of employers—10 to 15 through that period. In consequence of which: No seniority that was meaningful in terms of pension rights or the like with any particular firm. One person did have some pension rights with a firm, but it was a trivial amount; that is, the amount would be a fraction of what would be his allotment, say, under social security payments. So these men with 20 to 25 years professional experience had no income prospect other than their current salary. Some had attempted to do investments with greater or lesser success—mostly lesser—with substantial losses having been incurred in securities buying and selling.

It was also the common experience of the engineering group that those who had attempted to find civilian employment had had difficulties as follows: Consider the case of one man who was highly specialized in the design for and fabrication of high-strength, lightweight, high-stress-capability airframe skin parts and structural members. He appeared at certain automobile-manufacturing firms, who swiftly assured him that his set of skills was not clearly applicable to the automobiles they were then producing or contemplated producing. That is, in no conceivable circumstance would titanium alloys be employed in any such vehicles, and therefore the skills required in designing for and fabricating those were simply not to be contemplated.

I was very interested to see if there was even a trace of indication among these men, who were, after all, well-educated and very knowledgeable men—that is, the human material was, in ordinary understanding, high-grade in each case: among the management, among the engineers, and among the production workers—I was interested to see whether there was any trace of an idea about doing something for themselves along these lines. After all, the management was a coherent, organized group; the engineers certainly were—they were even in the process of unionizing; and the production workers had a formal union. So you see it wasn't the case that the men in any of these occupation groups had stood along, as isolated individuals. And so I ventured to inform them of the recent history of the Lucas Aerospace Division in England.

Lucas is a large, multi-division, multi-product firm that may be perhaps best known as making virtually all the electrical components for British automobiles. But they also have an aerospace division of substantial size, and about two years ago the word was out that the aerospace division might be coming into hard times. Well, one of the responses there was that the organization of workers and the organization of engineers got together at the plant level to think about what might be done. And they decided after some deliberation to undertake a series of investigations on what products they might produce with the labor force and the sorts of equipment and plant that they had available there, and which products would be commercially feasible—actually saleable. They proceeded to do this, and they discovered an enormous fund of imagination and ingenuity among the engineers, the technicians, the production workers—all classes. And so there developed an altogether unprecedented product—namely, a *Lucas corporate plan,* built up in elaborate detail in a multi-volume set of reports, giving data and new product designs, complete with estimates of production cost, production capability, resources required for production, and market prospects.

They approached the management with a fraction of this output, and the management was rather taken aback. But the idea was made public in rather short order, since the government in England had been proceeding to take various kinds of responsibility for full employment. It had a certain kind of resonance in the British press, among political people, and others. The point for our present discussion is that here is a case of an aerospace industry group very much like those of us assembled here—no real difference in terms of quality of people, education, backgrounds, professional interests—taking the unprecedented step of formulating a plan for alternative work and undertaking that initiative on their own and independently of the management.

Well, I have discovered from various inquiries that there has not been just yet any initiative in the United States—not of quite the same sort—but I did find some other things in the United States that are relevant here. Thus after some inquiries I found myself in the plants of the Boeing Vertol Company, a few miles outside Philadelphia along the Delaware River. Boeing Vertol had been, as many of you surely recall, an important producer of helicopters, especially large military-serving helicopters of the Chinook class, and they fell into bad times as the Pentagon preferred other sources of supply for further contracts. The Boeing Company looked into the possibility of doing something else, in transportation equipment especially, and so a project was started finally, and capital investment was made, to go into the business of making subway cars and trolley cars. And indeed, working with the federal government and in concert with the offices of various cities, Boeing Vertol participated in the design of what it was hoped would be a standard new-type trolley car, there having been no trolley cars designed or manufactured in the United States for 25 years. The expectation was that the federal government would fund, during the next decade or two, the purchase of electrically-powered urban and inter-urban transit systems. The light-rail vehicle looked rather attractive, since it could be set on rails and the land cost was small; the cost of laying the rails looked rather attractive compared to the cost, say, of superhighways, and the prospect of mile-a-minute transportation in modern, comfortable vehicles seemed an attractive prospect.

Actually, no serious federal commitment of a long term followed. The federal government—the Department of Transportation—did offer subsidy funds to certain cities, but these were translated in only two places—in Boston and in San Francisco—into serious orders, altogether totaling about 250 to 300 trolley vehicles, to Boeing Vertol Company. Other subsidies to other cities were permitted to be spent on non-standard vehicles, which opened the way to foreign producers who managed to seize the field rather nicely on a price-competitive basis. So no clear market appeared.

But let me put aside the idea of the clear market and turn to some of the internal problems that surround the Boeing Vertol effort. (I will now address myself in particular to the experience concerning the trolley cars, not the subway-type vehicles, and I do so underscoring that I'm giving special emphasis to this in order to bring out a series of considerations that are important in contemplating the whole idea of economic conversion.)

The management entered into this activity with the self-understanding that they were "the bearers of high technology" (their language), and that therefore little difficulty could be possibly experienced as they attempted to design a ground-located, relatively-slow moving vehicle to be operated in the limited space as bounded by a set of steel rails. In the course of designing, therefore, they attracted a team of engineers with experience mainly in aerospace, and no attempt was made to hire a team of engineers from some country where there had been no 25-year gap in the design and manufacture of such vehicles—in other words, no Japanese team, no German team, was brought in as bearers of the requisite design and production competence for this type of product. At the same time, the management saw themselves as carrying out what they called a systems engineering function; that is to say, they would design a product and then seek out the major components from various suppliers, and they would assemble them in some appropriate way. Hence, they would design and they would sell the *system,* leaving the manufacture of the components, as much as possible, to various already-established producers. It's also of moment that the management did make an effort to study the state-of-the-art in this field, but this effort consisted of dispatching a team of engineers to various places in the world where such vehicles were in use and where they were being manufactured. So they were industrial tourists, so to speak, and they visited the principal locations to pick up such know-how as one could acquire in the course of such a tour.

As the unit was developed, it was a 75-foot vehicle with allowance being made for bending at the center, and it was designed to ride on three main trucks—one on the forward unit, one on the rear unit, and one at the bending center. The unit was—and is—very attractive in appearance; it's long, it's sleek, the windows are large, it is air-conditioned, it operates quietly, there is considerable passenger comfort. The motormen competed for being assigned to these vehicles, because the motorman's position was comfortable, there was ease of control, there was none of the rattling to be found in the 30- to 50-year-old subway cars then in operation in Boston.

There were to be 30 suppliers of principal components, among whom were suppliers from Germany, Japan, and the United Kingdom. Interestingly enough, the main frame of the vehicle—being composed of steel plates welded together—the main frame was welded together in Yokohama, was hoisted onto a freighter, and was taken across the Pacific, through the Panama Canal, up the East Coast, up the Delaware River, and unloaded on the dock at the plantside; this being a reflection on the apparent inability to find steel fabricators—say within a mile—who would be competent to do the requisite work and deliver without anything remotely comparable to the transportation costs that were involved. There were various problems involved in the fact that these suppliers were from distant parts. That is to say, no assurance could be given of continuity of availability of various components from these very disparate suppliers.

There was no systematic effort to design for ease of maintenance. Thus it was necessary to use acetylene torches to disassemble certain parts, which with appropriate design should have been removable with a few turns of a set screw. Parts had to be gotten access to through indirect means and with great difficulties; it's as though you had to have a contortionist as part of the maintenance crew, whereas the requirement ordinarily is for ease-of-access, slide-in slide-out capability for important parts. Also, there being at once great confidence in being bearers of high technology, and being under pressure for early delivery, the management permitted itself to promise delivery at schedules that permitted no prototype testing whatsoever. Accordingly the prototype testing, if we may call it that, was accomplished by production vehicles delivered to the customer.

In point of fact the vehicles performed from the consumer point of view, as they functioned, very handsomely—comfortably, quietly, quick-moving, smooth. Indeed, the passenger traffic rose 19 percent on the lines after they were introduced. But the conditions that I outlined before also yielded unreliability of a rather gross sort, so that breakdowns were unsatisfactorily frequent, and it has proved impossible to date to obtain the 80- to 90-percent vehicle service availability that normally would be required. Also, a series of components functioned in ways which could have been either anticipated or certainly discovered in the course of servicing. I will illustrate with an important example—the doors. The doors on a trolley car (unlike those, say, on an aircraft, by way of comparison) must open and close very frequently—that is, many, many times per hour of use. Boeing Vertol wanted a door that would be sensitive so that, if a person's arm or some parcel were intervening, the arm or parcel would not be crushed. So it was specified that a door that would be pressure-sensitive was required, and the British firm that was sub-contracted to do that work did design such a door. However, its sensitivity was such that it was sensitive to itself; that is to say, as the door proceeded to close on itself, it was sensitive to its own touch and proceeded to open once again. Indeed, so exquisite was that sensitivity that there was the understandable problem of vehicle availability under those conditions. The door was removed, handed over to another firm for redesign—the specification then being given that it be composed of not more than half as many components as the previous door—and the problem was corrected.

Boeing Vertol stood behind its product. But standing behind the product meant at one moment dispatching a team of 30 engineers, technicians, and skilled workers to the Boston area, working in the shops of the MBTA (the Massachusetts Bay Transit Authority), and carrying out not only parts of maintenance, but the fixes, *mostly small ones,* that had to be made in various components to bring them up to acceptable reliability. All of which fixes could and should have been carried forth as a consequence of a proper prototype testing, which never happened.

There was an awkwardness with respect to replacement parts inventory, but it should be understood that this was necessarily related to the previous practice—that is to say, the absence of prototype testing. Hence a reliable basis for judging the reliability of principal components did not occur, and therefore there was no basis on which to judge the requirements for an inventory of spare parts in order to competently service the vehicle fleet that had been produced. In the absence of a rationally-calculated inventory of spare parts, there was then an absence of many components. The operator of the vehicle, seeking to keep a requisite number of cars in motion, was then driven to cannibalize. Now a cannibalized vehicle of that sort becomes a very expensive inventory, but desperate devices of this sort were necessary to continue the commitment to functioning.

All of which, I underscore to you, was part not of a random set of performances by a management or an engineering group; it was part of a set of performances by a management and engineering group which had not be retrained, reindoctrinated, for the requirements of producing a civilian type of vehicle to meet the cost, the maintainability, and the operating requirements of a civilian vehicle service. Unlike the Air Force, whose cost-of-maintenance records are at best cursory, the Massachusetts Bay Transit Authority is really strongly impelled by the costs and requirements of maintenance. Unlike the Air Force, the Massachusetts Bay Transit Authority operates under the whiplash of relating its income to its necessary outgo. They are not in a position to turn to a Congress with an indefinitely large competence for allocating new blocks of capital. There has to be some semblance of relation between the income and the revence service that is required.

The management of Boeing Vertol saw no need for carrying out a retraining of that sort; no need for teaching itself the idea of managing in the civilian environment; no need for retraining the engineers to design for cost minimization within stated constraints of service requirements. In consequence of which, this set of events has certain recurring characteristics somehwat reminiscent of the C-5A. However, the C-5A did not—and cannot—bankrupt the Air Force. But a fleet of vehicles of this type *can* financially embarrass a civilian transit authority, which operates with its costs and revenues in full public view, and whose vehicles suffer delinquencies not behind barbed-wire fences but with the ordinary public riding them, being discommoded by them, and knowing all about them when irate citizens—including journalists—proceed to describe in full detail the nature of the deficiencies as they arise.

The message—the inference—to be drawn from this experience, which I give you as illustrative, is the following: That *there are statable requirements for carrying out conversion from a military to a civilian economy.* Indeed, an attempt has been made to build these requirements into a new legislative proposal, the text of which reached me this morning. It's a Senate bill, its number is Senate-1031, and it appears in the Congressional Record of April 26, 1979. It's entitled, "A Bill to Facilitate the Economic Adjustment of Communities, Industries, and Workers to Civilian-oriented Initiative Projects and Commitments When They Have Been Affected by Reductions in Defense or Aerospace Contracts, and so on, and so on...."

I will outline to you in a nutshell the strategy of this bill. The bill provides for three major components:

One. The establishment of a national commission, personed at cabinet-member level, whose principal duties are twofold: Number one, to prepare a handbook offering strategic advice on how to carry out, how to do, conversion planning. Second, to see to it that major departments of government draw up capital investment plans on a large scale as to constitute new markets and new job opportunities along civilian lines. There's nothing unusual or unprecedented about this. Lyndon Johnson did this on a giant scale in January 1969—his last act in public office—as he published *The President's Economic Report,* which contained an appendix called "The Economy After Vietnam," which appendix included an agenda of new capital investment projects to be carried out following the hoped-for end to the Vietnam War; and that agenda of new capital projects amounted to $39.7 billion of new expenditures per year. The anticipation was that that list of items would constitute biddable, producible goods, services, and the like, which persons engaged in the military sphere could potentially participate in.

be different certainly from the ten-year-old agenda. It would, assuredly, contain high priority to railroad systems, light rail vehicles inside cities, making it possible for example for someone to travel from the vicinity of Columbia University to this location on Long Island swiftly, conveniently, at modest cost, by public transportation. It would surely include considerable expenditures for water supply, for waste disposal, for cleaning up the rather enormous accumulations of chemical wastes that we've heard about. It would include, in other words, a series of projects whose character would include major requirements of capital equipment, major requirements for engineering design, major requirements for capital goods production, installation, and operation. Furthermore, if this were to be extended, as is only prudent, to such matters as say waste disposal in cities on a grand scale, and if this were to include the reasonable refurbishing of a housing stock (half the housing stock of New York City is by reasonable standard eligible for refurbishing—not tearing down and redoing, just refurbishing, but serious refurbishing), the consequence would be an agenda of capital investments that would occupy the entire work force of the United States to the end of the century. Indeed, the prospect would easily be a shortage of skilled labor of every class far into the foreseeable future.

The second part of this bill—and perhaps its strategically important part—establishes the requirement that every military industry firm and military base shall establish an alternative-use committee, composed 50 percent of persons named by management and 50 percent of persons named by the people employed. And it is the obligation of this committee to prepare an alternative-use plan for that facility, making use of the people, the facilities, the land, the competence developed there, and orienting to possible plans for producing other products. (You see how this meshes together with the prospect of major new capital outlays.) This activity would be paid for by a fund made up on a per-capita basis depending on the number of employees in the plant. Thus, if one were to allot say 50 dollars per employee, and there were a thousand employees, there would be a 50-thousand-dollar fund which such a committee could draw on for any additional talent and requirements of knowledge or expertise that they would require for their task.

There's a third part to this bill. The third part is setting up a series of backstops on the contingency that even the best-drawn plans for economic conversion will not work or are really unfeasible under certain conditions. Shall I illustrate? Well suppose a particular alternative-use committee really repeats the Boeing Vertol experience. It won't work. That is, they'll design a vehicle, but if they stay with the series of limitations that I described it will become unsaleable in a few years. So the plan really wouldn't work. Well, there's another kind of circumstance of nonworking. Consider a rocket test facility out in one of the desert or near-desert areas of the Far West. There really isn't much you can do with a big rocket test facility. That for other purposes. There aren't many people living around, so it's not useful as an industrial park, as a school site, as an airport—you know, as any one of the other things that can be done with a set of established facilities with an infrastructure and services.

To deal with these cases, the bill would stipulate the following: First, that retraining funds are provided for—indeed retraining for the managers and for the engineers is made mandatory—as part of the operation of the alternative-use committee in planning. That is to say, as an alternative-use committee goes into motion, part of its task is to set up technical and managerial retraining for the appropriate persons in these occupations—that is, to orient them to the requirements of performing effectively under the conditions and constraints of the civilian economy. A second stipulation is that, where there is no alternative-use plan and people are laid off, then income up to 90 percent of previous salary becomes available for as much as two years. Third, there is insurance against medical calamity and there are funds provided to enable persons to relocate in terms of homes and the like.

Well, I don't consider the present draft of this legislation—though it bears five eminent signatures and in due course will no doubt assemble another 25 to 30 as sponsors—I don't consider this necessarily as the last word on the subject. The matter will surely go to hearings. It will surely be dealt with—and deserves to be dealt with—and indeed the reason I'm calling it to your attention is to leave this suggestion with you: Why don't you get copies of this bill? Why don't you *look* at it and ask yourself: What's in it that makes sense, and what's in it that makes nonsense, as far as you're concerned, and what recommendations would you make? And I issue this invitation to you: I am prepared to receive and to take very seriously your proposals and to bring them directly to the attention of the members of the Senate and the staffs who are involved. I have long been involved with helping in the design and preparation of this legislation, and I take very seriously the input from professionals like you. I invite you to consider this matter. I invite you to deliberate on it and to draw up serious comments with respect to your professional interests as you see them with respect to this kind of legislation.

Thank you very much.

[Ed. Note—To receive a copy of the bill, S-1031, write to your U.S. senator at: Senate Office Building, Washington, DC 20510. Comments concerning the legislation may be sent to Dr. Seymour Melman, Room 304, Mudd Building, Columbia University, New York, NY 10027.]

"LARGE DATA SYSTEMS IN OIL AND GAS EXPLORATION"

As a part of the 1980 International Symposium on Circuits and Systems, the Institute of Electrical and Electronics Engineers in cooperation with the American Association of Petroleum Geologists and Society for Exploratory Geology announces a one-day colloquium on "Large Data Systems in Oil and Gas Exploration." This will be held on Monday, April 28, 1980 at the Shamrock Hilton Hotel in Houston, Texas. Through a series of invited talks, the colloquium will present and discuss modern concepts in petroleum exploration. The operational emphasis will be on a serious dialogue between the attendees from the disciplines.

The MORNING SESSION will be devoted to the Seismic Data System, and will focus on the overall imaging concept as well as migration and modeling. This session will begin with a special paper on the key geologic premises for the habitats of hydrocarbon.

The AFTERNOON SESSION will have a synergistic theme in recongition of the fact that exploration decision-making is becoming increasingly dependent on the comprehensive use of surface and borehole geologic/geophysical data, and that digital computers are playing important roles in handling the large data bases needed for this purpose. The applications of Well Logs in Exploration will be the special topic of this session.

Direct inquiries to the Colloquium Chairman: Dr. Kamal C. Jain, Shell Oil Company, P. O. Box 831, Houston, Texas, 77001. Telephone (713) 241-3367.

Session Review

THE ENGINEER AND PUBLIC POLICY: SERVANT, GUARDIAN, GADFLY?

REVIEWED BY NORMAN BALABANIAN

This was the title of Session 7 at Electro/79 in New York on April 24, 1979. The session was organized by IEEE's Joe Casey and chaired by IEEE Member Conduct Committee Chairman James F. Fairman.

The speakers were charged with responding to the following questions: How can engineers safeguard the health, safety, and welfare of the public, and how can they influence policy in these areas, in view of the fact that most engineers are employees and their professional responsibilities lie primarily in the realm of designing products and performing specific services? The speakers and their titles were:

1. Public Policy—Rational or Irrational, Eric A. Weiss, Sun Company, Radnor, PA.
2. The Right of Technical Challenge, Virginia Edgerton, Intelligence Technology Resources, NY, NY.
3. The Engineer—The Problem Solver, Samuel C. Florman, Kreisler, Borg, Florman Construction Company, Scarsdale, NY.
4. Informed Consent?, Robert J. Baum, Center for the Study of the Human Dimensions of Technology, RPI, Troy, NY.

1. By way of preamble, Eric Weiss, the first speaker, commented on the ceremony held in the preceding hour at which the CSIT Award for Outstanding Service in the Public Interest had been presented to Virginia Edgerton. He said that the unpublicized nature of that event was an IEEE "indignity" because the award "Should have been presented at the $15 luncheon and with full publicity, but the IEEE is—as usual—a coward." [After that preamble, the rest of the presentation was anticlimatic.]

Eric Weiss's basic message was that before engineers address questions of public policy, they should first learn what the public is and what its concerns are. One way to do this is by intelligent use of public opinion polls. He presented a number of propositions: (a) The public is in overall charge; like an active board of directors, it sets directions. (b) The public is not a child; it's opinions are not infinitely malleable, as public relations people believe. (c) The public mistrusts large institutions, including government, business, and labor. (d) Opinions of the public are more influenced by actions than by words. If the words are different from the deeds, the difference is ascribed by the public to an attempt at deception.

2. Virginia Edgerton outlined the problems encountered by employed engineers when faced with conflicts between the dictates of management and perceived defective engineering designs. She summarized a number of noteworthy cases in which individuals acted in ethically and professionally responsible manners, calling the attention of management to potential hazards to the public. Almost invariably, the individual's life and career were adversely affected. The high cost of *not* going public and being satisfied with writing an internal memo or two is dramatically illustrated by the DC-10 case.

She then summarized and refuted the many arguments often given as to why engineers should not act in accordance with ethical principles and professional responsibility. These include:

(a) Figuring out what's ethical is not my job.
(b) If I don't do it, someone else will.
(c) I don't have enough wisdom to know what's right.
(d) There are too many variables for me to deal with.
(e) Engineers are just problem solvers, not goal-setters.
(f) If engineers act in principled ways, organizations will be destroyed; chaos will result.

(g) Improving defective designs will make products too expensive.

And, finally, she outlined some steps that might be taken:

(a) Get public backing for "the right of technical challenge."

(b) Get greater understanding by engineers of their ethical responsibility.

(c) Develop deterrents to arbitrary actions by management, e.g., by providing protection to whistleblowers.

3. Samuel Florman cast himself as the "heavy" and came down heavily against "the new ethics," "the new professionalism," or "techn~~iques~~ ethics," as he variously called it. He said that even as an ideal, the first canon of the revised (1974) ECPD code is insidious. This canon reads:

Engineers shall hold paramount, the safety, health, and welfare of the public in the performance of their professional duties.

Florman denigrated the ethical concerns he said he had heard expressed by many engineering students who asked him what they should do if their boss should tell them to do something (like design a product they believe to be unsafe) which they think is immoral. When do I blow the whistle for the public good, they would ask? He said that this represented fuzzy thinking. In the activities in which most engineers are engaged, "even the lowliest person is heard. The average superior does not make arbitrary decisions without taking account of the opinions of people technicaly below him," he asserted.

He then proceeded to give many of the reasons the previous speaker had already refuted as to why engineers should not act in ethically responsible ways, and added a few more reasons; the most notable of these was economy. "In a world of limited resources, economy is a moral good," said Florman. So, the ethical concerns of engineers for public safety should not vitiate the principle of economy by increasing the cost of a product.

As for permitting ethical considerations to influence the work an engineer will perform, Florman contended that "professionals should serve." "If each person is entitled to medical care and legal representation," he said, "is it not equally important that each legitimate business entity, government agency, and citizens' group should have access to expert engineering advice? If so, then it follows that engineers (within the limits of conscience) will sometimes labor on behalf of causes in which they do not believe."

Taking a stand at variance with many corporate executives (of which he is one) Florman said that he welcomed codes, regulations, laws and guidelines in accordance with which technological decisions would be made. And when they do not exist, decisions should be made by management based upon standards of legal liability. It is poor policy, he said, to rely on conscience and wisdom of practicing engineer when it comes to questions of public safety. "The whistle-blowing dilemma has received attention all out of proportion to its importance."

Florman made a distinction between engineers who are "creators" and those who are "guardians." The latter are "public service engineers....working for a government agency or some public interest group....whose assigned task it is to protect the public interest." Florman doesn't want an individual engineer working for Ford to decide what a safe car is; the same with nuclear power and other fields. He wants regulators and inspectors. Furthermore, "an individual engineer can move back and forth between the two roles" of creator and guardian.

"Just as ethicists have failed to distinguish between creators and guardians," said Florman, "they have confused the functions of solving problems and establishing goals." The engineer is a problem solver, not a goal setter, even though he may enjoy "a feeling of importance with being called a shaper of culture....He should work within parameters set by those who establish goals."

Florman sees as dangerous the use made of the "new ethical crusade" by "reactionary forces" in business and the professional community "who, in the guise of moral concerns, sees a welcome opportunity to strike back at the government controls they detest and fear." These forces on the right, together with the ethicists on the left, are attacking the one policy which is our best hope, namely, "the painstaking development of rules and regulations equal to the ever-increasing complexity of our technology." "This is a never-ending task," says Florman, "that people don't want to face up to, but say if only engineers would follow their consciences, our complicated problems would go away. The world's technical problems cannot even be formulated, much less solved in terms of ethical rhetoric. Especially in engineering, good intentions are a poor substitute for good sense, talent, and hard work."

4. Robert Baum summarized the evolution of codes of engineering ethics from the first AIEE code in 1912—which held that the engineer's first responsibility was to client or employer—to the latest ECPD code, which requires engineers to hold as paramount their responsibility to the public. He disputed Florman's contention that everyone is entitled to engineering service in analogy with legal or medical service. There is a disanalogy between medicine and engineering he contended because the ones most affected by the work of an engineer are not necessarily the client or employer, but members of the public. It is the general public that is the "patent" of the engineer.

Is it true that the public is in charge or control, as proposed by Weiss? Control is directly linked to information; without information, there can be no control. The public may have *power,* but not control without the relevant information. The fundamental principle involved here is the concept of informed consent. Even in medicine, the days of "doctor knows best" are over; the physician is not the one who is "in control" but the patient, whose instructions the physician follows after informing him/her of the consequences of various alternatives.

A principal responsibility of engineers is to provide information on the potential consequences of their work to all parties potentially affected by tha work. Their responsibility is not to decide whether their work is good or bad for the public. Two arguments advanced against this idea are: (a) There are no mechanisms for the general public to make decisions on the information provided, so why confuse matters? Even if this contention is true, it doesn't relieve engineers of the responsibility. The mere availability of the information might motivate and activate members of the public towards greater participation in the democratic process. (b) Things are so complex that the public can't understand the information and its implications. The same argument used to be advanced by physicians in support of their making the medical decisions and withholding information from their patients. After many costly malpractice suits, physicians have become very skillful in conveying the required information to their patients.

Baum concluded by recommending a modification in the IEEE Code of Ethics to include as a responsibility of engineers—or at least as a right—to make information about the potential consequences of their work available to all people who would be affected. "Virginia Edgerton acted with full professional responsibility in trying to get the appropriate information out," he said.

AUDIENCE COMMENTS ON FLORMAN'S PRESENTATION

A member of the audience disputed Florman's contention that codes and regulations, enforced by outside inspectors belonging to regulating agencies, were the answer to the production of defective products. In complex, evolving technologies, he said, not even a theoretical possibility exists of framing regulations that will cover all possible contingencies. The FAA couldn't possibly come up with a set of regulations that would guarantee a safe airplane. An agency couldn't possibly develop a set of regulations to cover all situations involving a complex real-time computer system. Even if this enormous handbook of regulations existed, the number of inspectors needed to certify such complex systems would equal the number of engineers actually doing the work. [In point of fact, agencies like the FAA, not having this number of inspectors, use employees of the manufacturer to certify that tests are satisfactorily carried out and inspections made].

In many cases, either an existing regulation does not cover the specific situation an engineering is facing, so the engineer has to make a judgment about it; or the regulation is being violated by the manufacturer and it is impossible for an outside inspector to know enough about the detailed design to detect the violation. Only the "creator" engineer can predict where the troubles are likely to be and can detect violations. Furthermore, even if adequate standards and regulations existed, and regulatory agencies had an adequate number of inspectors, Florman's solution would be inadequate because the regulatory agencies are notorious for working in the best interest of the regulated industry and not the general public. [One of the major reasons for this is the fact that regulatory agency personnel are most often drawn from the industry they regulate—and to which they later return. So it is ironic that Florman approves of engineers moving back and forth from regulated industry to regulatory agency].

The speaker favored having the best possible regulations, and having agencies to enforce these regulations in the public interest, but all this with the cooperation of ethically responsible engineers who would fill the gaps. Florman's only response was: "I would agree. In some fields of creativity, you get beyond where the regulations can be, and I would agree with you."

Another member of the audience questioned Florman's setting up the ethical concerns of engineers as antithetical to the goal of economy. He said that this counterposing was false because economy, or cost, is not an objective depends on what is subjectively included in the accounting system as a cost. To stick with Florman's profession, for example, reducing the insulation in a building under construction to make it narrowly economical to the builder may, in fact, make it very costly in energy terms to subsequent users and to society as a whole. Economy and professional ethics are not antithetical.

Florman's response was: "I agree that economy should be calculated properly, taking into account all factors." [But this concession argues against his original point on the issue.]

EDITOR'S COMMENTS

Samuel Florman is an accomplished speaker (and writer) with a good ability to turn a phrase. However, he has a tendency to set up "straw men," to caricature opposing arguments, for ease of knocking them down. He tends to ascribe to his opponents views they do not hold. Refuting the views he himself ascribed, appears to give his arguments some credibility. Of course, if he is challenged on this, he must concede the contrary view, as he did in response to two challenges from the audience.

Other examples abound in his presentation. "If only engineers would follow their consciences, our complicated problems would go away," he claimed that "people" (namely, those who champion engineers acting in principled, ethically, responsible ways) say. Since the position is clearly absurd—ethical conduct will not banish complicated problems—he seems to have won a march. But since no one has advanced the argument he shot down, Florman has contributed nothing to a meaningful debate.

"Good intentions are a poor substitute for good sense, talent, and hard work," Florman said. Now if those who applaud ethical behavior by engineers had claimed that good intentions are a fantastic substitute for talent, hard work, etc., Florman would have a point. Since no one is making such a claim, he has done nothing but knock down a straw man he himself set up. This might be good entertainment but does it contribute anything to the issues?

NEWS, NOTES AND COMMENTS

MAGAZINE STATUS FOR TECHNOLOGY AND SOCIETY

Over the past year, consideration has been given by CSIT to upgrading the status of TECHNOLOGY AND SOCIETY from Newsletter to Magazine. Among the obstacles noted by the Publications Board are: (a) the recent delay in the publication schedule, and (b) the insufficient number of articles of a technical nature.

The editorial staff has been working very hard to overcome the first of these problems. In a period of less than six months (January-July) four issues of TECHNOLOGY AND SOCIETY—a full year of publication—were published. By the end of 1979, we expect to have ended the publication delay. The second problem requires the help of our readers to overcome. We need your assistance in two ways.

1. As authors of articles on a wide range of topics listed in the March issue.
2. As referees of technical articles in these areas. (Technical papers published in an IEEE Magazine must be refereed.) We urgently ask our readers to volunteer their services as authors and referees. Please send your articles to the Editor and drop him a brief note listing the areas in which you feel most competent and comfortable to referee articles.

CSIT Proposed Amendment of IEEE Policy 14

CSIT proposes the following amendments to the New Policy 14 on IEEE Position Papers and Entity Position Statements which were adopted at the IEEE ExecCom and BoD meetings of February 14-17, 1979. The purpose of the amendments is to fairly represent to the outside world the various viewpoints held within IEEE on controversial issues, without unduly impeding the development of IEEE Position Papers or Entity Position Statements:

ENTITY POSITION STATEMENTS

1. Entity Position Statements must be circulated to all IEEE Entities.

2. Any Entity shall have the right to issue a Position Statement with a viewpoint different from that of other Entities.

3. When there are differing Entity Position Statements, complete or in preparation, each must include, starting with the second sentence, a sentence for each Entity with different view, indicating the existence of such a view, supplied by the Entity holding that view.

4. Whenever time permits, Entity Position Statements shall not be publicized outside IEEE until other IEEE Entities have had reasonable time to respond.

5. When time does not permit waiting for response from other Entities, the Entity Position Statement must be labeled "Preliminary" and must include the following first paragraph:

"This is a *preliminary* Position Statement by Entity X, which is one of N Entities constituting IEEE." (N to be supplied by IEEE staff). "It is preliminary because the remaining IEEE Entities have not yet had an opportunity to react to this Position Statement, or to exercise their right to develop a different position on the topic."

6. A preliminary Position Statement must be replaced, as soon as practical, by one including the responses of the other Entities. Use of the Preliminary Position Statement must then cease, and all references to it must be updated.

IEEE POSITION PAPERS

On IEEE Position Papers, Entities must be given the opportunity to append differing position statements (not requiring the approvals of #14.8B of Policy 14). In any use of the Position Paper, the existence of the differing position(s) must be elucidated.

CSIT Proposal on IEEE Employee Committee

The employment policies of IEEE with respect to its staff are not merely a means of obtaining the best possible services for the money spent, but can also be construed as an example of how IEEE expects an employer to treat professional employees, particularly electrical engineers. Indeed, the IEEE employer-employee relationship can serve as a test model of employment policies that the employed members of IEEE would like their employers to apply toward them.

In achieving desirable employment policies, two conditions should be fulfilled. One is that the benefits, both tangible and intangible, to the employer-employee partnership should be maximized. The other is that the division of the benefits among employer and employees should be fair.

The above objectives can best be achieved through a proper composition of the IEEE Employee Committee. The members of that committee should above all be committed to achieving these objectives. They should be sufficiently knowledgeable to recognize the many subtleties and tradeoffs in the employer-employee-outside world system. They should be willing to devote the time to acquaint themselves with the state of the art of enlightened employment practices and the desires of the IEEE membership. The membership of the committee should be broadly representative of the membership of IEEE, with no more than one member employed in a personnel capacity.

The Committee on Social Implications of Technology (CSIT) requests the IEEE Executive Committee to make its appointments to the IEEE Employee Committee in accordance with the above principles.

An Affair of Secrecy: On the Uses of Cryptography and Eavesdropping

RICHARD W. HARRIS

Because computer and communications technology can be the means to a multiplicity of ends, the questions arise: Which ends are appropriate? and, perhaps even more importantly: How do we decide which ends are appropriate? A recent and controversial series of events offers what I believe to be a paradigm of this problem of purpose.

'The Cryptography Affair,' as it was called in the *IEEE Information Theory Group Newsletter* of December 1977[1], intimately involved the IEEE. Recognizing that it is arbitrary to assign beginnings and endings in any continuum, we might say that the affair started during the preparations for the International Symposium on Information Theory held in Ithaca, New York in October 1977, and reached its conclusion with the publication of 'Privacy and Authentication: An Introduction to Cryptography' by Dr. Whitfield Diffie and Dr. Martin E. Hellman in March 1979.[2] The symposium was sponsored by the Information Theory Group, and the article was printed in *Proceedings of the IEEE.*

At issue were the new cryptographic techniques for guaranteeing communications privacy—techniques whose economic feasability could make them widely available to a large and rapidly growing body of users of electronic communications systems.[3] The question in 1977 was whether or not the new techniques ought to be made public; by March 1979 they has passed unhindered into the international realm. In 1977 some people saw the promulgation of the new techniques as a threat to national security; others saw the suppression of the techniques as a threat to free research and the right to privacy. In 1977 two questions came to the fore: When does a scientist or engineer have the right to communicate publicly? When does the public have the right to communicate privately? Now, in 1979, these questions have moved to the rear, where they are dormant, but not resolved.

National security versus personal and professional rights produced the spark that ignited the cryptography affair. On the one hand, it was feared that the promulgation of the new techniques would provide a valuable tool to enemy states and groups, who could make damaging use of secure communications. The National Security Agency had been monitoring telegraph and Telex messages sent into and out of the United States, and there was reason to believe that the loss of its ability to make communications scans might that cryptographic techniques represented a part of the United States' secret arsenal. In a letter[5] to Mr. E. K. Gannett, Staff Secretary of the IEEE Publications Board, Mr. J. A. Meyer of Bethesda, Maryland noted that the International Traffic in Arms Regulations existed as a method for controlling the effects of new technology on national security, and that scientists and engineers should submit papers on any technological topic that is covered by the ITAR (for example, cryptography) to the State Department for approval prior to dissemination. This letter was dated 7 July 1977, prior to the symposium to be held in October at Ithaca, where papers on cryptography were due to be presented. The Senate Select Committee on Intelligence recommended that the National Security Agency become involved in choosing which scientists and institutions receive Federal research grants in cryptology.[6]

Conflict arose, because it was feared that the right to privacy would be threatened by witholding the new techniques and allowing eavesdropping to proliferate, and that the right to free research would be endangered by governmental review and possible censorship of technological pursuits and publications.

The tone of the cryptography affair was set by a counterpoint between secrecy and scrutiny. In so far as the one is fostered, the other suffers; the wider the application of crytographic techniques, the more circumscribed becomes the effectiveness of eavesdropping techniques. Deciding how widely to employ methods for protecting communications means deciding which messages may enjoy the security of secrecy, and which must face the vulnerability of scrutiny. Promulgating the new methods leads towards security for all users of electronic communications systems. Reserving the techniques for exclusive employment by governmental intelligence agencies and the military entails security for the elect, but possible exposure to scrutiny for all other communicants—private and commercial users, besides enemy (or even neutral or friendly) states.

Just like the computer and communications systems to which they are applied, cryptographic and eavesdropping techniques can be the means to a multiplicity of ends. An international telephone call might be used to plan a family reunion or a terrorist meeting; a remote terminal and a host computer might exchange data needed for staging an assault on a new market by an expanding corporation or an attack on the United States by a warlike nation. Eavesdropping is as much a tool for bribery as for national defense, and the virtue of 'secret writing' depends very much on the goals of the author. There is, of course, no perfect balance to be struck between cryptographic and eavesdropping techniques, no way to foster all the good purposes and at the same time curb all the bad ones. Determining the domains of cryptography and eavesdropping means deciding which worthy purposes must suffer in order to stifle the baneful ones, and which baneful ones must flourish in order to protect the worthy. Perhaps even more important than the decision itself is the way in which

---

The author is employed by Programmed Control Corporation.

the promulgation as opposed to the restriction of the new cryptographic techniques, points inevitably towards the question: What is the most just and democratic process by which to judge personal and cultural purposes, to determine which are appropriate and which are not, and to weigh the constraint of the baneful against the nurture of the worthy?

The cryptography debate was inadequate, because it failed to address this question. Instead, it centered on a misleading polarization between national security and personal and professional liberty. 'Security' means, literally, 'without care' or 'without anxiety.' Expressed in these terms, the issues were private communication without anxiety over eavesdropping, public communication without anxiety over censorship, and a nation without anxiety about destruction. The debate focused more on what we want to be 'without' than on what we want to be 'with,' looking more towards what we have to fear than towards what we want to achieve. Security and liberty have in common that they are not ends in themselves, but are essential preconditions for the pursuit of human purposes. Our need for security and liberty—personal, professional, commercial, and national—stems from our need for an integrated cultural framework within which to pursue our aspirations.

Computer and communications networks are a burgeoning part of our culture, and the growth of these networks means a growth of power. Cryptographic and eavesdropping techniques can be the means for regulating—for enhancing or limiting—the potency of other information techniques. The cryptography affair represents the first time that a great many of the developers of information technology have been intimately involved in a dispute over the control of 'information power.' The problem of deciding how to use this power is a very difficult one. The solution cannot be left to a small group, no matter how benevolent, and neither can the problem be ignored. The tools to define the human purposes that might be furthered by information technology and to weigh them, one against the other, are provided neither by technology itself nor by bureaucracy. Any method for controlling the development and use of computer and communications technology ought to be based on thoughtful discussion and informed, public debate on the whole range of purposes to which the technology might be put. A tool's use cannot be controlled by its makers, but its misuse can cause it to rebound upon the community that developed it. The cryptography affair demonstrates the stake that the technological community has in a broadly based definition and evaluation of the spectrum of uses of information technology.

One step that the IEEE might take towards this definition and evaluation would be to sponsor a symposium on the uses and abuses of computer and communications technology, with speakers from engineering, from the social and natural sciences, from the arts and literature, from business and industry, from politics and law, and from religion and philosophy. Such a symposium would purposes of information technology. The creators of technology, those who provide the means, have a great deal to gain by fostering a mature, humanistic knowledge of the ends that their creations serve.

NOTES

1. 'The Cryptography Affair,' *IEEE Information Theory Group Newsletter,* no. 73 (December 1977): 5.
2. Whitfield Diffie and Martin E. Helmann, 'Privacy and Authentication: An Introduction to Cryptography,' *Proceedings of the IEEE* 67, no. 3 (March 1979): 397–427. Includes bibliography.
3. For general discussions of the cryptography affair, see the following:
   Deborah Shapley and Gina Bari Kolata, 'Cryptology: Scientists Puzzle Over Threat to Open Research, Publication,' *Science,* 30 September 1977, pp. 1345–1349.
   Stephen H. Unger, 'Privacy, Cryptography and Free Research,' *Technology and Society,* no. 20 (December 1977).
For a popular discussion of the techniques that were at issue, see the following.
   Gina Bari Kolata, 'Cryptography: On the Brink of a Revolution?' *Science,* 19 August 1977, pp.747–748.
4. *Supplementary Detailed Staff Reports on Intelligence and the Rights of Americans,* Final Report of the United States Senate Select Committee to Study Governmental Operations with Respect to Intelligence Activities, Report No. 94-755, Book 3 (Washington, DC: U.S. Government Printing Office, 1976), p. 765. Cited in Diffie and Hellman, 'Privacy and Authentication,' p. 397.
5. 'The Cryptography Affair,' p. 5.
5. *New York Times,* 13 April 1978, p. 88.

CONFERENCE ANNOUNCEMENT: Electrical Engineering Through the 1980's

A two-day symposium is being held at Ohio University, October 15–16, 1979; half a day each will be devoted to the following areas:

Energy
Computers
Electronics
Technology and Society

Speakers at the Symposium will include Dr. John Bardeen.

For further information, contact Dr. G.V.S. Raju, Electrical Engineering, Ohio University, Athens, Ohio 45701. Phone: (614) 513.

Dear Sir:

In the 1950's, I was Chairman of NSPE's New York Chapter Ethical Practices Committee because ethics and professionalism were synonymous and primary to me since the outset of my professional career. This is the point Professor Fielder so aptly makes in "Teaching Engineering Ethics" (*T&S,* March '79). Indeed, his article is the finest I have read to date.

Based upon my own 32 year career, to date, 17 years of which are in my own consulting practice, these are some specific answers to the questions Professor Fielder asks:

"What happens if you violate the code?"—If one does it often enough his peers know it first, and then, if he is in public practice, so do prospective clients. He loses referrals, business, and general credibility. He gains litigation and/or a practice in the seamy arena of work. Don't snicker! If you know the exception, I've seen the rule.

"What happens if you obey the code?"—Aside from self esteem and personal satisfaction as a professional, and recognition as a professional by your peers and clients, there is a practical side too. Practicing ethically inevitably is prudent business. Clients develop continuing relationships with the ethical practicioner—be he a doctor, lawyer, or engineer. Contrariwise, particularly when you're first starting out and "learning the business," if you avoid an unethical situation you will discover you have avoided a bad business situation that unfolds later on. Again, I've experienced this truth many times.

"Philosophical analysis of the code"—the 1946 edition of the NSPE Code of Ethics is framed on my office wall. It has been with me 33 years. The current Code is somewhat different, though essentially the same. But it is different! The change, in itself, is a philosophical problem. If we *change our standards* to meet "modern business conditions," we may never know when we so change that we eventually irretrievably stray from a basically ethical tenet. Consider, in contrast, the ethics of the Bible. The Law given to Moses is regarded as *immutable and irrevocable.* Whether succeeding generations like it or not, the unchanged ethical precepts are a standard beacon. One may create new philosophies, rationalize new standards, or advocate different behavior, but if one is to be considered as a follower of the Law, there is only that one immutable Law. Therefore, if a current Code was ambiguous in a specific situation I resolved the conflict by employing the fathers inscribed on our coinage "In God we trust." The difference with Professor Fielder's base, Utilitarianism, is that preceptions of "good and evil consequences" continuously change and are continuously influenced by historical, cultural, and environmental circumstances. As a professional ethics example, recall the AIA debate on advertising and the ASCE debate on bidding. But, in any event, whatever the basis, have one. A consistent practitioner will find greater success than an inconsistent one.

Cordially,

Herbert Argintar, P. E.

"Kreisky Yes; Nuclear Power No"

A brand-new nuclear power plant at Zwentendorf, Austria is standing idle as a consequence of a nationwide referendum held on November 5, 1978. By a vote of 50.5 percent to 49.5 percent, Austria's electorate decided not to activate Austria's first commerical nuclear reactor. The 692-megawatt boiling water reactor was designed and built by Kraftwerk Union and AEG-Telefunken of West Germany at a cost of $530 million. Construction started in 1972 and was completed in 1977. The reactor is located on the Danube about 20 miles northwest of Vienna.

In the spring of 1975, and anti-nuclear petition drive by people living near a site proposed for a *second* nuclear power plant led to the Austrian government's suspending plans for any more nuclear plants. The petition drive also prompted the government to launch a national debate about nuclear power, which ironically led to the November 5 referendum. Austria's popular chancellor Bruno Kreisky campaigned hard for a "yes" vote on the proposition to activate the nuclear plant. In general, business, organized labor, and political centrists supported the proposition; environmental groups, the left wing of Kreisky's own Socialist Party, and the right-wing sectors of the People's Party and the Freedom Party generally opposed the proposition. After rejecting Kreisky's nuclear power plant in November, Austria's voters re-elected the 10-year incumbent Kreisky chancellor in the May 6, 1979 national elections and gave his Socialist Party an increased majority in Parliament.

With inflation at 3.3 percent and unemployment at 2.2 percent—and with no nuclear power—Austria's economy currently is among the healthiest in Europe. Now Sweden and Switzerland are also planning nuclear referendums.

—F. K.