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HIGHLIGHTS

From the

IEEE 1982 Conference

on

U.S. Technology Policy

"Charting the National Course"

and the

IEEE 1982 Series of Board Meetings

During

National Engineers Week

February 21-27, 1982

"ENGINEERS ARE AT THE FOCAL POINT OF U.S. TECHNOLOGY POLICY," ACCORDING TO IEEE PRESIDENT

Robert E. Larson, IEEE President, commented on the need for engineering involvement in public policy in remarks concluding the 1982 series of Board meetings and the Conference on U.S. Technology Policy that were held during National Engineers Week.

"The U.S. possesses the resources," he said, "to continue its leadership in many areas through a large, skilled workforce with a high degree of technical knowledge, a combination of abundant natural resources with an excellent transportation system, a dynamic industrial structure capable of responding to new opportunities, a supporting science and education establishment constantly opening new frontiers, and a political stability that encourages constructive dialogue among various sectors."

"In this environment," he continued, "the engineer is at the focal point, where knowledge is converted into practice . . . and at this focal point, we see the need to consider the development of a more coherent U.S. technology policy." Among Dr. Larson's specific recommendations were:

- Development of a process toward consensus-building among government, education and business.
- Establishment of a Technology Council in the private sector to assess the health of U.S. technology, consider its continued growth and effective application to national needs, and prepare proposals for government action.
- Consideration of a more fundamental restructuring of the Commerce Dept. With a shift of energy responsibilities to Commerce, it appears to be an appropriate focal point for technology policy. Changing its name to the Department of Technology and Industry would reflect a broader role in supporting effective employment of technology to stimulate continued economic growth.

Dr. Larson's views were among a number expressed by IEEE members during the week of meetings in sessions that focused on resources for innovation, energy policy, and communications and information policy, as well as public understanding of technology. Congressional and Administration perspectives on technology policy were voiced by Congressman Fuqua, Chairman of the House Science and Technology Committee, Senators Glenn, Domenici, and Cranston, the Presidential Science Advisor George A. Keyworth II, Dr. Courtland D. Perkins, president of the National Academy of Engineering, and Dr. John H. Gibbons, Director of the Office of Technology Assessment.

Over the next several issues, *IMPACT* will carry the complete text of speakers' remarks, wherever available, as well as reports of policy sessions. The complete text of Senator John Glenn's keynote speech, "The R and D Crisis in America," appears in this issue starting on page 7. ■

EDITORIAL

ENGINEERING SHORTAGE DEBATE

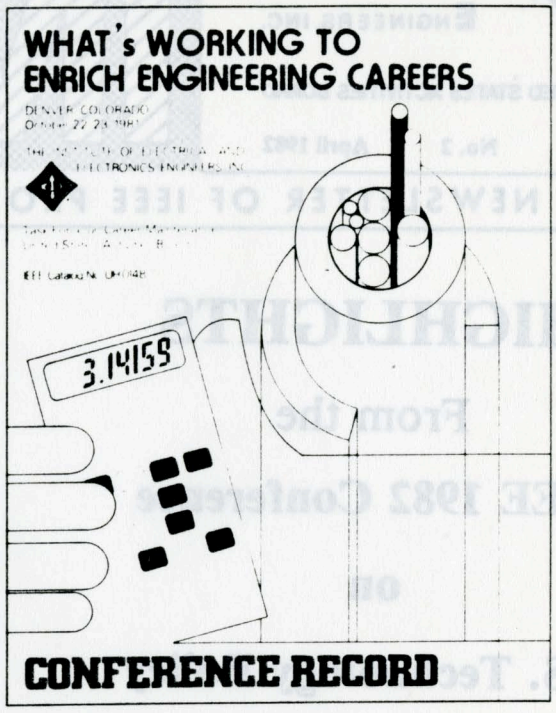
Kentucky Government Solves Part of the Problem

In the discussion of engineering demand and the debate as to whether or not there is a real engineering shortage, many people say that industry often under-utilizes our engineering talent. In spite of the present recession there is still a demand for new graduate engineers. Still many of our experienced engineers say their talents are badly under-utilized.

When economic hard times strike, employers institute hiring freezes, arbitrary travel restrictions, and other across-the-board austerity measures while trying to preserve their high level talent. As a consequence of this, many engineers find themselves spending much of their time on work that could be handled by clerks and technicians. This process has been going on for years. Certainly from 1959 to 1962, when I was at the Hughes Research Laboratories, we had a group of Ph.D's who could not get adequate programming or secretarial services and were thus forced to do these things themselves.

Here in the State of Kentucky our State Secretary for Transportation is solving the problem. There is no shortage of highway engineers here. When the Governor appointed this individual, he observed that the District Highway engineers were spending much of their time in work other than engineering. Thus, he eliminated the jobs. He then created district managers to run the District Offices of the Highway Department. These managers were not required to have an engineering background. Their background was to be in management, any kind of management. The new managers often felt that the jobs being done by their staffs were not engineering jobs. Money could be saved by replacing some of the engineers with lower level talent. At the present time, the State Transportation Engineers are petitioning the Governor and the Legislature to replace the Secretary of Transportation. They say that, in the long run, the roads will deteriorate even further. We all agree the State roads are not in terribly good condition. In the short run, he has saved money and he has certainly solved the problem. We have no shortage of Civil Engineers with a specialty in highways here in the State of Kentucky. *—B. J. Leon*

NOW AVAILABLE: IEEE CAREERS CONFERENCE RECORD



The Record of the IEEE Careers Conference, "What's Working to Enrich Engineering Careers," is now available. The Conference was sponsored by USAB's Task Force on Career Maintenance and Development and took place in Denver in October 1981. Speakers included G. E. Crain of TI, Gene W. Dalton of Brigham Young, Michael Driver of USC, J. R. Farron of Bendix, C. H. House of Hewlett-Packard, G. H. Hupman of GE, D. B. Miller of Vitality Associates, J. J. Rago of Cleveland State Univ., W. T. Sackett of Honeywell, J. F. Traexler of Westinghouse, R. F. Vetter of Engineers Union, D. Wilson of Bell Labs, and 21 others, including IEEE leadership.

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USAB CHAIRMAN'S MESSAGE: TECHNOLOGY TRANSFER, A TWO WAY STREET

The issue of preventing our enemies from obtaining critical information that could be used against us in a military conflict has been with us for a long time. It has been with us since at least World War II with the military classification system. In more recent times it has been with us through ITAR. The International Traffic in Arms Regulations were designed to prevent equipment of military value from being sent to our potential enemies and ultimately used against us.

In recent years, however, there have been situations where ITAR was used to block attendance at IEEE technical meetings, on the basis that the material presented at the meetings might be converted to military use. As a result, a joint TAB-USAB ITAR committee was formed to look into the situation to see what could be done to minimize the barriers to the flow of technical information within the technical community, while at the same time respecting the true military security needs of the country.

IEEE is, after all, in its technical operations, basically in the business of technology transfer. That's what we are about. At the same time, we are, on the technical side, a transnational organization. Our meetings are held worldwide and our members come from all countries of the world. The papers in our *Transactions* are written by whoever is the best technically, regardless of coutnry of origin.

And indeed the presenters of papers at our meetings, and the writers of papers in our *Transactions* have always been, and are increasingly from outside the United States. I have heard a statistic that one of our Transactions in a period of a year had some 40% of its authors from outside our country. In fact, a recent statement from one of our well known commentators on the IEEE scene said that he had found an issue of a *Transaction* with *only* non-United States authors. His concern was over the absence of U.S. authors. But the fact makes another point as well. In the IEEE, technology transfer is a two-way street.

For those of us who read the daily press, then, it is no surprise to find the issue of technology transfer escalating. The current Administration is obviously convinced that our "enemies" need our technology to destroy us and that we are giving it away. So the laws and regulations are being sharpened, not only ITAR but other government regulations. The Administration has recently proposed a revision of the military classification executive order, which appears to broaden the areas of technology that can be classified.

Reacting to this trend, the IEEE Board, at its February meeting in Washington, set up a new IEEE Committee on Technology Transfer to look into the situation and present our position to the government. One direction the Board gave the Committee was to set up a repository of recorded instances where these regulations are being used to impede our normal activities in the spread of technological knowledge throughout the technical community.

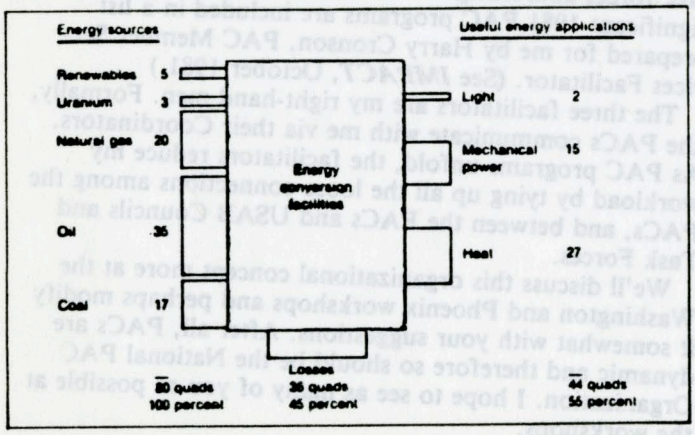
A recent news story in *The New York Times* revealed that a major Japanese semi-conductor maker had agreed to supply a major United States corporation with production technology to manufacture 64K RAMs in the United States. The story also went on to say that the administration is debating whether to restrict imports of 64K RAMs on national security grounds.

Indeed, technology transfer is a two-way street.

—E. J. Doyle

SECTION CHAIRMEN TO RECEIVE ENERGY SLIDE SHOW

The slide presentation on the U.S. energy problem, produced by the IEEE Energy Committee, is being distributed to IEEE Section Chairmen, in order to make the show available to as many IEEE members as possible. Working with members in local Sections and Chapters, arrangements may be made for presentations to IEEE groups, as well as other audiences, such as civic groups, schools, professional societies, government bodies, business groups, and other interested organizations. If conflicts in dates arise, slide sets are available without charge on a temporary loan basis from the IEEE Washington Office.

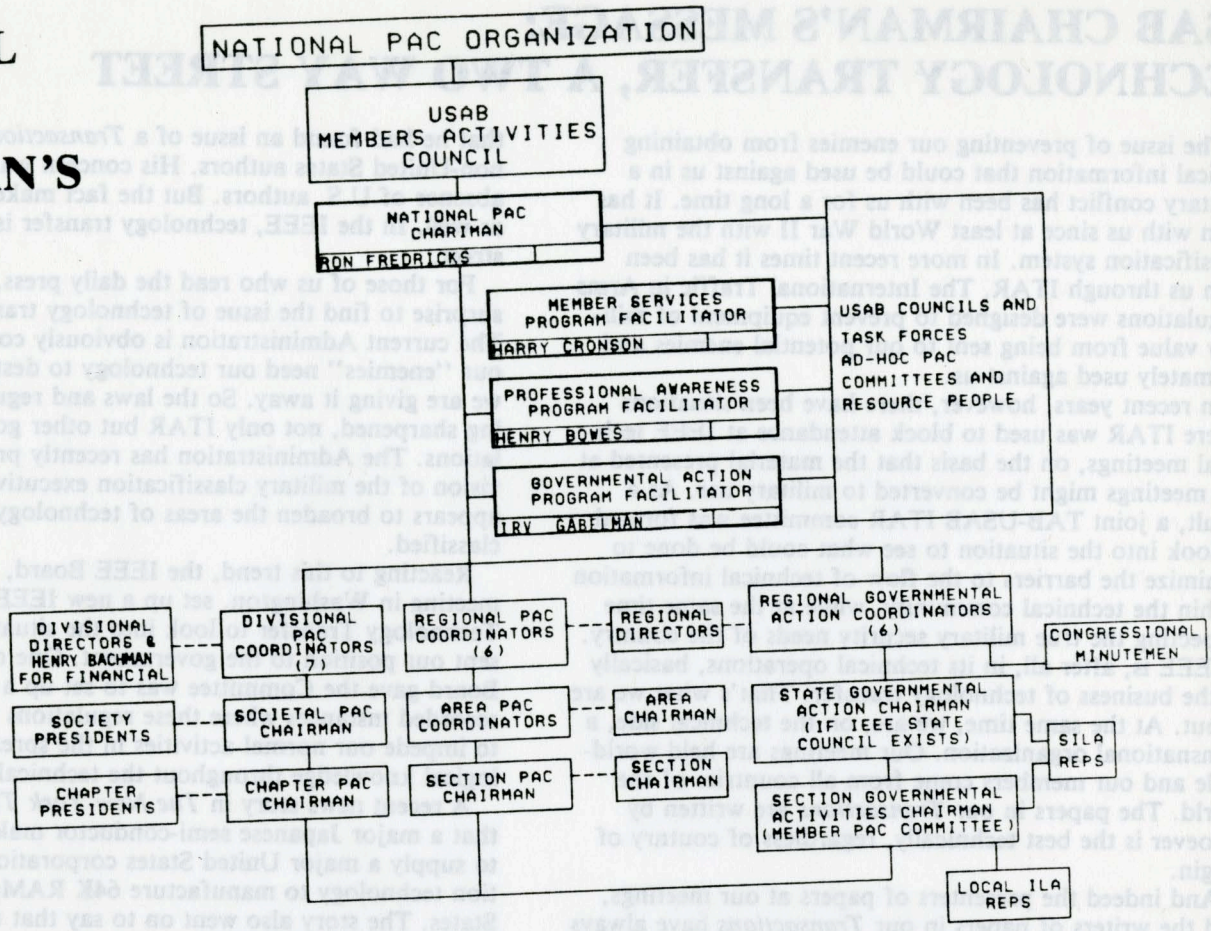


U.S. Energy Utilization in 1980: Redrawn from a slide in the energy show, this chart shows sources and applications. Conversion losses amount to 36 quads, or 45%. Seventy-two quads are derived from non-renewable hydrocarbon resources, and nearly half of those 72 quads comes from a single source: Oil.

The Energy Committee developed the presentation in response to the concern over this issue on the part of IEEE members and the public. The 30-minute show pictures U.S. resources and needs and recommends actions to be taken by individuals and public-interest groups at local, state and national levels to help resolve the problem, particularly in the critical period of the present to the year 2000. The message is energy awareness: Why the problem exists, what U.S. needs are, the impact of supply disruptions, the role of conservation, and the need for vigorous development of all U.S. resources to meet growing needs.

The complete presentation consists of the slides, arranged for viewing in a Kodak Carousel, a cassette tape of the script, a speaker's kit, and leaflets for distribution to the audience. ■

NATIONAL PAC CHAIRMAN'S CORNER



This month I would like to review the way the national PAC structure is organized for 1982, and in particular, just who reports to whom. I will be brief (not normal for me) since this is one of the sessions we will present at the April 3rd national PAC workshop in Washington and again at the planned September 10 and 11 workshop in Phoenix.

The national PAC organization chart really states it all as far as our current structure goes. Functional PAC communication channels are shown as solid lines, while IEEE line organization reporting and approval channels are shown as dotted. For example, a Society PAC chairman is probably appointed by his Society President and hence must secure his approval for any financial commitment by the Society or any activity undertaken in the name of the Society. At the same time, though, the Chairman might secure financial help and certainly advice from his Divisional PAC Coordinator. Note the triple tie at the Section level among a Chapter PAC Chairman, a local/state Section Government Activities Chairman and the Section PAC Chairman. Normally, the Section PAC Chairman would be the lead individual here, and the others would be members of his PAC committee.

The Coordinators normally interact directly with me. I have requested them to prepare quarterly, informal synopses of PAC activities in the Regions and Divisions, due at the ends of April, July, and October with a final report (including finances) due on January 31, 1983. This means they should be contacting the various Society, Section, and State SILA PAC Chairmen for status updates again next month.

I hope, though, that our communications are much more frequent than four times a year. Informal communication lines can be established between any two units of our organization chart: For example, directly between a Section Government Activities Chairman and the Government Action Program Facilitator, or between a Section PAC Chairman and the Chairman of a particular task force. The formal communication structure is there only to insure that PAC programs do not fall into the cracks. Useful results, ideas and information must get to all those who might undertake similar programs, or to the national task forces addressing related issues. Some of the more significant 1981 PAC programs are included in a list prepared for me by Harry Cronson, PAC Member Services Facilitator. (See *IMPACT*, October 1981.)

The three facilitators are my right-hand men. Formally, the PACs communicate with me via their Coordinators. As PAC programs unfold, the facilitators reduce my workload by tying up all the loose connections among the PACs, and between the PACs and USAB Councils and Task Forces.

We'll discuss this organizational concept more at the Washington and Phoenix workshops and perhaps modify it somewhat with your suggestions. After all, PACs are dynamic and therefore so should be the National PAC Organization. I hope to see as many of you as possible at the workshops.

—Ron Fredricks
National PAC Chairman

INFORMATION ITEMS

WASHINGTON SCENE

NASA Grounded?

During the week of IEEE Board meetings in Washington and the Conference on U.S. Technology Policy held during National Engineers Week (see separate story in this issue) former IEEE Congressional Fellow Theodore R. Simpson testified on NASA funding before the House Subcommittee on Space Science and Applications on February 23. Mr. Simpson, who covered the civilian space program while serving on the staff of the Senate Subcommittee on Science, Technology and Space, stated in general that "NASA has played a key role in advancing our nation's science and technology, and it should be encouraged to continue to do so . . . we are dismayed at the continuing cutback in the scope of NASA's tasks . . . funding for NASA should not be viewed as just another line item in the Federal budget, but rather as an investment in our future."

More particularly, Mr. Simpson expressed support for the space shuttle test and operational flights, development of a reusable orbital transfer vehicle and a space station, the Galileo project, the Venus Orbiting Imaging Radar, the space telescope, and communications satellites. He singled out the 30/20 GHz satellite flight demonstration project for support in saying that "$25-30 million should be added by Congress for this purpose, in order to assure continued U.S. preeminence in this important commercial area." He went on to say that "this is a proper activity for NASA . . . industry cannot afford to do the high risk R&D necessary to maintain U.S. leadership." Copies of the complete statement, along with the relevant IEEE and USAB positions, are available from the IEEE Washington Office.

Facing Congress, a panel of experts at the witness table included a former IEEE Congressional Fellow, Theodore R. Simpson (far right). Present on the Subcommittee were Chairman Flippo, Reps. Wynn, Hollenbeck, McGrath and Lowery, and a consultant, Dr. J. Irons.

Engineering Manpower: Shortage or Surplus?

Manpower issues have been in the forefront of activity as IEEE and other engineering professional societies gear up to respond to many well publicized warnings of critical engineering manpower shortages that have been forecast by government, industry, and trade associations.

The USAB Manpower Task Force is seeking additional data—and volunteer manpower—to deal with the question of shortage or surplus and employment issues in education, industry and other sectors relevant to the manpower question. Richard J. Gowen, former USAB chairman, has been appointed to direct this key effort as Manpower Task Force Leader.

Recent meetings and hearings that explored the complexity of the question and presented a diversity of views include:

- A January 17-19 meeting in San Antonio, TX, where more than 50 leaders from all engineering disciplines assembled to draw up recommendations for government and industry that might help solve present and future engineering manpower problems. The meeting was coordinated by ASME and sponsored by the Founder Societies, including IEEE. Engineering supply, demand and utilization were discussed. Approximately 20 pages of recommendations emerged; these will be published in a report to be sent to government, industry and educational leaders. Copies of the report may be requested from ASME, 345 E. 47 St., New York, NY 10017.
- A one-year study of engineering utilization, to be funded by the American Association of Engineering Societies (AAES), has been initiated by Bruno O. Weinschel, who served as USAB Chairman in 1978-1979. The study will include a survey of management practices at companies "known for their enlightened policies," according to Dr. Weinschel.
- USAB sponsored a conference on manpower supply and demand in Washington, DC, on November 16-17, under Dr. Gowen's chairmanship. Full details were reported in *The Institute*. Among the indicators cited were data revealing a dramatic rise in alien certification. (See related item in this column.)
- The National Science Foundation has awarded $93,911 to the AAES to develop a mathematical model to predict the number of engineering degrees awarded annually over the next 10 years. The AAES Engineering Manpower Commission will conduct the study in cooperation with Oklahoma State University.

Continued

Continued from page 5

- The question of manpower shortage or surplus dominated the discussion during the "cracker-barrel session" at the recent IEEE Careers Conference. The group agreed that a few specific engineering specialities are experiencing shortages, but no consensus was reached on an overall shortage.
- A group of expert witnesses representing government, academia and industry agreed that national security and the U.S. economy are threatened by looming shortages of engineers and other technically trained people at a hearing of the House Science and Technology Committee last fall. The Committee Chairman, Rep. Don Fuqua, warned that "all the advances in science and technology available to us will not prevail if we lack the human resources to apply those advances."
- A report by the American Electronics Association (AEA) predicting dire shortages has been given wide publicity. The data on which the projections are based, however, are under sharp attack by a number of IEEE volunteers.

The challenge for IEEE, and specifically the USAB Manpower Task Force, is to develop the hard data necessary to support or repudiate claims of shortage or surplus.

Importing Engineers, For Shortage or Profit?

A related issue, the certification of alien engineers, has also been given prominent attention. Statistics cited at the November Manpower Conference (see above) revealed that 1106 certifications for permanent hiring of alien EEs were issued in 1980, while only 340 were issued in 1976. Similarly, 598 certifications for computer engineers and scientists were issued in 1980, while only 97 were issued in 1977. The significance of these figures lies in the fact that an employer must convince the Dept. of Labor that no U.S. candidates could be found to fill these vacancies, prior to certification.

The USAB Manpower Task Force is prepared to deal with the issue of low wages paid to aliens, and IEEE members can help, according to Dr. Gowen. Members who are aware of cases of alien engineers being sought at substandard wages can help end this practice by informing their local Dept. of Labor office of the apparent violation and IEEE's position on such practice. The IEEE Board of Directors (BoD) has asked that the Dept. of Labor (DoL) deny work certification for a foreign national engineer if the advertised salary for the position is below that of 25% of engineers in comparable positions. It also suggested that DoL immediately certify job offers at 75% or above the prevailing wage. The Task Force used information in the IEEE Salary Survey to develop local guidelines, which it then urged DoL to use.

Evidence of abuse of alien employment regulations might include advertisements offering excessively low salaries for the experience required, or data on companies laying off numbers of U.S. engineers while retaining foreign nationals. Requests for such information have been used by the Task Force to demonstrate the problem of abuse.

The BoD-approved recommendation said in part that "foreign engineers and scientists choosing to practice in the U.S. should be afforded, at a minimum, the same recognition and compensation of similarly qualified persons already practicing in the U.S."

The Senate Subcommittee on Immigration and Refugee Policy held a hearing last fall on labor certification at which Dr. Gowen testified against changes being proposed in S. 1765. "Loss of controls," he warned, "will undermine current efforts to determine more efficient ways to utilize, educate, retain and retrain engineers." The full text of his statement is available from the IEEE Washington Office.

White House Science Council Announced

Dr. George A. Keyworth II, Science Adviser to the President, announced the formation of the White House Science Council on February 16. The Council is to advise on science and technology issues of national concern and deal with specifically assigned issues, as well as keep the Science Adviser informed of changing perspectives in the science and technology communities.

Solomon J. Buchsbaum, executive vice president of Bell Labs, will chair the Council. The Vice Chairman is Edward Frieman, vice president of Science Applications, Inc. Members are Harold M. Agnew, president of General Atomic Co., John Bardeen of the University of Illinois (Urbana), George A. Cowan of Los Alamos National Laboratory, Edward E. David, president of Exxon Research and Engineering Co., Donald S. Fredrickson of the National Academy of Sciences, Paul E. Gray, president of MIT, Robert O. Hunter, Jr., president of Western Research Co., Arthur K. Kerman of MIT, David Packard, chairman of Hewlett-Packard, and Edward Teller, most recently a senior research fellow at Stanford.

Members are appointed to a one-year term. The council will meet up to six times each year and at such other times as they may be called on by Dr. Keyworth. Subgroups may be formed to study specific issues as assigned. ■

EDITOR:

While reviewing this past year's activities of the Pension Task Force, I noted that the support and encouragement of certain Congressmen and Senators had gone unrecognized. This is unfortunate since many of these individuals played a key role, often behind the scenes, in efforts to keep the IRA concept in any joint tax bill. In particular, I feel the IEEE owes a large debt of thanks to Mr. Archer (R-Texas), Mr. Conable (R-NY), Mr. Pickle (D-Texas), and of course Mr. Rostenkowski (D-IL). Also, Senators Bentsen (D-Texas) and Dole (R-Kansas) effectively supported the IRA concept in the Senate.

Yours truly,
David C. Lewis

The R and D Crisis in America

Keynote Address by The Honorable John Glenn, United States Senate

To the IEEE 1982 Conference on Technology Policy, February 24, 1982

[Editor's Note: The complete text as released is printed here; due to the pressure of U.S. Senate business the actual address was a somewhat abridged version, but covered the same points.—DBD]

I am very happy to be here tonight to address this distinguished group of electrical engineers. You have every right to be proud of your organization, the Institute of Electrical and Electronic Engineers, and its previous incarnations, the Institute of Radio Engineers, and the American Institute of Electrical Engineers. I have a particularly personal reason to be grateful to the IEEE because I have had two IEEE Congressional science fellows work for me, one of whom, Len Weiss, has been advising me on science and technology matters almost from the time I arrived in the Senate.

It is highly appropriate for your conference on U.S. technology policy to be taking place at this time. First of all, as you know, this is Engineers Week in the United States—a time for all of us to sit back and reflect upon the technological innovations that engineers have produced that have made our country the envy of the world. Such reflection ought to produce a climate wherein those responsible for public policy decisions listen a little more carefully to what the scientists and engineers are saying. Secondly, your conference comes at a time when we are seeing a wholesale retreat in the Federal role in research and development in the United States. That is a subject which I know you will discuss in the various sessions of your meeting tomorrow and it is one of the topics I wish to address in my talk tonight.

It has become conventional wisdom in Washington to talk about the radical nature of the Reagan Administration program, the attempt to revitalize America's economy using economic theories that are rooted more in ideology than in analysis. It is a theory which suggests, apparently, that the root to economic progress lies, in part, through a reduction of Federal support for research and development. You will forgive me if I say that that is like bleeding a patient to cure his anemia. Our fundamental tool for meeting and shaping the challenges of the future lies today, as it has for so long, in the area of research and development. But in America today, the cutting edge of that tool—basic research—is under sharp and unrelenting attack. It manifests itself in the shrinking amount of research support available to our universities, our private non-profit research laboratories, and our national multi-program laboratories. It is apparent in America's retreat from the frontier of space and it shows up in the halls of Congress, where important basic research is sometimes cynically disparaged and presented with facetious awards, implying that it is little more than a clever rip-off. It is as if inquiry into the unknown is irrelevant to the removal of hunger, disease, and poverty from the world. Indeed just the opposite is true. Research has given us knowledge, knowledge has given us technology, and technology has revolutionized and is continuing to revolutionize the world. Consider that within a single lifetime, agriculture, the original basis of civilization, has lost its dominance in nation after nation. Today, in a dozen major countries, agriculture employes fewer than 15% of the economically active population. In the United States the figure is below 6% and is still shrinking.

THE BENEFITS OF TECHNOLOGY

The symbols of technology are no longer just images of smoky steel plants or the clanking noises of an automobile assembly line. Rather the symbols of technology today include the relative silence and clean surroundings of the advanced technological processes involving space technology, electronics, and gene-splicing.

This ongoing technological revolution is not a historical anomaly. Just as our first human ancestors were driven to satisfy their curiosity about what lay beyond that next hill or valley, just as Columbus, Vespucci, and Cabot were driven to venture beyond the horizon, mankind is driven by an insatiable curiosity to explore the unknown. Our job must be to nurture the inquisitive and inventive mind, not to stifle it. When we do nurture it the results may not be predictable, but the benefits can be incalculable.

Let's look at what has happened in the field of transportation over the past 100 years. First, recall that it took the human race millions of years to get to the point where man could travel at a speed of 100 miles-per-hour. That was in the 1880's. It took less than 60 years thereafter to quadruple the limit so that by 1938 airborne man was cracking the 400 mph line; in another 20 years the limit was doubled again; by the 1960's rocket planes approached speeds of 4000 mph; and men in space capsules were circling the earth at 18,000 mph. And even those who had the vision to be able to imagine such machines could not foresee all the benefits that would arise from their development. The spinoffs from the American space program, which includes the development of the field of microelectronics and the creation of powerful, portable, and low-cost computers, have led to a revolution in communications that will change the way we live and work from now on.

We are living today at a time of austerity. We are looking toward rigorous cost-accounting in the justification of the expenditure of public monies and that's not bad. But research is not amenable to the rigors of cost-accounting. We may start off looking for one thing and find another. Sir Alexander Fleming, through an accidental discovery in 1929 that green mold slowed the growth and reproduction of bacteria, began the research that ended with the discovery of penicillin and the development of antibiotics. And Michael Faraday's experiments, that ended with the principle of the discovery of electromagnetism and the dynamo, set the stage for the development of new industries that all electrical engineers in particular, are familiar with. There is, in fact, a story about a famous exchange between Benjamin Disraeli and Michael Faraday regarding the invention of the dynamo. After Disraeli had inspected this earliest of generators he pointedly asked Faraday, "What good is this?", to which Faraday replied, "What good is a baby, Mr. Disraeli?" The point of that story is that one cannot judge the potential of a new discovery or of a new idea any more than one can judge the potential of a baby.

Our prosperity, our national security, our industrial strength have come about because we were willing to invest in research into the unknown and that willingness has paid handsome dividends. Let me cite a few examples.

In 1843 the U.S. Congress actively supported the development of the first practical application of electric energy with a grant of $30,000 to Samuel F. B. Morse to construct a telegraph line from Baltimore to Washington. Within 20 years no developed area in the U.S. was without telegraphic service and submarine cables were in regular operation under the Atlantic Ocean. In some sense, that was the beginning of the communications revolution that we are experiencing today.

In 1956 John Bardeen, William Shockley, and Walter Brattain shared the Nobel Prize for physics for their invention of the transistor. Subsequent government policies on military procurement had a major effect on the development of the semi-conductor industry thereafter, an industry which has become a mainstay of the U.S. economy.

In 1964 Charles Townes became a co-winner of the Nobel Prize for his research on the maser and laser. Today laser technology is used in a variety of activities ranging from brain surgery to optical scanners in supermarkets.

Norman Borlaug won the Nobel Peace Prize in 1970 for his work on the development of high-yield grains. That research was not only used in this country, but was exported abroad where it provided the basis for the Green Revolution that fed a hungry world.

The list could go on and on, but the point is obvious. Research and the technology we develop to exploit the fruits of that research, has made America the wealthiest, most powerful, and most productive nation on earth. R&D supported by both government and private sources has transformed the United States into the dominant technological force in the world. It is the key to our productivity and to our ability to compete successfully in a highly competitive world market. Let us therefore examine what has been happening with respect to productivity in the U.S. and investment in R&D.

U.S. SLIPPAGE

Between 1961 and 1978 the annual productivity gain in manufacturing averaged 3% in the United States. This should be compared to an average gain of 9% in Japan, and 5% in Germany. Moreover, total U.S.-private sector productivity has actually declined in recent years. That decline in productivity has cost us two-million jobs since 1970.

Continued

That fact makes me mad, especially with unemployment hovering at the 9% mark in this country today, but we can't sit around wringing our hands. The Japanese are presently out-producing us by a factor of 15 when making motorcycles, and by a factor of 2 when making either steel or pianos. We are being challenged as we never have been before. But let me tell you something. I welcome the challenge because given the proper tools, Americans can still out-work, out-produce, out-innovate, and out-compete anyone on this face of this planet. But if we're going to do it, we're going to have to turn around some worrisome trends that are occurring in the United States today—trends that indicate lagging capital investment, shortsighted management, lagging human resources, and most important of all, slippage in our commitment to maintain and extend the amount of research and development necessary to stay ahead in the technological race.

In capital investment we were first in the world in 1963. By 1975 we had slipped to 6th place on a per-capita basis. Europeans are increasing their per-capita investment in industrial plant and equipment at a rate which is double ours and the Japanese are doing so at a rate which is 5-times ours. We need to encourage savings and we're not going to do it by voodoo economics.

We have to educate our corporate managers to look beyond the planning horizon of 3-4 years. The economist, Edwin Mansfield has shown that there is a direct relation between the amount of basic research carried out by an industry or firm and its rate of productivity increase, all other things being constant. The short-term, bottom-line mentality must be refocussed toward the future. Short-term advantages can evaporate almost overnight and can have a devasting impact on our national security. Let me give you an example. A recent Rand report discusses the difficulties the Soviets had until the early 70's, in trying to develop equipment for grinding precision miniature ball-bearings which are important in current missile guidance systems. Within less than a decade, the Soviets are now claiming to have developed high-precision machine tools capable of turning out miniature ball-bearings with tolerances of 2/10,000th of a millimeter. These are closer tolerances, they claim, than Western equipment allows. The conclusion is obvious. If we sit back and try to rest on the technological laurels we have, we will find the leaves of our laurels plucked away one-by-one. Unfortunately, when one sees what we have been doing with respect to human resources and investments in R&D over the past 10 or 15 years, it appears that we have indeed been sitting down on the job. And, I might add that if the Reagan Administration's philosophy and budget continue to be accepted, we will go rapidly from a position of sitting down to a position of lying prostrate before the world.

Over the past 15 years the proportion of America's GNP invested in research and development has steadily declined—dropping more than 20% since 1965. During that same period and by that same measure, the Soviet Union's R&D investment has climbed by 21%, Japan's has risen by 27%, and West Germany's by 41%. Over the 12-year period, 1968-1980, investment by industry in basic research as a fraction of net sales declined by 32%. Similarly, investment by the Federal government in basic research as a fraction of the Federal budget declined 27% over the same period. Overall, R&D spending by the Federal government as a fraction of the Federal budget decreased 36%. There are other worrisome indicators as well. At a time when domestic U.S. patents have decreased by almost 25%, U.S. patents of foreign-origin have increased by more than 70%. Thus, the foreign-origin share of total U.S. patents increased from 20% in 1966 to 36% in 1977. On top of this, we must remember that much of the R&D in the United States supported by government is for defense purposes. If we look only at civilian R&D, then we see that as a percent of GNP, civilian R&D in the United States rose only 10% during the past 14 years; in West Germany it rose 30%, and in Japan it rose 25%. Is it any wonder therefore, that during the same period manufacturing productivity rose 30% in the United States, 85% in Germany, and 290% in Japan?

With statistics like these, with the knowledge that 40-60% of all technological advances occur as a result of doing basic research, and with studies showing that advances in knowledge constitute the single-most important source of productivity gain in economic expansión, does it make sense to have a hands-off national policy on R&D? Does it make sense to have a policy that removes the prime source of investment in basic research, the Federal government, from a good part of the game, in the hope that private industry will take up the slack? I submit that to even ask the question is to already give the answer, and the answer is a resounding no!

In addition to the huge underinvestment in R&D that has been occurring in the United States over the past 15 years, we are failing to produce the technical people that we need to sustain needed increases in productivity and to make advances in knowledge that will be the basis for our economic prosperity and national security in the coming decades.

For example, last year American colleges and universities granted 58,000 degrees in engineering. By contrast, Japan, with roughly half our population, graduated 74,000, and the Soviet Union graduated about 300,000 engineers. In the field of computer science there is an estimated demand for 54,000 graduates at the bachelors level, but we are only supplying 13,000 graduates. The estimated demand at the masters level is for 34,000 people; we are only graduating 3,400. And at the doctoral level the estimated demand is 1,300, whereas last year we only graduated 330.

The intense demand for technically trained people has resulted in high salaries that are luring faculty and graduate students away from even our best universities. The result is unfilled faculty positions in our nation's engineering colleges, and a dramatic drop in the number of science and engineering students who are going on for advanced degrees. In 1979 for example, a full 46% of U.S. doctoral degrees in engineering went to foreign students—2/3 of whom were studying here on temporary visas.

To complete this dismal picture, there is mounting evidence that the research labs and instrumentation in American universities are rapidly becoming obsolete. According to an ASEE assessment, the engineering teaching equipment found in most university labs is 20-30 years old and equipment to teach new growth technologies is almost non-existent. Few colleges and universities can afford expensive computer-aided design or computer-aided manufacturing teaching equipment. Yet, without such modern equipment efficiency of output is sacrificed, promising areas of research are foreclosed, and the ability of our universities to attract and retain top-quality professors and graduate students is further diminished.

THE REAGAN ADMINISTRATION RESPONSE

In the face of the international challenge that I have outlined, and in the face of the clear indication that an expanded national R&D effort is needed to shore up our productivity, strengthen our national defense, and halt the scientific brain-drain, what has been the response of the Reagan Administration? Let us examine four specific areas; energy, space, science education, and the national labs.

ENERGY

For over three years I worked, and jawboned, and cajoled the Carter Administration to increase its funding in energy R&D in the areas of solar and renewables and conservation. My goal was to have this R&D funded at a level which would represent at least 1% of the cost of our annual oil import bill which was projected to be about $80 billion in FY 82. We finally got this amount and a bit more in the FY 1982 budget request submitted in January 1981—about $777 million in solar and renewable energy R&D and $336 million for energy conservation R&D. And then what happened? At a time when the Pentagon was asking for billions more for defense—a goodly portion of which was justified on the grounds of maintaining our access to oil supplies, the new Administration cut $487 million or 62% from solar and renewable R&D and $248 million or 74% from energy conservation R&D for FY 1982. That was in the revised FY 1981 budget submission by President Reagan, presented to the Congress on March 15, 1981. On September 15, 1981 another revised budget submission came along calling for additional cuts of 12% across-the-board. In trying to save some of these programs, Congress deferred funding for some programs from 1981 to 1982. Thus, for FY 1982 the amount of money available for R&D in solar and other renewables is $374 million, while R&D funds for conservation for FY 1982 amount to $144 million. DOE's own Energy Research and Advisory Board (ERAB) disagreed with these cuts. In their report of November, 1981 they stated that:

> ". . . R&D funding for energy conservation and end-use technology is underfunded, particularly when compared with funding levels for supply technologies. A balance . . . should be achieved by increases in funds allocated to buildings and community systems and industrial conservation."

So, what is the Reagan Administration's response to the ERAB report's recommendations? In FY 1983 the Reagan Administration is requesting a total of only $18 million for energy conservation R&D, which is a cut of 87.5% from FY 82, and a cut of 95% from the original Carter FY 82 figure. All this at a time when the Japanese government has doubled its investment in conservation, France's investment has increased 221% and Germany's commitment increased 66% to a level of $1 billion. In the case of solar and renewables R&D the Reagan figure

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for FY 83 is $83 million. That represents a cut of 78% from the amount available in FY 1982, and represents nearly a 90% cut from the original Carter FY 82 figures.

The impact of these cuts is incalculable. The programs that are being zeroed out include the Industrial Energy Conservation Program, the Transportation Energy Conservation Program (which includes the all-electric and hybrid vehicle research and development), the Buildings and Community Systems Conservation Research Program (which includes the Energy Efficient Buildings Research Program at the Lawrence-Berkeley Laboratory), and the Energy Storage Program, which includes long-term, high-risk battery R&D that could make electric vehicles and utility load-leveling devices possible, as well as eliminate some of the practical difficulties that arise from the use of solar and renewable energy technologies because of their intermittancy.

These budget cuts may be penny-wise to some people, but they are the most pound-stupid moves I have ever seen.

The Energy Efficient Buildings Research Program at the Lawrence-Berkeley Laboratory has a 1,000 to 1 potential return on investment. It has been costing the nation less than $10 million annually, but has been producing technology and knowledge which have the potential of saving consumers and business more than $10 billion annually. None of this research is likely to be taken over by the private sector. For less than $1 million, this program produced an innovation in high-frequency ballasts for fluorescent lamps that advanced the adoption of these ballasts by 5 to 10 years and saved the U.S. ballast industry from severe foreign competition. The electrical savings are about 35%. The importance of that figure becomes obvious when I tell you that the electricity used to run fluorescent lamps in 1981 is estimated to be approximately the output of 40 base-load power plants and costs businesses nearly $10 billion. So every 10% gain in efficiency saves a billion dollars a year and the equivalent output of 4 power plants.

The Industrial Energy Conservation Program also has major achievements to its credit. It produced innovations in coil coating, textile foam finishing, crop residue grain dryers, granulated fertilizer production, efficient slot forge furnaces, high temperature recuperators, and cogeneration. The potential energy savings coming out of this program were of the order of many tens of millions of barrels of oil equivalent per year, and of course, these are savings that would occur every year once the innovation is in place. All this for an investment which last year amounted to less than $50 million. Once again, there is no evidence that the projects that were being worked on under this program would be taken over by private industry.

In the case of the Energy Storage Program, the decision by the Reagan Administration to zero this program out is particularly egregious in my view. We are presently in the middle of a technological race to develop a suitable battery capable of being used in electric vehicles or in utility load-leveling markets. A number of laboratories in Western Europe, Japan, and the U.S. have entered this competition, the result of which is a world-wide renaissance in battery technologies. About ten advanced battery systems are being developed for this application and many techncial advances have been made. General Motors and Ford have said that they intend to market electric vehicles as soon as battery technology permits. However, the technical barriers are numerous and difficult. There are cost barriers making for narrow profit margins. There are technical risks. The potential savings by the year 2000 could amount to over $400 million barrels of oil equivalent per year, not to mention the possibility that power plants which are currently being planned might not have to be built, thereby freeing up a huge amount of investment capital for other purposes.

Does the Administration really, seriously believe that the private sector will take up the slack in all these scientific areas that are being abandoned with such dispatch?

Here's what DOE's Energy Research and Advisory Board said about the new policy.

> ". . . ERAB is concerned that some energy R&D of great potential significance for the achievement of the nation's energy goals will fall between Federal and industry responsibilities.
>
> The new policy recognizes that private industry cannot be expected to do basic energy research or projects of a long-term, higher risk character, but there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R&D responsibilities abdicated by the government, however worthy the projects involved, and despite the provision of new generous tax incentives."

Thus, I ask again. Should our future be determined only by the private sector's response to the level of market prices for commodities like oil? I submit this is risky at best, and may be downright dangerous for the future welfare of our country. We need look no further than to an unusually candid interview given to a pro-government Saudi newspaper in Jidda by Shiekh Ahmed Yamani. In the interview, he stated that Saudi Arabia has opposed recent petroleum price increases because increases in 1979 and 1980, "caused a great rush toward investment in energy technologies, with the aim of reducing consumption and developing alternative energy sources. . . . This has resulted in a drop in OPEC's share of the market from 31 million barrels per day in 1979, to less than 24 million barrels a day this year." Yamani goes on to say that such Western actions could further reduce OPEC's leverage in the future which would mean "the end of the organization." He finally adds that keeping prices low enough to "curb investment in alternative sources," will ensure continued Western dependence and Saudi Arabia "will be assured of obtaining income sufficient to meet its financial requirements for the next 20 or 30 years." Well, it's all in that statement. If we refuse to be farsighted enough to provide investment in alternative sources and in conservation in order to keep up our technological base and prepare us to switch to alternative fuels in the future, we will be forever condemned to be at the mercy of the OPEC oil producers who are honest enough to state that they intend to keep the price low enough so that any strategy for obtaining alternatives through market forces will fail.

SPACE

If you think that what the Reagan Administration is doing to energy R&D is ridiculous, wait till you examine their decisions on the space program. The FY 1983 budget for space shows sharp reductions for the planetary program. The Galileo Program is now the only remaining U.S. planetary program in development. The Venus Orbiting Imaging Radar Mission wich was "postponed" by the Reagan Administration last year, is cancelled this year and the FY 82 operating plan deletes the $10 million provided by Congress for this project. They are even cutting the research and analysis line items for planetary programs. The argument has been made that the United States can forego planetary exploration for the next decade because we still have a great deal of data from past spacecraft to analyze, but now the funding is being cut for this data analysis function. In addition, some of the older space probes which continue to return data from their locations in space may be turned off because of insufficient funds for continued tracking and data acquisition. This action would affect Pioneer-10 which is now the farthest man-made object from Earth. Funds have also been cut for technology transfer and technology utilization programs, as well as for the construction and launching of a satellite to test new advances in communication. Last but not least, aeronautics research and technology has been cut by more than 1/3 from NASA's original request to OMB—this for a program which helped us to achieve and maintain our technological lead in commercial aircraft around the world and which the Department of Defense still says is important to our national security. Is this the time to cut back on aeronautics research, at a time when the Europeans are challenging us with the development of the Airbus, when the Japanese and even the Brazilians are thinking of launching major forays into the international aircraft market? I submit once again the answer is no!

SCIENCE EDUCATION

The Administration claims that it *is* interested in the future. That it *is* interested in supporting long-term, high risk, potentially high payoff R&D activities which the private sector will not support. They like to point to the increase in the budget of the National Science Foundation, which is up by 7.7% for FY 83 over FY 82 if you don't take inflation into account. What the Administration prefers to ignore is the zeroing out of NSF's request for extra funds to upgrade university laboratories and, in addition, the 70% reduction that they forced on NSF in the science education budget. Now isn't that a wonderful way of ensuring that we will get the amount of engineers and hard scientists that we're going to need in the future? I wonder if anyone at the White House has heard of the words population and demographics. The birth rate has gone down and college-age populations are going to be decreasing for a number of years into the future. Besides that, only 6% of U.S. college graduates are engineers or hard-scientists, as opposed to over 35% in West Germany, or 20% in Japan. We are right to be concerned as to whether we will be able to meet the demand for technical people in the future. We are also right to be concerned about whether we will continue to have the kind of social and political climate in the United States that is supportive of the work of technical people. All of this requires better scientific and technological literacy within our population. But for the

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sake of saving a few million dollars at the National Science Foundation the Administration is willing to give up on attempts to create more scientifically- and technologically-minded young people. That says a great deal about the Administration's attitude toward the technical manpower of tomorrow.

And, more generally, what about all of the technological spinoffs from the space program that have helped to raise our standard of living and that have kept us ahead in the international race for technological supremacy? I'm talking about satellite communications technology, the microelectronics industry, and hundreds of new consumer items based upon new materials for packaging and clothing. Is turning off this type of activity what we should be doing at a time of increasing international competitiveness? Is this what you would call leadership, foresight, and orientation toward the future? Not in my book.

THE NATIONAL LABS

What about the technical manpower of today? Here is what is happening at our national laboratories. At Argonne, which is deeply involved in energy and environmental research, 600 positions already have been cut. The Laboratory's Director says 600 additional employees may have to be laid off. At Brookhaven National Laboratory, 270 of 3,600 employees have been laid off and officials say further cuts may eliminate 25% of the work-force within the year. About 12% of the staff at the Fermi National Accelerator Laboratory, which I talked about earlier, the staff was trimmed by 200 people after the March budget projections. The Laboratory's Deputy Director has been quoted as saying that an additional 200-300 people may be let go in a worst-case situation. At the NASA Lewis Laboratory in Cleveland, a center which employs 2,700 persons, and which used to employ 5,500, more than 200 full-time equivalent slots are scheduled for the ax in 1983. The Jet Propulsion Laboratory at Pasadena may end up having so little to do because of the cutbacks in the planetary program at NASA that its best people will inevitably start drifting away.

The Administration seems not to realize that it takes 8-9 years to produce a Ph.D. scientist, and years to assemble a research team and carry a project to fruition. When funding disappears for a few years, so do the people—and you can't necessarily bring them back.

As Dr. John McCarthy, head of the NASA-Lewis Laboratory put it, "It is time that this country came to its senses and supported the vital research and technology necessary for national economic health. Cyclical, inadequate funding is the road to disaster."

WHY GOVERNMENT SUPPORT OF RESEARCH IS NECESSARY

The mood in this Administration, and in many places outside it, is that government should leave well-enough alone, even in the R&D area. In answer to that let me quote what President Harry Truman said to a joint session of the Congress on September 6, 1945, only three weeks after VJ Day:

> "Progress in scientific research and development is an indispensable condition to the future welfare and security of the nation. No nation can maintain a position of leadership in the world of today, unless it develops to the full its scientific and technological resources. No government adequately meets its responsibilities unless it generously and intelligently supports the work of science in university, industry, and in its own laboratories."

We must remember that much industrial R&D is devoted simply to meeting the requirements of government regulation, rather than to the kinds of risk-taking research that promises true technological breakthroughs. Basic research by definition will rarely result in a saleable end-product. There are problems of raising capital and having inadequate patent protection to justify the risk.

Let me be clear. In no way am I suggesting that the government should seek either to compete with, or supplant the business community's research and development efforts. Both efforts should be complementary and, wherever possible, symbiotic.

I have spent a lot of time giving you my views on what's wrong with our present situation in the area of science and technology, research and development.

Now I want to say a few words about what, specifically we ought to be doing about it.

1. *Increase financial support for scientific and technological research.* We should restore funding for research programs that have potentially high payoffs and which the private sector will not pick up. Government funding for basic research should be stable and predictable—and should be given on a multi-year basis for selected fields of particular importance to the health of our economy or national security. Such stability of funding should be available to our best universities, non-profit research institutions, and government laboratories. In addition we must upgrade the equipment in our university laboratories. Finally, we should remove artificial impediments to increased support such as the remaining vestiges of the Mansfield Amendment that has hampered the ability of the Department of Defense to support basic research along a sufficiently wide spectrum.

2. *Alleviate shortages of technical personnel with advanced training, including faculty at our schools of engineering.* Our brightest students should be given incentives to go on to post-graduate training, and our scientists must receive adequate compensation commensurate with their abilities and contributions. Incentives for industry-endowed university chairs and/or the use of industrial laboratory equipment for graduate training and research should be explored.

3. *Provide incentives for better university-industry cooperation in areas of both basic and applied research.* Industry must recognize some responsibilities to support the training of the next generation of scientists that will be of use to it, and the universities should recognize that raising the health of our technology is part of the key toward increasing the economic benefits that mean more support for university activities. At the same time, we must ensure that increased university-industry cooperation does not lead to a significant loss of university independence to play its traditional role of pursuing knowledge for its own sake.

4. *Improve and expand science and mathematics education at our primary and secondary schools.* We can build the society of the future only if our population is scientifically and technologically literate. A first step in this direction is to restore the science education program at the National Science Foundation. In addition, we must explore ways of increasing the supply and training of science and math teachers at the pre-college level.

5. *Improve the climate for research, development and technological innovation within the private sector.* We should seek to implement additional incentives for R&D wherever necessary and effective. In this regard, a reexamination of our patent policy would be valuable. We should also reexamine our antitrust laws to see if we have unnecessarily restricted cooperative R&D ventures within industry.

6. *Develop a coherent national science and technology policy, and raise the visibility and the voice of the science and technology community in the making of such policy.* Decisions about support for research on energy, space, and health should not be made only by lawyers and accountants. If the Office of Science and Technology Policy cannot be sufficiently effective in this role then we should start thinking seriously about creating a cabinet-level department of science and technology as a focal point for federal non-defense research activities. Such a department could include energy research and development, the multi-program national labs, NSF, NOAA, NBS, possibly the major federal statistical agencies, and possibly a national engineering foundation to do for applied research what NSF has done for basic research.

It is my intention to introduce legislation to deal with these issues in the near future.

In the meantime, I hope you will join me in sending a message to the Executive branch of our government. The message is that greatness cannot emerge from the stifling of exploration of the unknown in the name of economic ideology; that the future will not be ours if we seek only the return of the past; that we have cast our lot as a people and a nation with giving man the freedom and the resources to use his ingenuity to find a better way—and that our character as a people is reflected by our commitment to this ideal.

The future will be ours if we have the vision to pursue it. Remember the wise words from Chapter 29 of the Book of Proverbs: "Where there is no vision, the people perish."

I urge all of you in the science and technology community to do what you can to help us get back on the right track and keep us there. ■

IEEE EDITORS: THIS IS FOR YOU!

Editors of IEEE publications are invited to reprint—completely or partially—any stories appearing in *IMPACT* in their own Section, Society, or other IEEE publication. Simply credit source.

Senator Pete V. Domenici, chairman of the Senate Finance Committee agreed with science policy guidelines expressed by OSTP director.

Senator John Glenn spoke out against Administration cutbacks in R&D funding at the Technology Policy Conference.

TALKING POINTS FOR THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

By Pete V. Domenici, United States Senate

February 25, 1982

- In a recent appearance before the House Committee on Science/Technology, the President's Science Advisor, George Keyworth made a point about science that bears repeating. He said, "Science policy is not made in a vacuum. It is an exercise in priority setting and decision-making that must be carried out in the context of other national policies such as those concerning national security, international relations, energy, social services, and the economy. For example, science policy, made without considering economic policy, is irrelevant."
- I could not agree more. Federal investment in R & D activities is exactly that, an investment in this country's future, through productivity and technological innovation. This investment is essential to the economic well-being of this country today and in the years to come.
- I want to congratulate the Administration for the strong support it has shown for federal R & D in the FY 1983 budget request. I also commend the President for vigorously pursuing a strong, well-defined national scientific policy. This pursuit has been long in coming from other Administrations in other years.
- Because I believe in the strong link between federal investment in R & D and a healthy economy, I personally support an increase over FY 1982 levels. I am particularly pleased with the proposed 9 percent increase in obligations for basic research funding. Investment in basic research is clearly a federal responsibility.

  To quote Richard C. Atkinson, former Director of the National Science Foundation, "It is our ability to innovate that ensures steady progress at home and high standing among nations of the world. And our ability to innovate stems in part from the quality of basic research conducted in the United States. In a practical sense, then, federal funds spent for basic research are a wise investment.
- The U.S. needs to keep supporting R & D if it wants to keep up with the rest of the industrialized world. The U.S. is second to the U.S.S.R. in the proportion of R & D scientists and engineers in the labor force. From the late 1960s to the early 1970s, the ratio declined. For the past two decades, West Germany and Japan have had the highest ratios of civilian R & D expenditure to GNP in the world.
- As noted by Lewis Branscomb, Vice President and Chief Scientist of the IBM Corporation and Chairman of the National Science Board, "The basic and applied research base of American universities is still the strongest in the world. This of course is primarily a federal and state government investment. Unhappily, university research support has shown virtually no growth since the 1960's although Presidents Ford and Carter made strenuous efforts to reverse that stagnation and began to rebuild the intellectual base for our national progress."
- Research and development requires not just scientists and academicians but the kind of entrepreneurs and inventors who aren't afraid to take risks. The government's R & D policy should provide the incentives people need to take the risks that ultimately benefit society. Under the Reagan Administration, such incentives have increased. The 1981 Tax Act should encourage corporate R & D spending. In addition, the elimination of some counterproductive regulations should allow more funds to be used for productive R & D—not for government-mandated red tape.

Opportunities for informal discussions were provided. Above (l.-r.) are former IEEE Congressional Fellow Thomas L. Fagan, PAC Coordinator Joseph A. Edminister, and former National PAC Chairman H. Mark Grove.

Congresswoman Margaret Heckler (c.), a member of the House Science and Technology Committee, joined IEEE Past President Richard W. Damon (2nd from r.) and other IEEE Massachusetts constituents Bruce D. Wedlock (far l.) Region 1 Director, Richard E. Sparks (c.), and Alexander Kusko (far r.) of the IEEE Energy Committee, at a reception during the 1982 Tech Policy Conference.

UNIFORM ETHICS CODE PROPOSED FOR ALL TECHNICAL PROFESSIONALS

The USAB Ethics Task Force completed its draft of a Uniform Code of Ethics last fall for submission to the Ethics Committee of the American Association of Engineering Societies (AAES). The March 1982 issue of *The Institute* carried a page purchased by the USAB Ethics Task Force to acquaint IEEE members with the proposed uniform code, to explain the intent of its provisions, and to elicit comment. Questions that might be raised were answered by the Task Force. Member response to the questionnaire included on that page will be helpful to the Task Force and its representatives on the AAES Committee in considering further changes.

At some point in the future it is expected that the AAES Committee will submit the Uniform Code simultaneously to the member societies, including IEEE, for ratification.

Dr. Russell C. Drew, Conference Chairman, addresses participants.

USAB PUBLISHES GUIDE TO ETHICS

USAB has published a guide to ethics entitled "The IEEE Role in Engineering Ethics." It is the third in a series of "PAC Guides" to provide information and guidance to members on professional topics. PAC chairman will receive a complimentary copy to be placed in the *PAC Source Book*.

The ethics guide discusses the IEEE Code of Ethics and the procedures for enforcing the Code, including IEEE support for members placed in jeopardy for adhering to the Code, and discipline of members for Code violations. Another section of the guide discusses the anatomy of ethical decisions and includes two recent case studies of IEEE involvement. Finally, the guide presents a number of activities that may be undertaken by local PACs, pointing out the USAB resources available to PACs.

Additional copies of the *PAC Guide to Ethics* are available for sale from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. The price is $2.25 for members and $3 for nonmembers. Ask for IEEE Catalog No. UH0149-5. The earlier guides include PAC Guide to Service Contracts ("Your Rights As A Service Contract Employee") and PAC Guide to Patents ("Employed Engineers: Who Owns Their Inventions?"). ■

Dr. John L. McLucas (l.) former president of Mitre Corp., and most recently FAA Administrator, talks with IEEE Congressional Fellow Feisal S. Keblawi, who is on a year's leave from Mitre to fulfill the fellowship term on the staff of Sen. Thurmond.

NEED ENGINEERS? OFFER SPORTSCARS

With competition becoming stiffer for scarce software designers and electronics engineers, companies are increasingly offering bounty to employees who help bag new recruits in these fields.

Mitel Corporation, with headquarters in Kanata, Ontario, has one of the biggest prizes going: a $25,000 De Lorean sportscar. According to "The Wall Street Journal," the telecommunications equipment company is offering one chance in a drawing for the car each time an employee refers a qualified candidate for a posted job opening.

The company also is distributing T-shirts reading "I Found One" to employees whose referrals make it to the interview stage at Mitel. So far, hundreds of potential applicants have been referred, and the company believes it's getting its money's worth in the recruitment agency fees it won't have to pay.

(From *Eng. Times* 3/82)

While one IEEE focus begins to sharpen on the IEEE Centennial just two years away, the Editors of *IMPACT* point to the following perspective on USAB, reprinted from the February 1982 special issue of the *IEEE Washington Section Bulletin*. To be sure, the "Century of Electrical Progress" expressed in the IEEE Centennial is distinguished, and our heritage is strong. IEEE members, however, especially PAC leaders, ought not to lose sight of the fact that USAB, since its inception as an IEEE constitutional mandate for change, is just ten years old in 1982.

USAB'S GROWING PAINS: IEEE COMES OF AGE IN WASHINGTON

USAB, the United States Activities Board, has too often been viewed as the radical vocal element of an otherwise quiet and unassuming professional society that pursues its work of increasing the body of technical knowledge and literature and educating its members to the most current state of the art without much fanfare.

USAB's accomplishments, however, are beginning to stand out amid the noise. The level of noise has, in fact, diminished, while the message of professional concerns comes through clearer. The actions of this major board of the Institute has matured, and in the recent three to four years, a greater degree of sophistication in its operations is noticeable. The past is truly prologue in the sense that solutions to professional problems have come about.

As an example, the following four professional dilemmas were presented in the prologue to the annual report prepared by USAB at the end of 1976. In only five years, three of the four dilemmas have been resolved, and the fourth is targeted for 1982. Consider the first of the problems as outlined in the annual report:

- *"You are a 50-year-old EE working on a Government aerospace contract for $17,290 per year. A new company takes over the contract and you receive an offer to continue your employment at $8,700 per year."*

In 1978, following a year-long struggle to devise a legislative solution, USAB achieved an administrative solution to the problem of wage-busting with OMB Policy Letter 78-2, which made professional salary considerations central to service contract bids. Government agencies were directed to consider whether realistic salary levels had been proposed. Under the new regulation, action can be taken by individuals working under service contracts to assure compliance. A booklet, *PAC Guide to Service Contracts* (subtitled "Your Rights As A Service Contract Employee") was published by USAB to provide guidance to members through the Professional Activities Committees of the IEEE Sections and Societies. Pressure is being continued, however, on the legislative front, with testimony and support for various bills. Another serious problem in 1976 was:

- *"You are 35 years old and far-sighted. Consequently, you're troubled by your company's inadequate pension plan. You would like to "opt out" and set up your own Individual Retirement Account (IRA). This way, you could sock away 1500 tax-deductible dollars every year and thereby add a tidy supplement to your ultimate retirement benefit. But the law forbids this simply because you are covered by your company's pension plan."*

In 1981, investment in IRAs was opened to all workers under the provisions of the Economic Recovery Act. The limitation is $2,000, and the deduction will be effective for tax years after 12/31/81. But USAB's efforts towards more equitable pension benefits are not limited to IRAs. Portable pensions is still an objective that will continue to be addressed in 1982. A third problem posed in USAB's 1976 report concerned:

- *"You are an EE with a severe conscience. You take seriously the IEEE Code of Ethics' charge to "protect the safety, health and welfare of the public and speak out against abuses in those areas affecting the public interest." But you also have a family to support and so you keep quiet about what you consider an unsafe practice on the project on which you're working. After all, if you "blow the whistle" and lose your job in the process, who will help you?"*

IEEE can help, according to policy and procedures initiated by USAB and approved by the IEEE Board of Directors in 1978. Procedures for support and procedures for discipline of members were outlined in various IEEE publications following BoD approval. A Member Conduct Committee is appointed each year to deal with ethical matters. USAB has published a number of materials to provide guidance to members through PACs. The fourth professional dilemma was described as follows:

- *"You are a prolific inventor. You've garnered a number of patents over the years, and while this has brought you a lot of praise, it rankles a bit that you've had to assign your company all the rights to your inventions. True, you've had some promotions, but you would still enjoy having some direct share in the income from these inventions. But there's nothing you can do. It's "company policy," and not unusual at that."*

The present Congressional session saw USAB's patent bill introduced, while a major lobbying effort is getting under way among volunteers. The provisions of this bill have been described in several publications. Essentially, it would provide rights to inventions made while employed, if such inventions are unrelated to the employer's business and did not involve the employer's time or materials. Last year, USAB supported legislation that returned to contractors the rights to inventions made under Federally sponsored research projects.

While these dilemmas may represent the major thrusts of USAB, they are by no means all the programs in progress in the Washington Office. When members decided that energy problems were foremost in their minds, according to the 1980 Opinion Survey conducted by USAB, the Energy Committee swung into action. It provided testimony on a number of energy projects, to the Congress and DOE, and it developed a number of positions ultimately approved by the BoD as IEEE Position Papers. The Committee also developed a slide presentation on the U.S. energy problem that will be distributed in January 1982 through the PACs. In turn, members may take it to other professional societies, civic organizations and schools for presentation.

USAB is ten years old in 1982, and the past years have often, not surprisingly, been turbulent ones. If, as engineers, we think in terms of lead-time from conception to marketing of an electronic system, ten is a decent average for the never-easy effort to go from ground zero to a focused, self-sustaining program aimed at meeting real needs at a reasonable cost.

Happy Birthday USAB!

A Kind Word for the Engineers

by Harry Schwartz

(Harry Schwartz, for many years a member of the editorial board of the New York Times, *is writer-in-residence at Columbia University's College of Physicians and Surgeons.)*

There is an extraordinary gulf between public attitudes toward technology and the attitudes of those most intimately involved with it—the engineers. The public, especially its best-educated members, seems to grow more hostile to technology with every decade. The earlier notion that it was more or less synonymous with progress has been replaced by a sense that it is a kind of poisoned wine, more likely to produce cancer and deformed babies than to improve human well-being. In *Blaming Technology* (St. Martin's Press, $12.95), Samuel Florman writes glumly: "Technology threatens to become in the 1980s what Communism was in the 1950s, or even what witchcraft was in Salem in the 1690s—a word so steeped in emotional implication that its very mention drowns out the voice of reason."

Thus the never-ending demonstrations against nuclear power and nuclear weapons (and the increasing tendency to lump the two together). Thus that incredible sequence last summer when California Governor Jerry Brown had to be virtually blackmailed by the Reagan Administration before he consented to the use of an aerial insecticide in fighting the Mediterranean fruit fly. Thus the continued stubborn insistence of the Food and Drug Administration on delaying approval of medicines whose safety and utility have been proved by years of experience abroad.

Resisting the message

Corporations have spent a lot of money trying to fight these attitudes—to argue, for example, that offshore oil drilling is compatible with good fishing and bird nesting. But such messages tend to be received skeptically because of the evident connection between the message preached and the profits of the preacher.

Missing in this debate have been the voices of working engineers. There has been no shortage of eloquent scientists—witness Francis Crick, Carl Sagan, Freeman Dyson—but it has been hard, until now, to find articulate engineers. Florman is the man we've been looking for. Incredible as the combination may appear, he is both a practicing engineer (vice president of Kreisler Borg Florman Construction Co. of Scarsdale, New York) and a truly gifted writer, published repeatedly in such magazines as *Harper's* and the *American Scholar*.

His responses to our modern Luddites will sometimes seem familiar to FORTUNE readers, but he has an unerring eye for irony and is pitiless in dealing with anti-nuclear foolishness. He pounces, for example, on a *New Yorker* article of several years ago that told of a woman afraid her child might contract leukemia because they live "not far" from a route traveled by trucks carrying nuclear waste. Florman notes that such trucks emit "less than one millirem per hour at a distance of three feet" and wonders "whether the woman permits her child to watch a couple of hours of television each day, for an annual dose of four millirem, or allows any dental X-rays at 20 millirem each."

What will seem much less familiar is Florman's perspective on several popular ideas about technology. One is that it is in some sense "out of control"—that our society persists in mindlessly producing things merely because it's possible to produce them, that "technology conquers all," and that we therefore keep ending up with scientific marvels that nobody really wants. This idea has considerable intuitive appeal, and Florman has great fun shooting it down. He does this devastatingly by reminding us of all the breakthroughs that didn't sell and were therefore withdrawn. For example, Corfam. Du Pont invested and lost a fortune when it turned out that people didn't really like shoes made of this miraculous plastic and stubbornly kept on preferring leather. For example, the rotary engine, on which General Motors lost an estimated $250 million to $300 million. Minnesota Mining & Manufacturing invented a thin loudspeaker that hi-fi fans presumably should have prefered to bulkier models but perversely didn't. Polaroid struck out on instant movies. And, Florman reminds us, "business executives who could rent television conference rooms . . . prefer getting up before dawn and flying halfway across the country to meet face-to-face in motel rooms."

The proposition that technology has a life of its own is closely related to another idea that, not surprisingly, Florman also challenges—the idea of technocracy. In its original form, this was a utopian concept, traceable to the pre-revolutionary French philosopher Henri de Saint-Simon, and referred to a future society in which the specialized knowledge of scientists and engineers would be translated into political power. Saint-Simon was a socialist, but a few nonsocialists, including Ayn Rand (whose views about technology were set forth in *Atlas Shrugged*), have also played with the idea that the no-nonsense engineers might eventually get the power they deserve.

Then there is the view that technocrats *already* have power, or, at least, are on the verge of attaining it. This view has been held in recent years by a variety of thinkers, most of whom tend to view the scene they describe with misgivings. One such thinker was President Eisenhower, whose farewell warnings about the military-industrial complex were accompanied by comparable concerns about an emerging "scientific-technological elite." Such views have been expressed by many academics, including John Kenneth Galbraith. In *The New Industrial State* (1967), he described a world in which "effective power of decision is lodged deeply in the technical planning and other specialized staff."

They do as they're told

Florman does not believe that engineers are entitled to greater political power and finds ludicrous the suggestion that they're already running things. The truth, he argues persuasively, is quite the opposite. In fact, engineers are an oppressed and generally powerless lot who do as they are told. Our schools graduate only a small proportion of their students as engineers because young Americans perceive correctly that engineering is the road to neither power nor wealth. Florman cites data showing that in the late 1970s, fewer than 15% of the chief executives of our largest corporations had engineering backgrounds. In a survey of high-level executives from the FORTUNE 500 industrials and the non-industrial "50 largest" lists, more than 1,700 were asked to state which of several listed factors had counted most in their success. Only 2.5% mentioned "technical competence."

Florman comes at the question of engineers' influence from an interesting angle—by reporting on the disdain for the field exhibited by women. He begins an absorbing chapter on "The Feminist Face of Anti-technology" by noting that "most bright young women today do not want to become engineers" even though "engineering is the only field in which average starting salaries for women are higher than those for men."

How can this be? The answer, plainly, is engineers' lack of social status. Florman likens them to ethnic minorities, and observes that engineering has appealed in recent years mainly to bright young men of lower- and lower-middle-class origins. He also observes that young women who know enough mathematics and science today to have options about engineering are mainly from the upper classes. They sense that becoming engineers would tend to lower, rather than raise, their status.

Beyond words

The author of *Blaming Technology* is manifestly a man of conservative instincts, and he certainly has no desire to transform the capitalist system. Yet he ends with a kind of complaint about it: by the time he is through demonstrating that engineers lack clout, he has made it clear that he considers the situation unjust. He believes that our society is failing to recognize the unique contribution of technology and those who develop it. The engineer, he believes, is "the somebody in our society [who] has to design, create, fabricate, build—to *do*. A world full of coordinators, critics, and manipulators would have nothing in it but words. It would be a barren desert, devoid of *things*."

My own sense is that, both in defending technology and complaining about the status of "technologists," Florman accurately represents the feelings of the generally inarticulate group to which he belongs. He is also reminding us—and it's evidently a reminder needed by the intellectual and business communities—that any modern society is in trouble when it implicitly disparages the role of the people who make things work. ■

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OPINIONS AND ITEMS FOR DISCUSSION

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Ms. Melba Meek, Job Service Order #559678, 505 Washington Avenue, St. Louis, Missouri 63101.

Dear Ms. Meek:

With respect to your employment opportunity advertisement in the December, 1981 issue of IEEE's *Spectrum Magazine* I am enclosing an excerpt from the IEEE 1981 U.S. Membership Salary Survey. In particular on page 12 of the survey exhibit 10, "Income vs. Highest Degree Earned," shows the first decile for Doctoral Electrical Engineering Degree holders employed full time in their primary technical area to be $27,321 per annum. It further shows the first quartile salary level to be $33,437 and the median to be $40,000 per annum. Current entry level B.S. degree holders in Electrical Engineering are receiving $23,500 to start in 1982 according to a just-completed forecast survey conducted by Fox-Morris Personnel Consultants. Hence, I as a senior Ph.D. Licensed Professional Engineer at a large mid-west firm and more importantly, as the National Chairman of all of IEEE's local Professional Activities Committees throughout the U.S., am appalled by your offer of $22,000-$25,000 per year. The experience and educational level you are seeking to work on the DoE contract on large interconnected power systems does not match a salary lower than the average paid this year to a graduating B.S. student. Furthermore, this ad does not appear to be for an academic position as no teaching will be required nor is any University even mentioned. Hence it cannot be weakly justified because "the Dean only received so much money for faculty salaries from the legislature."

The overwhelming majority of all the U.S. Professional Activities Committee Organizations' leadership can view your clients' ad as only a possible subterfuge to satisfy DoL requirements before bringing an alien engineer into the country or allowing one to remain here after graduation. To us only an alien desperate for a U.S. job would work for this shockingly low wage. Certainly no American engineer with 7-8 years of school plus the demonstrated expertise and experience you request would do so. We therefore request that you please refrain hereafter from placing such low salary offer advertisements in an IEEE membership publication. Furthermore, by way of copy to IEEE's Publications Board we request that such advertising be rejected in the future using the guidelines proposed by IEEE's United States Activities Board last year.

I thank you for reading this and for your consideration of the sensibilities of engineering professionals in the future.

Sincerely,
Ronald J. Fredricks

POSTSCRIPT FOR *IMPACT* READERS

Undoubtedly, Melba Meek is a fictitious person, but to be sure, the Meek agency will continue to search for an experienced E.E. with a graduate degree willing to work for such a low salary. However, I feel my letter and especially its copies to Headquarters and PUB serves a purpose, if I can cause such low-paying position offers to disappear from our own membership-supported magazines, journals and newsletters. While not illegal under U.S. law, such ads are just as insulting to the overwhelming majority of our membership as those which would discriminate on the basis of race or age. Why, I ask, should we allow ourselves to be offended monthly in *Spectrum* or *The Institute*?

I therefore view the writing of such response letters as a useful PAC project for all of our PAC volunteers. Up to now it appears that only one member, Irwin Feerst, has done any significant amount of letter writing to the IEEE Publications Board. Unfortunately, for the point he is trying to make, Mr. Feerst usually calls for the removal from office of various volunteers or the firing of various staff people. Hence, his letters tend to be ignored by such individuals as Herz, Christiansen, Rubinstein, or Rodrigue, who could do something about adopting a publication policy similar to that approved by USAB last August. I feel we must have well-composed, tactful, but firm letters written from a broad cross section of our membership to PUB before anything will be done! Please copy Jack Doyle and me on any such correspondence you write. I am looking for your support on this.

—Ron Fredricks
National PAC Chairman

EDITOR:

The first and last paragraphs of Mr. Malcolm Drummond's "Common Sense" (*IMPACT*, Aug. '81) succinctly summarizes the dilemma of our growing high technology society. However, his proposed solution is NOT the answer to the problem. We have had *registered* professional engineers for a long time. There is no evidence that they are either more competent, more productive or more ethical than the general engineering population. Changing to "certified" engineers would be merely a sematic substitution.

There *is* compression in *average* engineering salaries due to a leveling off of responsibilities. But there is *no* compression in salaries of *individual* engineers whose responsibilities have *not* leveled off!

The point is that responsibilities level off only as a result of leveling off in contribution and competence. Engineers who maintain and extend their technical competence and maintain and extend their contribution will *not* level off in either responsibility or salary.

Published data on *average* engineering salaries can be very misleading. As Mr. Drummond said in his last paragraph, there is a golden opportunity for the mature engineer who is also ethical, visible and productive. But this is not a new situation. There have *always* been and always will be golden opportunities for such people.

In today's high growth, high technology companies, mature engineers who are ethical, visible and productive become managers, directors and vice presidents, in engi-

Continued

Continued from page 15

neering, as well as in *other* departments. Thus these people *grow out* of the engineering ranks and their high salaries are no longer included in the salary surveys.

Whereas in most professions (doctors and lawyers, for example) the professional retains his identity throughout his or her career, the most competent and productive engineers eventually lose their identity as a practicing engineer. This is not necessarily bad, it's just the way things are. Minds developed under an engineering discipline are valuable and are needed in *all* departments of the company, from accounting to warehousing. As our society continues its industrial-to-high technology evolution, these needs will become greater and greater. The *real* challenge is the growing shortage of entry level engineers and technicians to supply these growing needs.

Mr. Drummond's proposal to reduce the demand by keeping engineers from leaving the profession just won't work. Somehow the supply *MUST* be increased.

Perhaps it's time for the engineering societies to look beyond the fields of practicing engineers, and promote the advantages of a technical education in virtually *all* professions.

Regards,
Earl J. Rogers

(cut here)

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