TECHNOLOGY and SOCIETY

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EDITOR: NORMAN BALABANIAN **VOL. 8, NO. 4, DECEMBER 1980 (USPS 321-090)**

Do We Know What "Technology" Means?

GEORGE SINCLAIR

Engineers are becoming more and more involved in the issue of the impact of technology on society, but do we engineers know what is the meaning of the word "technology"? Is it a well-defined concept? I think the answers to questions such as these, will prove to be rather discouraging.

There are probably as many definitions of the word "technology" as there are people who use it. A few typical definitions are:

1. The science of the industrial arts (*Oxford Concise Dictionary*[1], 1951).

2. The application of science, especially to industrial or commercial objectives (*American Heritage Dictionary*[2], 1970).

3. The organization of knowledge for the achievement of practical purposes (Mesthene[3]).

4. Man's efforts to cope with his physical environment and his attempts to subdue or control that environment by means of his imagination and ingenuity in the use of available resources. (Kranzberg and Pursell, Jr.[4]).

5. How things are commonly done or made, and what things are done or made (Charles Singer[4]).

6. The system by which a society provides its members with those things needed or desired. (*Webster's New World Dictionary*[5], 1974).

Modern writers, other than the philosophers of technology, rarely mention the question of definition of the term, it being presumed that the meaning or definition is well-known and does not need repetition.

It is quite unreasonable to ask for a single-sentence definition of words like technology, science, engineering, medicine, architecture, profession, etc., except possibly for dictionary purposes. It is impossible to compress into a single sentence, enough information to convey, in any meaningful way, the complexities of the concepts encompassed by such words.

A complete analysis of the activities involved in the concept "science," for example, clearly would occupy a whole volume, and the contents of such a volume would constitute a *philosophy of science*. Similarly, a complete analysis of the concept of "engineering" would require a volume, covering the *philosophy of engineering*. Regretably, there does not exist a useful philosophy of engi-

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In This Issue

TECHNOLOGY AND SOCIETY serves as a forum for free, informed discussion of all aspects of social implications of technology and welcomes articles and letters from readers. The views and statements published in TECHNOLOGY AND SOCIETY are those of the respective authors and not necessarily those of IEEE, its Board of Directors, the Technical Activities Board, or CSIT—or of any organization with which an author is affiliated.

CSIT Meeting Schedule

The next two meetings are tentatively set as follows:

Saturday, January 17, 1981. From 10:15 to 3:15. Columbia University, New York, 13th Floor, Mudd Building.

During Electro 81, either April 7, 8, or 9.

Anyone wishing to attend a meeting should call Steve Unger to confirm the dates.

AAAS Sessions of Interest to CSIT

At the next Annual Meeting of the American Association for the Advancement of Science (AAAS), to be held in Toronto, January 3–8, 1981, there are at least two sessions that might be interesting to CSIT members. One session on Science and Secrecy being held in the morning of January 6 was organized by CSIT chairman Stephen H. Unger. The stated purpose of the session is "to explore the conflicts between secrecy based on national security and the free flow of information necessary to the scientific community as well as to a democratic society." (See related article on cryptography research in this issue.) The other session is scheduled for the morning of January 4 and is titled: Do the Engineering and Scientific Societies Have a Role in Promoting Ethical Conduct among Their Members?

Book Reviews Associate Editor Appointed

Professor Naresh Sinha has accepted the position of Associate Editor for Book Reviews. Anyone who would like to review a book for *Technology & Society* or has a suggestion for books to be reviewed, please contact him at the address appearing elsewhere on this page.

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Letters

To the Editor:

The Program on Science, Technology and Society maintains a library of periodicals, monographs, and books for use of faculty and students having scholarly interests in the interplay of science, technology, and society. I was distressed to learn that our library has not subscribed to *Technology and Society* published by the IEEE Committee on Social Implications of Technology. I believe this quarterly is an important source of material which we should have available to us.

It was even more disturbing to learn that it is an IEEE policy to restrict this publication to its members only. I find this policy difficult to understand. Clearly, the issues of professional responsibility merit discussion by all of us in the engineering profession and your publication provides a responsible vehicle for identifying and discussing topics of importance.

I would like to urge you to consider making *Technology and Society* available to others who may be interested in subscribing.

Walter R. Lynn
Director, P.E., Ph.D.
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The Professional Rights of Engineers

ALBERT FLORES

I

A great deal of the literature in the field of "engineering ethics" concerns itself with the duties and professional responsibilities which engineers owe to clients, colleagues, employers, and society, or with case histories of their failures to adequately satisfy these duties and responsibilities. From the point of view of the engineering profession this is, of course, understandable given the importance which it places on practicing according to the standards laid down in its codes of ethics (in various versions). It is reasonable too, from the wider perspective of the public interest. Professional authority, if abused, can adversely affect the interests of society and this may undermine public confidence in a profession and its practitioners. Thus, it is important that professionals acknowledge their duties and proper that much of the discussion of the ethics of engineers focus on professional responsibilities.

Unfortunately, although these are issues which deserve our careful attention, it is apparent that we have ignored a topic intimately connected with the issue of professional responsibility and one, perhaps, equal in importance to the public's interest, viz., the *rights* which individuals possess as a consequence of their *professional* status.

But why is it important to recognize that engineers have professional rights and how are professional rights different from the other rights we have as individuals? It is the purpose of this paper to try and provide answers to these questions.

II

What do we mean when we say that individuals have *rights*: for example, the right to speak freely or the right to be treated with respect?[1] In general, we normally mean that they are entitled to expect that *others* will not interfere with them when they act. For example, when we say that engineers have a right to publicly express an opinion on the development of nuclear power as an energy source, we mean that it would be wrong for others, including employers, to prohibit or interfere with engineers stating their views. A right is, hence, a capacity to act which others are duty-bound to respect. In other words, to have a right is to be in a position to make a claim against the behavior of others.

The nature of this claim is in the form of an obligation or duty which others owe to us as right holders. These obligations are of two kinds: *positive obligations*, in the sense that a right holder profits or benefits from the actions of others because they are duty-bound to give us something; and *negative obligations*, in that others are required to restrain themselves from interfering with us when we act. Thus, the right to do something, implies (a) that there is no existing obligation which prohibits our acting in a particular way, and (b) that others are obliged to us either (i) because they owe us something we are entitled to, or (ii) because it would be wrong for them to interfere with our performance of this action.

Generally, the possession of a right entails that individuals have discretion as to whether or not to exercise it. Engineers may have a right to adequate compensation for work performed. But they may choose to waive this right when, for example, they donate their time and expertise by assisting underdeveloped countries in public works projects, consulting on the design of an addition to a local church or half-way house, or relieving a bankrupt client of some or all of the debts owed to them. There are, however, important exceptions to this principle. Some rights cannot be waived if we are to maintain our dignity as human beings and our integrity and self-esteem as professionals. Historically, governments have been most responsible for taking advantage of our failure to exercise certain individual rights, but with the pervasive growth and influence of organizations and institutions employing large numbers of individuals, including professionals, the threat to individual and professional rights from this source is even more insidious.[2]

To summarize when we say that individuals have rights we are asserting that they are entitled to benefit or profit from the behavior of others against whom the right is claimed. A right is an *interest* deserving special protection which may be derived from law, socially established rules, or by the fact of one's status, (e.g., human being, parent, citizen, creditor, professional, etc). It imposes obligations on others either to give to the right-holders something they are warranted in claiming as their own, or to refrain from interferring or prohibiting them from performing acts to which they are entitled as their right. When individuals demand their rights they are seeking satisfaction from those who have obligations to them, for which they have a legitimate claim.

III

If this is what we mean when we say that individuals have rights, what then are *professional rights*?

The answer I propose is an instance of a more general theory of rights, in that it appeals to a common notion of what it means and why it is important to have rights. It assumes that there is an intimate connection between rights and having a valued status or characteristic, and that rights

This is an extract of a longer paper forthcoming in Issues in Engineering (Autumn 1980) entitled "Engineers' Professional Rights." I extend my thanks to Deborah Johnson and Fred Elliston for their helpful criticisms of an earlier draft of this paper; to Frances Anderson for her assistance in preparing the manuscript; and to the National Endowment for the Humanities, for a grant (No. 27912-77-271) that supported some of the research for this paper.

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are a way of protecting certain activities or interests which contribute in some essential way to the existence of this status or characteristic. Thus, just as human rights set off certain activities for special protection from the interference of others or provide for what may be our just due, professional rights will serve a similar purpose.

So, for example, lawyers and physicians could not practice unless they have the right to protect privileged information. In order to serve the client's needs, these professionals require sensitive information concerning the client's situation, which the client would have no good reason to reveal without first obtaining an assurance that it will remain confidential. The right of confidentiality not only promotes trust, but it is necessary if these professionals are to fulfill their professionally defined functions. Thus, to say professionals have rights *qua* professional is to imply that certain activities and interests which one may have as a professional are crucial to the satisfaction of one's professional function.

The case is similar for engineers. For example, engineers are required to "protect the safety, health and welfare of the public and speak out against abuses in these areas affecting the public interest" (IEEE Code of Ethics for Engineers). But in order to satisfy this duty it is necessary that they have the right to judge the technical and design details of products to whose production they contribute; and the right to publicly express their views when these products adversely affect the public's interest, without fear of jeopardizing their position of employment. Without these rights, they cannot be expected to adequately fulfill their duties to protect the public from harmful products, materials, or constructions. In short, since engineers should enjoy protection from unwarranted interference in the satisfaction of this duty, activities which promote public safety should be matters which identify some of the professional rights of engineers.

Generally, then, professional rights can be established and justified by careful consideration of the things essential to the satisfaction of a profession's purpose, goal, or function. It should, however, be noted that it is not easy to clearly define a profession's purpose. In part, this is a question of competing conceptions of what the *ideal* professional engineer, lawyer, physician, etc. should be. Obviously, then, there will be considerable debate over what rights professionals can claim as their *professional* right. But if we can come to some agreement on the ends of a profession, and on which activities are crucial to the promotion of these ends, we may want to single these out as activities which professionals are entitled to perform as their right.

One cautionary note: Some of the rights which are claimed as "professional" rights are in reality *contractual* rights. Those who make a contract voluntarily incur obligations which they owe to the person with whom they have contracted. The benefits resulting to either party from this contract can be claimed as a right, i.e., something to which one is entitled.

So, for example, the engineer's right to receive adequate compensation for work performed is a right that Robert Whitelaw singles out in his "Bill of Rights for Engineers" as a "professional" right of engineers.[3] But it is not a "professional" right *per se*. Rather it is grounded in a contract between the engineer and the client. The benefit which a client receives from the exercise of engineering skills requires appropriate compensation for which the engineer is entitled. Here a contract establishes the engineer's right and imposes on the client an obligation to honor this claim. Obviously, one can have this kind of right regardless of one's status. Thus, these and similar rights are not strictly speaking "professional" rights, though professionals can have them.

IV

Rights have been historically important because they function as a method of protecting individuals and their interests from the abuse of the power and authority possessed by rulers, police, institutions, etc. With the growth and concentration of power in these sources since the middle ages, there developed a need to identify certain interferences in matters of personal sovereignty which no power could justly exercise over individuals. To identify something as a *right* is to specify a limit on the authority of others by imposing obligations on them either to refrain from interferring or to provide what is due; and in this way individual interests are protected from the tyranny of authority. Thus the need to protect ourselves from the abuse of authority is generally a ground sufficient to justify claiming certain rights.

The importance of *professional rights* may be similarly explained. For with the increased institutional control and supervision of professional activities, practicing professionals are forced to develop a way of protecting their professional interests in matters which they alone should have jurisdiction. If we define a "professional" as someone who has a skill which serves an essential social need, then the proper use of this skill depends upon the unrestricted exercise of professional judgement. In an organizational context, professional interests and judgements will not necessarily take priority over the interests and needs of the organization. Realistically, this is to be expected, but the effect may be a perversion of professional judgement serious enough to affect a profession's ability to serve society's needs. To avoid this unacceptable consequence, it may be necessary to acknowledge the existence of special rights which organizations are obliged to respect and which employed professionals are entitled to act upon by the mere fact of their professional status.

For the engineering profession, it is of vital importance that it pay serious attention to the professional rights of its members. First, most engineers practice their profession as employees of industry or government. Except for a small minority of self-employed consultants, few engineers enjoy the autonomy characteristic of the more traditional professions and, consequently, their rights are easier to ignore.

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CSIT Meeting Highlights

A meeting of the Committee on the Social Implications of Technology was convened at Columbia University in New York City on September 13, 1980. Attendees were: Stephen Unger (chairman), Norman Balabanian, Carl Barus, Daniel Berger, R. J. Bogumil, David Cook, Irwin Feerst, Victor Klig, Richard Koch, Frank Kotasek, Richard Labonski, Lester Nagel, Gerald Rabow, Susan Thomas, William Underwood, Donald Wilson, Esmi Bidstrup (IEEE Staff), and Mona Reisman (IEEE Staff). The following is a summary of the meeting minutes.

Status of Effort to Convert CSIT to an IEEE Society

Unger had attended the July 17–18 meetings of the Technical Activities Board to press CSIT's proposal to convert CSIT to an IEEE society. He summarized the outcome of those meetings as follows (see also T&S, September 1980, pp. 14–15; and *The Institute*, October 1980, p. 4): On July 17, TAB OpCom gave preliminary approval to the CSIT proposal. On July 18, most of the society presidents who spoke expressed opposition to the proposal. Leo Young suggested that, in order to accommodate their concerns about the proposed society, the SSIT constitution provide that a substantial number of SSIT's governing body (AdCom) be appointed by divisional directors. It was agreed that Unger would chair an ad hoc committee, representing various viewpoints on TAB, to prepare a draft constitution that would be submitted to the December 4 TAB meeting for approval. However, substantial opposition to society status for CSIT still remained among TAB members.

Subsequent to the TAB meeting, TAB Chairman Robert E. Larson named the members of the committee (with Unger as chairman) to draft the SSIT constitution.

The following motion was passed by CSIT: that Unger convene the committee, appointed by Larson, for the purpose of drafting the SSIT constitution.

As of September 13, the CSIT petition for society status had 750 signatures. (The statutory minimum required is 100 signatures.)

Future Plans for CSIT

A number of ideas to increase CSIT's effectiveness were discussed (see p. 15, September T&S). CSIT will organize a systematic membership drive to carry out these tasks and, in particular, to increase the number of subscribers to T&S; a firm plan of action will be hammered out at the November 15 meeting. Four people volunteered to begin work immediately on the membership drive.

Report from DC Area Working Group

A Washington-DC-Area Working Group of CSIT has been formed (T&S, September, pp. 2, 20). Labonski and Thomas reported that thus far the Group has held four monthly meetings and has thirteen active members on its roster. The primary activity to date has been to organize the October 29 dinner and speaker meeting, at which Rosemary Chalk of AAAS will speak on "Ethical Dilemmas in Modern Engineering." (See report in this issue.) The meeting has been well publicized, and it is hoped that many of the people who attend the meeting will become active members of the DC Group.

Cooperation with IEEE Environmental Quality Committee

EQC has expressed an interest in submitting articles to T&S. Balabanian invited EQC to appoint an associate editor to T&S to facilitate this process. Nagel will contact Bernard Manheimer (EQC Chairman) about this.

Nagel invited CSIT to work with EQC in organizing sessions and other activities at the Electrotechnology and Environment (ETE) program at the IEEE Centennial in Philadelphia in 1984. Cook, Kotasek, and members of the DC Group will work on this. Barus and Berger will help EQC coordinate its activities with the Philadelphia area IEEE sections.

Technology and Society

The editor is seeking volunteers to put together special issues of T&S on specific topics. He is also seeking a book review editor. (Note: Subsequent to the meeting, Naresh Sinha volunteered to serve as book review editor.) More book reviewers are also needed. Volunteers are asked to please contact Norman Balabanian (315) 423-4401.

T&S invited the Union of Concerned Scientists and the IEEE Power Engineering Society to each name an author to take part in a written debate on nuclear energy in T&S (one short article plus one rebuttal for each side). UCS accepted the invitation, but PES declined.

Report from Working Group on Ethics and Employment Practices

Unger had discussed the possibility of re-activating the USAB Task Force on Ethics with Richard Gowen (IEEE VP for Professional Activities) and had offered to serve on the Task Force. In accordance with these discussions, Unger submitted a written proposal to Gowen on August 4. The proposal for the Task Force included the following agenda of action items:

1. Publish a notice once a year informing all IEEE members of IEEE's procedures to discipline them if they violate the IEEE Code of Ethics and to support them if their careers are placed in jeopardy as a consequence of their adherence to the Code.
2. Provide for publication of an annual report on the activities of the IEEE Member Conduct Committee.
3. Provide for publication of reports on ethics cases investigated by the MCC.
4. Develop recommendations for:
   a) A Legal Defense Fund to aid IEEE members placed in jeopardy as a consequence of their adherence to the IEEE Code of Ethics.
   b) Model legislation to make it clear that engineers

c) Adoption, by employers of engineers, of internal procedures that encourage responsible professional behavior.

To date, Unger has received no reply to his proposal.

It was agreed that the CSIT WG-Ethics will proceed to tackle the above tasks if USAB does not wish to pursue them, and that CSIT will continue to seek the support of USAB in this endeavor. (Note: Subsequent to the CSIT meeting showed that USAB had reactivated its Ethics Task Force, but that the Task Force would not be working on any of the tasks proposed by Unger.) T&S readers who are interested in working on any of the proposed tasks are asked to please contact Stephen Unger (201) 567-5923.

Frank Kotasek
CSIT Secretary

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neering, and this is precisely why the term "technology" is controversial. If we fully understood what constitutes engineering, we would lose most of our interest in "technology."

The ECPD definition of engineering which has been used for several decades, in the accreditation of engineering education programs, is a good example of the absurdity of single-sentence definitions. It reads:

> Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgement to develop ways to utilize, economically, the materials and forces of nature, for the benefit of mankind.

A close examination reveals that most of the words are actually defining what is meant by the word "profession," namely[6]:

> A profession (is a vocation) in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgement to develop ways to (achieve a particular goal), economically, for the benefit of mankind.

If these words are deleted, as being redundant, there remains:

> Engineering is the profession concerned with utilizing the materials and forces of nature.

This says nothing more than that engineering is the profession concerned with our physical environment. As a single-sentence definition of engineering, it is acceptable, but quite useless for accreditation purposes.

If one desires to probe the real meaning of the concept "technology" it is obviously necessary to examine the *philosophy of technology*. Unfortunately, this proves to be quite disappointing, because, if there is a common theme to current writings on this topic, it is that a *useful philosophy does not exist*.

Consider the following:

a. "A number of serious, albeit beginning, attempts have been made to address the problem of the lack of a respectable philosophy of technology in English-speaking circles ... what I propose here is not another beginning; I have already added my voice to the chorus of those lamenting the lack of an adequate philosophy of technology." Paul T. Durbin[6]

b. "There is at present no highly developed philosophy of technology. One reason is the lack of agreement on the sense in which technology calls for an explanation. There is little fruitful controversy because it is not clear what precisely one should disagree on." Albert Borgmann[7]

c. "Perhaps the most accurate observation one can make about the philosophy of technology is that there really isn't one." Langdon Winner[8]

The philosophers are obviously struggling to define what is meant by the term "technology." Winner's article should be required reading for every engineer concerned with the subject of technology and society.

The problem faced by the philosophers of technology is not merely one of finding the right set of words, but the more fundamental question of what is the precise concept involved, as pointed out by Borgmann. Technology is a most ambiguous word, which evokes totally different concepts in the minds of different people.

Words of ambiguous meanings can be used (truth, beauty, justice, etc.) but they differ from "technology" which involves erroneous concepts. The impact produced by technology on society, is mostly produced by human beings rather than by "artifacts."

Any engineer who thinks that he knows what is meant by the word "technology" should read an article by the well-known philosopher of technology, Carl Mitcham, entitled "Types of technology."[9] He states that there are four categories of meanings for the ways in which social scientists use the term technology:

1. *Technology-as-object*. This class includes utensils, apparatus, utilities (such as roads, buildings, power lines, etc.) and tools.
2. *Technology-as-process*. This includes the processes of both making and using artifacts, involving invention, design, fabricating and using artifacts.
3. *Technology-as-knowledge*. This category presents many difficulties for the philosophers. It includes rules of thumb, cookbook recipes, empirical laws, and technological theories (such as engineering science).
4. *Technology-as-volition*. This category has to do with such matters as technology and values, problems of personal involvement with technology, technology and

society, etc. It includes technologies associated with the will to survive, the will to power, the will to realize almost any self concept.

The problems with these definitions is that they are completely divorced from any human involvement. For example, technology-as-knowledge does not produce an impact on society. The impact occurs when some human being decides to exploit the knowledge.

Mitcham required *sixty-five pages* to define technology. It was quite astonishing, therefore, to note that he disposed of the definition of engineering in a *single paragraph*! He said:

> Engineering is identified with the systematic knowledge of how to design artifacts—a discipline which (as the standard engineering educational curriculum shows) includes some pure science and mathematics, the so-called "engineering sciences" (e.g., strength of materials, thermodynamics), and is actualized by some social need. But while engineering involves a relationship to these other elements, still it is design (and the technical ideal of efficiency which distinguishes engineering from, say, artistic design) that constitutes the essence of engineering

This is actually a definition of "engineering science," as a branch of knowledge, and it definitely does not bring out what is truly the essence of engineering, namely, that *engineering is one of the professions*. It is precisely the failure to recognize and understand what this means, that is the missing factor which the philosophers are seeking and not finding. The words "profession" and "professional" never appear in anything written by social scientists, historians or philosophers of technology; hence, what they say about engineering is inherently deficient.

Any engineer who discusses issues relating to technology and society, must surely be misguided if the professional aspects of engineering are ignored or overlooked. It is an unfortunate fact that few engineers today have the competence to explain to nonengineers what it means to be a *professional* engineer. Clear evidence of this is exhibited in the perennial discussions at engineering meetings on the subject of the conflict over the role of the engineer versus the role of the engineering technologist. The correct view is that the engineer is (or at least, should be) a *professional*, while the engineering technologist is not. Their relative technical competence is not the issue.

The universities no longer produce engineering graduates with training which leads to becoming professional engineers. Nearly all engineering academics today are actually engineering scientists (and quite competent ones) but in no sense can they claim to be professional engineers.

Mitcham's definition of engineering is unacceptable, on several counts. It is not acceptable as a definition of engineering science since it contains these words within the definition. The idea that it is "design" and "the technical ideal of efficiency" which constitutes the essence of engineering is quite obsolete and inaccurate. The essence of engineering *should be its professional characteristics*.[10,11] It will come as a surprise to most people that about two-thirds of all engineers today are engaged in the service areas, where they have little or nothing to do with the design of "artifacts."[3]

A proper definition of engineering cannot be compressed into a single sentence or a single paragraph. When it takes Mitcham 65 pages to define technology, it should take as much or more to define engineering as a profession. We need a philosophy of engineering as a profession,[12] not a philosophy of technology.

Engineers are very much concerned with the matter of engineering ethics. I cannot understand how anyone can expect to pass judgement on ethical matters relating to engineering when there does not exist a philosophical basis to provide guidelines as to what constitutes engineering. We cannot even produce a proper definition of engineering.

I suggest that what society needs, very desperately, is not studies on the impact of "technology" on society, but on the conspicuous failure of engineers to produce impacts on society, in their *professional capacities*. Take the energy problem, for example. Few engineers are aware there is virtually no possibility that a realistic solution to the energy crisis will appear in the foreseeable future.

As is well known in Washington, but less well known in academic circles, innovation has vanished in U.S. industry, over the last decade. It will surely require industrial innovations of considerable magnitude to produce an impact on the energy supply; but since innovation is nearly impossible to produce, it is rather unlikely there will exist a solar energy industry, a wind energy industry, a fusion energy industry, etc., of any consequence. Even if we actually knew how to create industrial innovations, which we don't, it would still take 10 to 12 years before such ventures would become profitable,[13] and several more to be large enough to help solve the energy crisis.

Unfortunately, time is not on our side. This year, the United States will import about $100 billion of petroleum. Compare that with the fact that the total assets of all the industrial corporations listed on the New York Stock Exchange have a value of less than ten times that amount! The U.S. will have to mortgage most of its industries to pay for imported oil for the next decade.

Yet the engineers are not objecting while the scientific community, which dominates the research in fusion energy, says it will take the *scientists* from 20 to 25 years to solve the problems of fusion, most of which now are engineering problems. The scientists are planning to make the choice between magnetic confinement and inertial confinement, but surely that choice should be made by engineers in industry.

Unfortunately there are few professional engineers with the competence to provide useful advice in the energy field. President Carter was absolutely correct when he said in his so-called "Confidence Speech" on July 15, 1979 that the U.S. faces a problem more serious than inflation and more serious than the energy crisis, namely, the "crisis of confidence." There is little reason anymore for placing much confidence in the competence of the engineering profession for providing advice, particularly in the field of energy.

The failure of U.S. industry to produce important industrial innovations in recent years, is partly attributable to the erroneous concepts of science policies. During the amounted to about $360 billion, but there was not much innovative industry created. Industrial policymakers are now focussing on technology policies[14] for economic growth, but there is little hope for success.

Economic growth results when human entrepreneurs create successful new ventures (and this is how new "technologies" are actually generated). As pointed out by Biggadike[13] the incentives and rewards for entrepreneurship are virtually nonexistent. It is mostly engineers rather than scientists who launch innovative new businesses. What is needed is an engineering policy, aimed at encouraging engineers to create new industries by providing adequate rewards.

Academics who teach courses on technology and society seem to be unaware that the concepts which underlie the word "technology" are poorly understood, so such courses have very shaky foundations. As pointed out by Eugene S. Ferguson:[15]

> ... the sudden demand for relevant discussions of technology and society puts the history of technology under intense pressure to claim more understanding and wisdom than it is, in its present state, likely to deliver.

His explanation is:

> The ingredient that is noticeably missing from nearly all histories of technology, both internal and external, is a serious inquiry into the nature of technology itself.

I suggest that what the historians and philosophers of technology are missing, is the fact that it is the professional activities of engineers, and others, which produce the major impacts attributed erroneously to "technological" artifacts.

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Flores, continued from page 4

In an organizational context where one's actions are subject to review by superiors, it is difficult to assert or demand that one's rights be recognized. Secondly, the profession's failure to acknowledge the importance of professional rights may contribute to a public attitude which can undermine professional authority and which may lead to a loss of respect for professional judgement. Moreover, the public's indifference and ignorance of the rights of professionals only lends credibility to those unscrupulous practitioners who believe that they are justified in ignoring professional responsibilities because their rights are threatened, violated, or ignored. Finally, without the autonomy and authority, dictated by skill and conscience, to act on professional judgements, it is doubtful that we can hold engineers wholly responsible for their activities when these may be harmful to the public's welfare.

For engineers it is important that they know what rights their professional status accords them. Currently, many decisions relating to engineering design, manufacture and construction, highly technical matters which only an engineer may be qualified to assess, are often routinely made by superiors in management who are normally without the necessary expertise to decide such matters. In many cases, this abridgement of professional authority can adversely affect the public's interests, as the growing concern over product safety so amply demonstrates.[4] Acquiescence in these matters can only lead to a serious deterioration in the respect which the rights of engineers deserve. Just as our natural right to act on our conscience or the right to freedom of speech are examples of rights we cannot choose not to exercise without also abdicating our role as responsible moral agents, engineers cannot afford to waive those rights which are essential to excellence in the practice of their profession and remain faithful to the character that defines a professional engineer.

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A Question of Credibility

DONALD N. ZWIEP

The issue of credibility, which is crucial to the status of the engineering profession, will come under increasingly intense scrutiny and controversy in the months and years ahead. If our competence can be successfully questioned and our professional ethics bent and distorted, then we will soon become the handmaidens of any number of outside alien interests and pressures. Furthermore, our independence and integrity will be undermined and our authority diminished. Protecting our hard-won and irreplaceable professional credibility, therefore, becomes a matter of the utmost priority. We must answer our critics rationally, firmly, and irrefutably. We must continue to work to strengthen our professional practices and code of ethics. And perhaps the most important, we must stimulate widespread debate and discussion among our members on what steps we can take to maintain the high prestige and respect traditionally accorded the engineering profession.

In 1949, a British writer by the name of George Orwell published a chilling novel called *Nineteen Eighty-Four*. The book portrayed an extreme version of a fictional totalitarian state and its devastating impact on the lives of its inhabitants. His story introduced into the English language such expressions as *Big Brother*, *Newspeak*, and *Doublethink*. When it first appeared, *Nineteen Eighty-Four* troubled millions of thoughtful readers throughout the world, who feared that totalitarianism might be the wave of the future. Well, the year 1984 is almost upon us and the specter of totalitarianism does not seem to be so overwhelming or so inevitable as it did perhaps 30 years ago. However, several of Orwell's make-believe predictions are suddenly beginning to loom very large and very real. First and foremost is the question of credibility.

The most serious immediate and obvious problem that the nation faces is the energy crisis. Presidents Nixon, Ford, and Carter have repeatedly told the American people in compelling and unequivocal terms that the energy crisis is a reality—that it is upon us—that we must do something about it forthwith—that it threatens our standard of living and even our way of life. Yet the latest polls show that the majority of Americans still believe that the energy crisis is contrived. And the sad thing is that no one really knows how to bridge this credibility gap.

The Physicians

The issue of credibility has taken its toll in other aspects of our daily life. We have become a litigious society because some people no longer trust or have confidence in many of the most prestigious and respected professions. For instance, it used to be that the doctor was a pillar of the community. His judgment was rarely questioned. When he pronounced you ill, you were truly ill! When he performed surgery, it was an essential and necessary step. But then a few doctors made mistakes—unfortunately well-publicized mistakes—in their diagnosis of symptoms or in their operating-room procedures. The consequences are clear: The credibility of the medical profession has become suspect. Now patients who feel that they have been deceived, improperly treated, or otherwise abused by their physicians have taken their grievances to court. Today, malpractice suits are a major headache for the doctors. The entire medical profession has fallen under a cloud, and whether it will ever regain its former status of unchallenged credibility is a moot question.

The Lawyers

Lawyers, by virtue of their numbers and their widespread influence, undoubtedly constitute the single most important profession in the U.S. Aside from those in legal practice, lawyers sit on the boards of virtually every corporation in the country. They dominate the executive, legislative, and, of course, the judicial branches of our federal government. And they are equally numerous in those same functions at the state, county, city, and municipal levels. As regulators, they scrutinize and supervise everything from airline operations to TV commercials. As governmental watchdogs, they point the searchlight of publicity on those public servants who misuse their positions of trust. As public defenders, they zealously guard the rights of the poor, the alienated, the ignorant, and the neglected.

But in almost every situation and circumstance, lawyers have only one overriding concern, and that is either to promote or to protect the interests and welfare of their particular client—be that an individual, an institution, a corporation, or a cause. Professionally, they are not involved in the right or wrong of the specific dispute or controversy. It has often been pointed out that a smart lawyer can take either the pro or the con of a case and effectively defend it. Through their legal training and by the nature of their everyday working experiences, lawyers are especially sensitive to the human frailties—their own as well as those of others. And like master chess players, they are quick to cover themselves while at the same time moving to exploit an attractive opening. Clearly, there are both pitfalls and bonanzas in living in a litigious society—depending on which end of the gun barrel you are looking down!

The Engineer

The engineer has historically enjoyed a relatively high standing in the eyes of the public. The reason is that engineering is practically an exact science and therefore can

The author is Professor and Head, Mechanical Engineering Dept., Worcester Polytechnic Institute, Worcester, Mass. He is 1979–80 President of ASME. The article is based on the President's Luncheon address during the 1979 ASME Winter Annual Meeting. A slightly different version appeared in the September 1980 issue of Mechanical Engineering.

guarantee results that most of the other professions cannot begin to match. A lawyer cannot predict the outcome of a court case for a client. A doctor cannot promise to cure his patient's ailment. But an engineer *can* guarantee to design and build a piece of equipment that will meet a customer's rigid set of performance specifications. We have demonstrated to the world over a span of many years that we have the ability and the know-how to develop and manufacture a bewildering array of engineered products that, by and large, have given satisfactory service. This record of accomplishment is the bedrock on which our credibility rests. And our main concern now is how do we protect our hard-earned credibility from the onslaughts of an increasingly litigious and skeptical society?

Of one thing we can be very certain! Every time we make a mistake in judgment—every time a piece of equipment fails and lives and property are lost or endangered, every time that blame for a breakdown can be assigned to faulty machinery—we will come under harsh scrutiny and criticism. And whenever our competency is questioned or cast in doubt, our credibility will be placed in the balance. Today we enjoy high credibility; but tomorrow we could very easily be at ground zero along with the politicians and the used-car salesmen! Let me briefly outline the potential threats that I perceive to our credibility as a profession and my suggestions for how we should deal with them.

The Nuclear Controversy

At the top of the list is the controversy over nuclear energy. The nuclear industry, which employs many of our members, has flatly stated, time and again, loud and clear, that nuclear power is completely safe. But that old dog won't hunt after Three Mile Island! The near catastrophe in Pennsylvania has severely, if not irreparably, damaged the credibility of the nuclear industry. And I submit that until such time as credibility is reëstablished and it is proven to the general public beyond the shadow of a doubt that nuclear power plants are safe and reliable, the further commercialization of nuclear energy will remain in a state of suspended animation.

There was a time some 60-odd years ago when boilers were exploding like firecrackers at a Fourth of July picnic! When the system reached epidemic proportions, it was finally decided by the boilermakers, the users, the municipal authorities, and ASME to get together and take concerned action. By carefully building a system of stringent self-imposed codes and standards, and by vigorous self-policing and strict enforcement, without any push from the federal government or other outside agencies, they succeeded in eradicating the scourge of boiler explosions. Why not the same medicine for nuclear power plants? Just as it is technically possible to construct a nonexploding boiler, so it is technically feasible to engineer and manufacture a foolproof nuclear power plant and to set up procedures to have it continue that way. A cooperative relationship among all of the concerned parties—manufacturers, utilities, government regulators, environmentalists, consumer advocates, and engineering societies—working toward a common goal, could, in short order, restore a modicum of credibility to a troubled industry. *I, for one, am thoroughly convinced that some form of nuclear power is imperative in our immediate future energy equation, and I strongly urge the engineering societies to use their credibility, experience, and human resources to help breathe new life into the nuclear power program.*

Cover-Up

One of the more colorful buzzwords to emerge from the Watergate fiasco is the phrase *cover-up*. Cover-up, of course, is the antithesis of credibility. The connotation is of hidden evil or skullduggery. In this world of instant media coverage, enterprising investigative reporters, and the commercial market for scandal, there is almost no possibility of keeping a secret buried for very long. Nor is there any quicker way to commit credibility suicide than by being caught in a cover-up situation. The only responsible path I know to avoid being tarred by the cover-up brush is to blow the whistle as early in the game as possible.

What I have in mind for the engineering profession is the provision of a public forum for engineers who are prepared to blow the whistle whenever they see or are inadvertently involved in technical programs and projects that violate the engineering ethics of sound practice. We should give a high priority to the establishment of a mechanism whereby engineers who are caught in this situation can, without fear of retaliation and anonymously, if necessary, bring their case into the open for judgment by their professional peers. In order to ensure the future overall credibility of the engineering profession, such a public forum is a vital necessity.

And here is where the new federation of engineering organizations—the American Association of Engineering Societies (AAES)— can play a leading role for all engineers. Within its framework we could construct an Engineers' Forum. We must see to it that procedures are formulated that will allow engineers to be the final arbiters of safe and responsible engineering practise.

Individual Responsibility

Regrettably, many of our most respected institutions and professions have already been damaged because they have allowed their credibility to become compromised. Even the engineering disciplines have suffered when they have bent to the demands of nontechnical considerations, such as the profit motive and similar commercial expediencies. Let me underline that there is no need for this to happen if we are prepared to fight to uphold our principles. However, if we permit our credibility to be gradually eroded away, we can look forward to becoming increasingly subservient to all kinds of outside forces and special interests. And in the end, we will lose our cherished identity—just as George Orwell warned in *Nineteen Eighty-Four*.

In the final analysis, it is the individual engineer who

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Study Group Agrees to Voluntary Restraints

GINA BARI KOLATA

A voluntary system of prior restraints on research publications in cryptography was approved this month by the Public Cryptography Study Group, most of whose nine members represent professional societies in mathematics and computer science. The system will be tried for 2 years, reports Daniel Schwartz, the general counsel of the National Security Agency (NSA). If, after that time, the process is not found to be "useful and efficient," the NSA may decide to seek legislative authority for mandatory restraints.

The study group was formed last year by the American Council on Education (ACE), a group representing university administrators, in response to a request by NSA director Bobby Inman for a dialogue between the NSA and the academic community. The agency was concerned because mathematicians and computer scientists are beginning to publish papers on cryptography—an area that previously was the near-exclusive domain of the NSA. Academic and industrial scientists are becoming so interested in cryptography because there has been a growing demand by business and industry for secure codes to protect computer messages and information stored in computers. With the advent of electronic fund transfers and electronic mail, the need for codes has become especially pressing.

The problem confronting the NSA and the academic community is to balance the NSA's worries that open research in cryptography might imperil national security against researchers' rights to publish their work and some scientists' and industries' claim that national security is also imperiled if new developments in cryptography are kept from the private sector. Since computers are so easily tapped, it would be possible for foreign powers to wage economic warfare, for example, by intercepting corporate messages carried by electronic mail.

In a previous meeting, the study group voted to consider prior restraints on cryptography research (*Science*, 27 June, p. 1442). The meeting this month was held to discuss a paper, largely written by NSA general counsel Schwartz, detailing how such a system of restraints might operate. Although the meeting was scheduled to last two whole days, 6 and 7 October, the group quickly agreed to the restraints and the meeting adjourned at 3 p.m. on 6 October. Cochairman Ira Michael Heyman, a constitutional lawyer and chancellor-elect at the University of California at Berkeley, did not even call for a vote. Instead, he said that since everyone evidently agreed to the system of restraints, it would be written up in final form, mailed to the members for approval, and then it would become the study group's recommendations to the NSA director, to professional organizations, and to the President's science adviser.

The group agreed that individual researchers and editors of technical journals will voluntarily submit papers on cryptography to the NSA for review. If the NSA wants to prevent publication of all or part of a paper, it will consult with an advisory group, most of whose members will come from outside the government, but all of whom will have top security clearance. The advisory group will recommend to the NSA director whether publication should be enjoined. The NSA director, however, is not bound by the advisory group's recommendations.

For 2 years the system will be purely voluntary. But if the voluntary system does not work, the NSA may seek legislative authority to prevent publication of papers and to seize papers that are not voluntarily submitted to it.

Why did the study group members so quickly concede so much to the NSA? One reason may be that they thought the NSA already has the legislative authority it threatens to seek and so actually they were conceding very little. Cochairman Werner Baum, who is dean of the College of Arts and Sciences at Florida State University, says he had this impression. And Todd Furniss of the ACE, who kept the minutes of the meeting, wrote that the group agreed to "the last-resort use of court orders" to enforce restraints on publications.

What does NSA have up its sleeve?

The study group members were aided in their confusion by the paper they received detailing how the prior restraints would work. The paper said, "The government, on behalf of the NSA, would be authorized to seek an order from a court to enjoin publication." It also said, "the NSA would have the authority to obtain for review either through a voluntary request, or, if necessary, through a court-enforceable Civil Investigative Demand, copies of any articles or other publications about which the Agency hears but which have not been submitted voluntarily." Nowhere did the paper say that the NSA does not have the authority to restrain publication and that Civil Investigative Demands apply only to the Justice Department and the Federal Trade Commission in antitrust suits.

Science asked some members of the study group whether they thought the NSA might have been deliberately deceptive, in light of the confusing paper on prior restraints and in light of the rapid adjournment of the meeting. Baum replied, "In the absence of any evidence to that effect, I would not accuse the NSA of trying to deceive anybody." But one member, who wishes not to be identified, said, "I would have disagreed completely [that NSA was deceptive] until about 3 o'clock that afternoon [of 6 October]. I walked

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Energy Conservation: A Role for CSIT

GERALD RABOW

It has been acknowledged and asserted by many cognizant authorities, including the IEEE [1] and authors from the Harvard Business School [2], that conservation of energy should be the component of national energy policy having the highest priority. Conservation is the "energy source" capable of making available significant amounts of additional energy most quickly, with the least capital expenditure and the least damage to the environment of any proposed source. The purpose of this article is to examine some of the obstacles to a more vigorous pursuit of energy conservation, and to suggest ways in which CSIT members might advance the cause of energy conservation.

Energy should be used only to the extent that the benefits from the energy exceed the costs of the energy. Expenditures for energy efficiency should be made as long as they do not exceed the cost of the energy saved. Energy conservation is merely the proper application of the above principles, using proper costs, valuation of benefits, and institutional arrangements. The application of the above principles will result in reduced energy use because present energy practices are largely based on the availability of low-priced energy.

To arrive at the proper conservation tradeoffs, energy price should include not only the full costs incurred due to pollution and safety risks, but should also reflect the negative effects of our dependence on foreign oil. In the report of the Energy Project at the Harvard Business School [2], the effective cost of petroleum energy to the United States was estimated to be about twice that of the current OPEC (Organization of Petroleum Exporting Countries) price, based on a relative reduction in price on all the oil imported as well as the amount of oil imported if demand is reduced through conservation.

The valuation of benefits is the prerogative of individual consumers. However, they can be aided in making societally desirable conservation decisions by having the energy costs to society properly reflected to them (with the aid of tax credits for energy investments), by making it credible that conservation investments will pay off, and by facilitating credit for conservation investments.

An example of societal action is the imposition of federal automobile fuel economy standards. These standards were opposed by the auto manufacturers at the time they were imposed, evidently because they were perceived by them not to be in their self-interest. Subsequent events have proved the standards to be more than justified from all viewpoints, and the auto manufacturers are now planning to achieve even better fuel economy than the standards require.

Since energy conservation is the proper way to manage available energy resources, the main obstacle to the more extensive use of conservation is lack of understanding of the process and tradeoffs involved. As an "energy source," however, conservation competes with other energy sources and may hence be opposed by those with a vested interest in other energy sources. One such group is Scientists and Engineers for Secure Energy (SE^2), organized in 1976 to promote nuclear power. Since successful conservation efforts would reduce the demand to increase energy supply, SE^2 strongly opposes energy conservation. They cosponsored a meeting (together with Stanford University and its Hoover Institution on War, Revolution and Peace) of energy specialists in June 1980 to consider the problem of how to make the U.S. less dependent on imported oil. The dominant outlook of the meeting was opposition to conservation. As one speaker put it, "Conservation may be absolutely necessary as a tactic, but it is potentially disastrous as a strategy." [3]

To counter such opposition and to provide the public with an understanding of the factors, processes, tradeoffs and means of implementation involved in energy conservation, groups such as CSIT might be able to contribute in the following ways:

(1) Clarifying some of the tradeoffs, big and little, that the individual faces in applying conservation to his or her needs. This might be done through uncovering, integrating, and presenting work that has already been done, or through original research where the knowledge is lacking.

(2) Uncovering and advocating improved institutional arrangements, including appropriate pricing, to aid individuals in making and carrying out proper conservation decisions.

Energy conservation consists of many measures which are each sufficiently limited so that they can be independently analyzed by an individual or a small group. However, the cumulative effect of many such contributions can result in significant national energy saving.

One of the areas with a large potential for energy conservation is residential energy use. According to a number of studies [2, 4], of the orders of 50% or more of the energy use in existing buildings can be saved economically through retrofit. Much larger savings can be achieved in new buildings, but it is retrofit of existing buildings that has the potential for saving a significant fraction of U.S. energy use in a relatively short time.

One of the more careful studies of the energy savings to be achieved through retrofit has been done by a group from the center of Environmental Studies at Princeton University [4]. Their major finding, aside from the large savings possible through retrofit, is that a fairly sophisticated understanding of the thermal properties of houses is required to do retrofits properly, rather than the standard approach of treating the building as an idealized box. They found, for example, that because of "attic insulation bypasses," actual heat losses to the attic were typically three to seven times greater than losses calculated from heat

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who follows advice to add more ceiling insulation is likely to get only one to two thirds of the fuel savings claimed for the insulation job. While this may be cost effective, it would be much better to block the bypasses first.

In order to achieve within a few years a saving of half the fuel the nation uses for space heating, the authors of the Princeton report [4] propose a three-part retrofit strategy. One part is pilot retrofit projects involving the intensive investigation of heat losses for thousands of individual houses and apartments representing all the major housing types in every region of the country. The second part is the establishment of a new profession of "house doctors," who would go into homes and recommend cost effective retrofit measures, and follow up to make sure that expected fuel savings have been realized. They would also themselves make simple partial retrofits that can be done on the spot; it has been estimated that such partial retrofits alone could typically save 15 to 20% of space heating fuel. The third part is the financing of the retrofit improvements by the utilities, and a suitable financing corporation in the case of oil heat. The repayment and rate structure could then be set so that the utility would value conservation and energy replacement costs on a comparable life cycle basis, and the customers could minimize their total monthly payments through the proper retrofits.

In the above plan, the availability of "house doctors" may be the most critical part, since of the order of 50,000 to 100,000 full time "house doctors" would be needed if the job is to be completed within a few years. It is here suggested that a resource that should be tapped to perform this function is students in engineering and related disciplines—we should then perhaps call them "house engineers." Because of the urgency of energy conservation, a program of training such students should be initiated as soon as possible, without waiting for the other components of the retrofit program to be in place.

There would be a number of benefits both to students and to society.

1. Training to become "house engineers" could be provided as part of an interdisciplinary engineering program. Even if no employment resulted, the learning achieved would have validity in its own right.

2. The use of engineering students would solve the problem of obtaining house engineers. The existence of a large number of house engineers would provide a constituency for energy conservation which may help in getting the other parts of the retrofit approach adopted.

3. The temporary peak demand for house engineers would fit in well with the need of many students for temporary work which is relevant to their studies and could help finance their education. A continuing demand at a lower level of effort would, probably, exist for an extended period, and could provide back-up employment and hence a stronger economic position for engineers.

4. A rare opportunity would exist for direct contact between engineers or prospective engineers and a large segment of the public, giving opportunity for enhancement

(The author hopes that some engineering faculty members will initiate a project or a course for implementing the preceding concept. Also that readers of *T&S* will be interested in undertaking a variety of activities in the area of energy conservation, either individually or as part of a group. He would like to hear from those who are interested and would be willing to coordinate any resulting activities. Please contact Gerald Rabow, 21 Berkeley Terrace, Livingston, NJ 07039, (201) 992-4014. Any comments for publication in *T&S* should be sent directly to the Editor.)

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Reviews

Engineering for Architecture, Edited by Robert E. Fischer. An Architectural Record Book, McGraw Hill, 1980, $26.50. 9 1/4″ × 12″, 240 pages, illustrated. *Reviewed by William H. Scarbrough, Associate Professor of Architecture, Syracuse University.*

Architectural Record is one of the three major professional architectural journals published monthly in the United States. Since 1974 the "Record" has entitled the mid-August issue *Engineering for Architecture*. This issue in the words of Walter Wagner, Editor, is "intended to honor the best work of the best engineers and consultants: to recognize their absolutely essential and all-too-often unrecognized inventiveness and resourcefulness in working with architects to achieve economical and rational and beautiful buildings." Robert E. Fischer has assembled articles from these mid-August publications: as well as articles, I believe, from the regular monthly publication for the current hard cover version of *Engineering for Architecture*. The book is the twenty-second volume of a series of Architectural Record Books. It is the second of the same title.

Considering the stated objective for publishing articles illustrating the engineering aspect of building, it is reasonable to question whether Mr. Fischer's work should be viewed as anything more than honorific. Specifically, is there a direct value to architects, engineers, students, and even as is suggested, to building owners, in studying the works presented? The language of the text is for the most part nontechnical or at a fundamental level. Despite this fact there is value to the professional and to the student. The majority of articles is devoted to case studies. This format clearly enables the reader to assess the current state-of-the-art. Perhaps, of equal importance, is that the architects and engineers are listed for each project. The serious researcher will find this compilation of sources an invaluable aid in the quest for more detailed information pertaining to a specific building. The suggestion that presenting engineering solutions in a nontechnical manner would extend the readership potential to building owners sounds more like promotion from the McGraw Hill sales department than anything else. Providing technical data in a thorough and professional way would have necessitated fifty volumes for the fifty case studies in lieu of the single volume.

There are two ways to organize a series of building case studies. These options are: (a) typology format (multifamily residential, office, laboratories, arenas, hospitals, etc.) and (b) subject format (high-rise structure, long-span structure, HVAC, lighting, etc.).

Mr. Fischer has chosen the subject format organization for his book and has subdivided the work in six chapters. Four of these are related to structural engineering, one to mechanical systems and one to lighting and the integration of lighting and mechanical services. The subject area of this last chapter raises one of the problems developed by this particular format.

Few architects would disagree with the thought that well executed buildings result when all the systems of construction are properly integrated. Decisions pertaining to structure, for example, may be heavily influenced by the requirements of the distribution systems. A case in point, would be the way high-rise multifamily housing is built. If there is no requirement for air distribution (always the scheme except in luxury apartments), then, thin floor systems with relatively short spans are utilized. To consider deep systems would simply be capricious and result in uneconomical solutions. There is little opportunity for the reader to explore the interrelationships of the various systems under the subject format. While this may not be a serious problem for the experienced professional, the student reader must be cautioned with regard to drawing simplistic conclusions regarding the inventiveness of certain proposals contained therein.

The first section of Mr. Fischer's book is about high-rise construction. There is a particularly lucid review of cantilevered tube structures, including framed tubes and bundled tubes. The problem of damping the structure is shown to have several solutions in addition. To the uninitiated reader, the need for new structural responses for tall buildings would appear to be caused simply by the fact that architects decided to abandon masonry walls in favor of thin lightweight glass and metal enclosures. There is no clue that this decision is based on anything but current fashion. For the record, thin wall construction came about in response to building owners requirements for the maximum rentable floor area within the total building envelope. The understanding that fashion is not at the root of many of the uncommon solutions to the complex problems illustrated is critically important.

Unfortunately, the same cannot be said for a structure in Chapter 4 which is a medical library for Toledo, Ohio. This article is entitled "Long-Span Precast Structure for a Medical Library." Why a long-span structure for a library building would be seriously considered is beyond any fundamental logic and must be seen as simply a way of accommodating an architect's whim.

The portions of the book dealing with environmental control systems outlines a range from multizone air handlers to active solar installations and new concepts in lighting. The latter category is of critical importance today. Sufficient evidence exists to demonstrate that most of the energy use in nonresidential construction is attributable to lighting. Fischer's book illustrates systems that go beyond the drop-in luminaire that many have accepted as being the state of the art. The Bank of Canada project, for which William Lam was the lighting consultant, is worthy of careful study. The same may be said of the material dealing with task-ambient lighting design.

The previous observation contributes to this reviewer's primary concern with publications such as *Engineering for Architecture*. The value of such volumes beyond simply providing a format for separated articles and information is whether the information presented can be generalized to apply to current or future problems confronting the architect and engineer. With the exception of the solar work and some of the structural work presented, the author has done an admirable job in meeting this criterion. Coupled with the lavish illustrations and photographs, the fact that a good amount of generalization can be gained from the text makes the book a valuable beginning reference for the professional.

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must accept the responsibility for the credibility of his/her work—and ultimately for the credibility of the profession. Individual engineers are the linchpins that make and maintain the complex whole. I have faith that engineering societies and their individual members are strong enough to persevere, to do what is right no matter what the circumstances and the conditions, irrespective of the temptations and the pressures. And when called upon, they will unanimously generate the necessary strength of character and the courage that will hold up in the face of the trials and attacks on our credibility that almost surely lie ahead.

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News, Notes, and Comments

Society on Social Implications of Technology: A Progress Report

At the July TAB meeting, a resolution was passed setting up an ad hoc committee to make recommendations to TAB on the form that an entity on Social Implications of Technology should take, and to draft a constitution for it. I was to chair the committee and to appoint one member, the others being F. A. Furfari, Division II Director, Jack Jatlow, Engineering Management Society Representative, and William Underwood, Power Engineering Society Representative. (See the September T&S.)

In September I activated the committee, appointing Communications Society President Don Schilling as the fifth member. An initial draft of a constitution and bylaws for a Society on Social Implications of Technology was prepared, based on the corresponding items of an existing society, with one important modification. This was a feature intended to give the new society some of the character of a council by including in its AdCom individuals appointed by Divisional Directors (in accordance with a suggestion made by President Leo Young).

As of the middle of October, members of the committee are revising and discussing modifications of the draft. It appears likely that a draft constitution, bylaws and covering report will be completed in time for presentation at the TAB meeting in early December.

Since the TAB meeting in July, although we have not been actively soliciting signatures on our petition for the formation of SSIT, they continue to arrive; the cumulative total to date is in excess of 820 signatures.

Steve H. Unger
CSIT Chairman

Scientific Freedom and Responsibility Award

The Board of Directors of the American Association for the Advancement of Science (AAAS) has approved an AAAS Award whose purpose is "to foster scientific freedom and responsibility by honoring scientists and engineers whose actions at significant personal cost have outstandingly exemplified these principles." The intention of the AAAS Freedom and Responsibility Award is "to recognize scientists and engineers who have:

- acted to protect the public's health, safety, or welfare; or
- focused public attention on important potential impacts of science and technology on society by their responsible participation in the public policy debates; or
- established important new precedents in carrying out the social responsibilities or in defending the professional freedoms of scientists and engineers.

The Award consists of a plaque and a $1,000 prize.

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Washington CSIT Meeting Draws Good Response

The newly-formed Washington Area Working Group of CSIT held a get-acquainted dinner meeting on October 29, 1980. Approximately 20 IEEE members came to the Chase II Restaurant in Washington, DC to hear Rosemary Chalk speak on "Ethical Dilemmas in Modern Engineering." Ms. Chalk said that the pervasive impact of technology on society had made ethics a vital element in the practice of engineering. She discussed the full range of ethics issues—from standards of conduct in the practice of engineering to the relationship between ethical principles and societal values. She suggested some activities by which the Washington CSIT Group could contribute to resolving—or at least understanding—these issues. Ms. Chalk is staff director of the Committee on Scientific Freedom and Responsibility of the American Association for the Advancement of Science. Her talk will be published in the March 1981 issue of T&S.

During the informal part of the meeting preceding the talk, the participants exchanged ideas relating to engineering ethics. It was clear that many of them had given considerable thought to this idea as it related to their jobs. For roughly half the participants, the meeting was their first personal contact with CSIT, and they all signed up afterward to become members of the Washington Group.

Meeting chairperson Will Anderson said the Group would hold a speaker meeting every three months. (The Group holds regular meetings once a month.) Anyone who wishes to join the Group is asked to contact Mr. Anderson, (301) 867-3179.

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off with a funny feeling that may be completely irrational. I kept thinking, What the hell do they [the NSA] have up their sleeve?"

With one very vocal exception, the study group members expressed little concern about the implications of prior restraints. Most are not directly involved in cryptography research and so would not be personally affected by the restraints. But Martin Hellman of Stanford University, who observed the meeting and who will be one of the researchers affected by the restraints, is willing to go along with them—as long as they are voluntary. "Given the outward signs of reasonableness at the NSA, I'm willing to show I'm reasonable, too. The alternative is to refuse to cooperate on a voluntary basis. That would force the NSA either to back down or to seek legislation," he says.

The group's lone dissenter is George Davida of the Georgia Institute of Technology. Acting like a gadfly, he continuously and vociferously objected to even voluntary restraints, noting that the NSA has never explained in any detail why it is more in the national interest to have restraints than not to have them. Schwartz replies that the NSA cannot fully explain because its reasons are classified. "It is very difficult for me to discuss the NSA's point of view without clearing everyone," Schwartz says.

One observer who has a great deal of experience in dealing with the NSA shares Davida's concerns. Timothy H. Ingram, staff director of the House Subcommittee on Government Information and Individual Rights, is especially interested in the conclusions of the Public Cryptography Study Group because his subcommittee has held hearings on public cryptography and has heard Inman testify in favor of voluntary prior restraints. Ingram is wary of the effects of the restraints the study group is recommending. He says, "The questions are, what is the statutory authority for this censorship and what do these researchers get in exchange for what they are giving up? It's hard to see, other than a cage."

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