The Social Responsibility of Engineers and Scientists

F. B. WOOD†

INTRODUCTION

RECENTLY there has been some interest in the question of the social responsibility of engineers. A series of articles and letters to the editor appeared in the early part of 1958 in *Computers and Automation*[1-6] which dealt first with whether a journal such as *Computers and Automation* should publish articles on the social responsibility of computer scientists. Then specific topics such as the possibility of the destruction of civilization due to some component failure in the computer linked to a missile-warning radar network were treated. A series of viewpoints has been presented ranging from conscientious objection to working on a computer system that might be used for destructive purposes at one end of the scale, to a viewpoint of no concern with the use of one's work at the other end. My interpretation of these discussions is that people are arguing about the implied hypothesis: there is a danger to the existence of our civilization because social institutions have too long a time lag in making adjustments to utilize the latest technological advances wisely.

This apparently sudden interest in the social responsibility of computer scientists was preceded by a long and fluctuating development of concern for social responsibility in science and engineering. Meier has reviewed the status of social consequences of scientific discovery and has made specific recommendations concerning the social responsibility of administrative scientists.[7] Layton has studied the history of the idea of social responsibility in the American engineering profession.[8] Rothstein has discussed some of the deeper philosophical aspects of these problems in his book.[9] The Western Joint Computer Conference at Los Angeles, Calif., May 6, 1958, conducted a panel on "The Social Problems of Automation."[10]

The various viewpoints appearing in *Computers and Automation* present an uncoordinated distribution of differing ideas. The views of the 1958 WJCC panel have a certain amount of coherence. It would be desirable to find a straightforward way for an individual or engineer to determine his responsibilities in this area. The ideas which I am about to develop are hypotheses brought forward for the purpose of obtaining discussion on this important subject. At this stage, they represent my own personal views and are not to be construed as representing a policy of my employer. I would have preferred to have this paper follow a historical analysis of this problem of the social responsibility of engineers so that I could be sure that I am not repeating the same mistakes made in previous periods of interest in the subject. Perhaps by next year we will have a sounder base to operate from in discussing the subject of the social responsibility of engineers.

DISTINCTION BETWEEN THE SOCIAL RESPONSIBILITY OF CITIZENS IN GENERAL AND THAT OF SPECIALISTS

In a democratic nation such as the United States, all citizens have a responsibility to keep aware of the major problems of our country. This is necessary to be prepared to make wise decisions in electing public officials and in voting on basic policies. Specialists such as engineers and scientists of course share this basic responsibility with all citizens. I maintain that specialists have an additional responsibility beyond that of the citizen because of their special knowledge which is not readily accessible to the layman.

WHAT SOCIAL RESPONSIBILITIES DO ENGINEERS AND SCIENTISTS HAVE?

In the long run, technology is undoubtedly making changes in the organization of our society. We cannot expect engineers and physical scientists to become sociologists. However, we can expect engineers to ask questions and urge that appropriate social scientists study the social problems related to their work. Each scientist or engineer can ask himself where his own specialty fits in the development of devices or new knowledge which may affect social organization. Then he can speculate as to what problems might come up in the future due to the application of his work.

† IBM Corp., San Jose, Calif.
[1] Readers and Editor's Forum, "Curse or blessing?" *Computers and Automation*, vol. 7, pp. 9-10; January, 1958.
[2] E. C. Berkeley, "Cooperation in horror," *Computers and Automation*, vol. 7, p. 3; February, 1958.
[3] A. A. Burke (I), W. H. Pickering (II), and Editor (III), "Destruction of civilized existence by automatic computing controls," *Computers and Automation*, vol. 7, pp. 13-14; March, 1958.
L. Sutro, "Comments on 'Destruction of civilized existence by automatic computing controls,'" vol. 7, pp. 6, 31; May, 1958.
[4] Editor (I, III) and Readers (II), "The social responsibility of computer scientists," *Computers and Automation*, vol. 7, pp. 6, 9; April, 1958.
[5] "Ballot on discussion of social responsibility of computer scientists," *Computers and Automation*, vol. 7, p. 6; May, 1958.
Later results, vol. 7, p. 6; July, 1958.
[6] N. Macdonald, "An attempt to apply logic and common sense to the social responsibility of computer scientists," *Computers and Automation*, vol. 7, pp. 22-29; May, 1958.
Discussion: "Locks for front doors," vol. 7, p. 24; August, 1958.
[7] R. L. Meier, "Analysis of the social consequences of scientific discovery," *Amer. J. Phys.*, vol. 25, pp. 609-613; December, 1957.
[8] E. Layton, "The American engineering profession and the idea of social responsibility," Ph.D. dissertation, Univ. of Calif. at Los Angeles; December, 1956.
[9] J. Rothstein, "Communication, Organization and Science," The Falcon's Wing Press, Indian Hills, Colo.; 1958.
[10] H. T. Larson (chairman), H. D. Lasswell, B. J. Shafer, and C. C. Hurd, "The social problems of automation," panel discussion, *Proc. WJCC*, pp. 7-16; May, 1958. (AIEE Publication T-107.)

This may be a further stage in the development of the last decade in which it has become popular to use human factors engineering studies directed by psychologists to determine if proposed electromechanical devices requiring human reading or manipulation are consistent with the way human beings function. As our industrial society becomes more complex, it may be necessary to extend this concept to "social factors" studies where the engineer calls in sociologists to investigate the social effects of applying his new knowledge or devices.

At this stage the engineer's responsibility may be to see if there is someone or some group studying these problems, and if there is not, he can recommend to the appropriate agency that such a project be undertaken. In this way the engineer can shorten the time lag between the introduction of a new technology and the appreciation of its social consequences. I have noticed that even specialists sometimes fail to recognize the division point between their domain and that of other specialists. The important thing here is to obtain the advice of the appropriate specialists, instead of just relying upon our own ideas and feelings.

A Checking Chart to Aid the Engineer in Developing Social Responsibility

Let us construct a chart to outline the factors involved in determining what an engineer's social responsibility should be. Such a chart is shown in Fig. 1. Starting in the lower left-hand corner, there is a box to write in the "Engineer's Special Work." To the right appears a box for the "New Knowledge and Devices" which may result from the work of the engineer.

The next step is more speculative, namely the listing of "Potential Social Consequences" in the third box. The next box, "Find Expert Advice," is for statement of the problems that the potential social consequences indicate as requiring investigation by social science advisors. A sample of the principal fields of science advisors who might be consulted is listed with boxes for checking to see if they are needed on this problem. Some engineers' special work may lead to problems of a biological or medical nature, while the work of others may require the aid of psychologists or social scientists.

After preliminary contact has been established by the engineer with the required science advisors, the engineer must determine how far he will go himself in taking action. In the box on the right, four different magnitudes of action are indicated. The engineer may find all he has to do is to inform the appropriate social scientists about the problems, and they will pick up the responsibility from there on. In other cases there may be no funds to support the social scientists, and the engineer may feel it is his responsibility to campaign for appropriation of funds to support social science projects or to convince industrial management to include social scientists on their staffs.

I claim that the engineer, who does not have much spare time because of his basic engineering work and
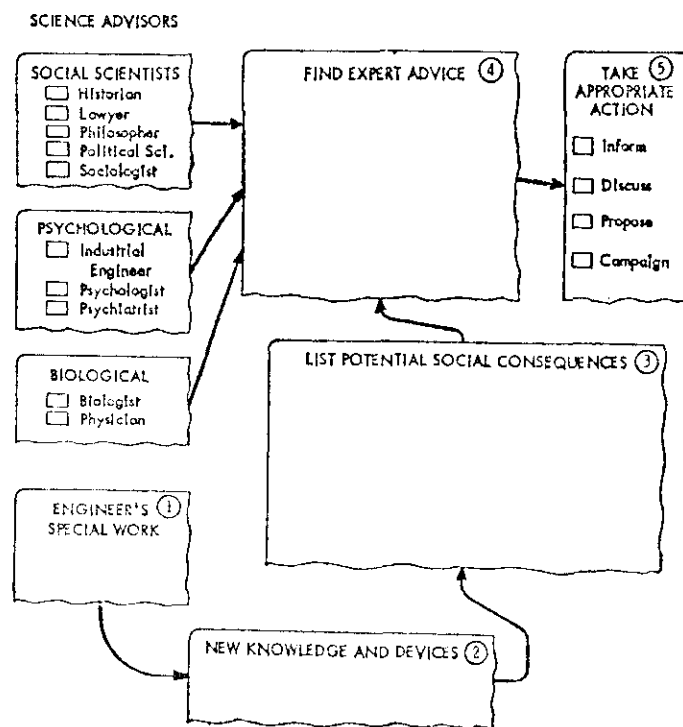

Fig. 1—A checking chart for analyzing the social responsibility of engineers and scientists.

his family responsibilities, can find short cuts to understanding the social implications of his work through devices such as the checking chart of Fig. 1. I have faith that the engineer can fulfill his social responsibility to help utilize the results of his work in keeping with mankind's highest aspirations.

To fulfill his social responsibility the engineer must understand that it is a responsibility he shares with many people both inside and outside his profession. He may not need to devote a tremendous amount of time and energy to the social implications of his work. The key to success lies in developing a fruitful perspective of the relationship of his work to the society in which he lives.

A Sample Use of the Checking Chart

Consider an engineer working on the problems of data communication in connecting remote stations to a central computer. This is entered in the first block in Fig. 2. A successful solution to the data communication problem might result in a universal credit system, where every store, airline, doctor's office, race track, stock exchange, etc., would have terminal sets which would make transactions when the customer's coded credit card is inserted in the set. This would eliminate the need for money for most transactions. This new device is entered in the second block in Fig. 2.

Then we go on to block 3, "List Potential Social Consequences," such as:

1) The elimination of money might mean there would be no more armed robberies, which would be a step forward in the development of civilization.
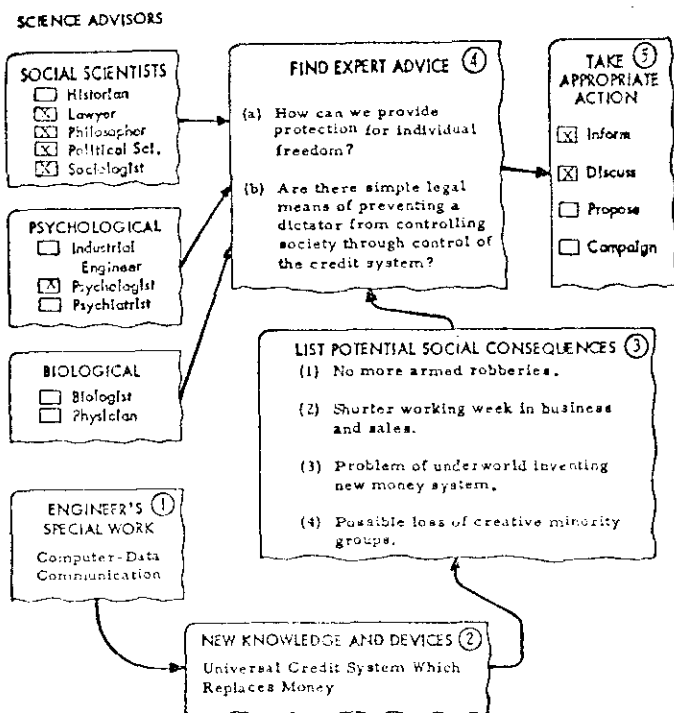
Fig. 2—A sample use of the checking chart.

the natural course of events. It would be desirable if we engineers could just refer these questions to some agency such as the National Science Foundation (NSF) for consideration. At present the NSF has a limited representation from the social sciences, so the engineer may have to find appropriate experts wherever he can. To assist the engineer in finding advice, I have listed some of the more obvious classifications on the checking chart under the principal categories of biological, psychological, and social science. At present the potential science advisors can usually be found on the staffs of nearby colleges or research institutes. In this case I have checked the boxes opposite the relevant categories in this sample case.

Informal discussion with these expert advisors results in a restatement of the problems as follows:

1) How can we provide protection for individual freedom in a more complex society where new technology such as computer-data communication systems permit a centralized accounting system covering all financial transactions in the community?

2) Are there simple legal means and technical characteristics of a computer-data communication system which permit safeguards to prevent potential dictators from seizing control of the system as means of gaining control of our country?

These questions as now restated are questions of importance to all citizens. The social scientists and the engineers both have additional responsibilities over and above their basic responsibility as citizens. However, the citizens at large have the basic responsibility of providing for financial support of such studies. The extent to which the engineer is responsible for taking action on these matters depends upon the state of development of social science research projects.

On the checking chart I have shown four degrees of action the engineer might take:

1) Inform: If through government agencies or private foundations there exist social science research projects adequate to study the problems, the engineer may discharge his social responsibility by simply informing these social scientists about the potential technological changes that may result from his work. In some cases an engineering research organization, in order to protect its proprietary interests, may prefer to hire social science consultants instead of releasing technological data to outside institutions.

2) Discuss: If the social science consultants are available and are financed, but do not have sufficient understanding of the technology involved, the engineer may have to organize discussions with the social scientist in order to pass enough of his special knowledge on to the people otherwise qualified to investigate these problems.

2) The universal credit system might permit a shorter working week in sales and business administration work, permitting individuals to devote more time to creative hobbies which would enrich our community life.

3) New problems might arise such as gangsters inventing a new money system to finance illegal activities.

4) Police measures instituted to suppress the underworld gangsters might interfere with groups working on important social problems. For example, some public officials might be violating some of the provisions of the United States Constitution by discriminating against some minority racial or religious group. People in the community involved might feel like contributing a few dollars each to hire a lawyer to look into the case. These people might be afraid to contribute to this important cause when the accounting system would keep a record of each transaction. How do they know whether some future official will be able to distinguish between supporting a legal test case to protect the Constitution, and supporting some subversive activities? In such a situation the existence of this universal accounting system might inhibit people from protecting our constitutional government.

The next step for the engineer is to find expert advice to evaluate which of the potential social consequences pose real problems that won't just solve themselves in

3) Propose: If there are insufficient social scientists available and the funds available are inadequate to support such research, the engineer may find it necessary to propose new appropriations and scholarships through his company, the existing research foundations, or through government agencies.

4) Campaign: If the agencies having the power to allocate funds for the study of these social problems fail to act, and the engineer is convinced that the problems will soon be urgent, he may have to plan stronger action such as campaigning to get political groups to pick up the problems. He may have to carry his campaign directly to the people, if the political leaders are insensitive to his proposals.

MAINTAINING A PERSPECTIVE

In his specialized engineering work the engineer has acquired through education and experience the portions of basic science that are most useful in his particular engineering assignment. The human needs on his job assignment usually have been evaluated by other people so that the human needs have already been translated into engineering objectives. To fulfill his role as "interpreter of science in terms of human needs," he needs some more direct contact with both science and with human needs. He can read such magazines as the *Scientific American*, which has popular articles on all levels of phenomena, as a way of keeping abreast of developments in science. To obtain a more direct contact with human needs, he can participate in a local church social problems study group. In order to develop a better understanding of the business world in which the results of his engineering work are used, he can read a magazine such as *Fortune*. He can develop a better perception of the social effects of science on a world scale by following the activities of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) by reading one of their bulletins such as the quarterly *Impact of Science Upon Society*. The technical societies such as the AIEE and the IRE might eventually develop a monthly one-page abstract of significant articles relating to the social consequences of new technology.

CONCLUSIONS

Recent articles and panels on the social problems of computers and automation are a healthy sign that some engineers are developing a perspective of how their special field relates to the activities of mankind in general. Engineers need some kind of a framework to present an abstract but meaningful view of human activity to which they can correlate their own work.

A checking chart has been developed to assist the engineer in tracing the potential social consequences of his own work. A table of major sections of the biological, psychological, and social sciences is included to assist the engineer in selecting expert advisors.

In a democracy all citizens have a responsibility to keep aware of the major problems of our country. I believe that specialists such as engineers and scientists have an additional social responsibility because their knowledge is not readily accessible to the layman.

I believe that the engineer can carry out his social responsibility primarily by being concerned with the question: Are qualified experts investigating the potential social problems that might result from the engineer's work? The engineer can use the checking chart developed in this paper to assist in arriving at an answer to the question and in determining to what level of action his responsibility should extend. He shares with other specialists the responsibility for seeing that these problems are being studied and that provisions to inform the voters are made in our society.

I do not suggest that the engineer should be responsible for solving the social problems related to his work. The engineer's responsibility is more of a coordinator to alert the people of our country to the status of our coverage of the problems. If the engineer finds that a social problem relating to his engineering work is not being adequately investigated, he has a responsibility to refer questions to management, social scientists, government agencies, and to the citizens at large to stimulate the investigation of such problems.

ACKNOWLEDGMENT