A Working Paper Draft

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A series of manuscripts on the social relations of engineering and related philosophical questions dealing with the interaction of science and society. Distribution is limited to reviewers and discussion groups for criticism prior to consideration for possible publication.

"THE DILEMMA OF SPECIALIZATION: FUTURE PERSPECTIVE"

A Part of

A Proposal for a Book on

"FRONTIER PROBLEMS OF ENGINEERING SOCIOLOGY"

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Stage*:	Seminar	Notes:C-13	M,No.18	M,No.13-A	Revised

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Problem: How can we deal with the dilemma of specialization in our increasingly complex society which requires both deeper specialization in each branch of science and technology and at the same time requires a broader generalist view of the relations between the different fields?

The following notes "Future Perspective" are reproduced from my seminar paper on the "History of Electromagnetic Theory." (1) A start on a bibliography of more recent papers and books on the subject is added below as a Supplementary Bibliography.

Frederick B. Wood
January 21, 1961

Supplementary Bibliography: Dilemma of Specialization.

(1) Frederick B. Wood, "The History of Electromagnetic Unpublished seminar paper, University of California, Berkeley, 59 pp, Jan. 10, 1947. Copy on file in University of California Library.

(2) George M. K. Baker, "The Dilemma of Specialization." Proceedings of the Institute of Radio Engineers, Oct. 1948, p. 1195.

(3A) Stuart Chase "Some Things Worth Knowing - A Generalist's Guide To Useful Knowledge" N.Y.: Harper and Bros., 1958.

(3B) Ernest M. Lignon The Psychology of Christian Personality. N.Y.: The Macmillan Co. (1937)
For notes on this reference see SEP No. 49.

(3C) Frank B. Jewett and Robert W. King "Engineering Progress and the Social Order" Science vol. 92, No. 2391, Oct. 25, 1940, pp. 365-371. (PAM 01666).
See also editorial Journal of Applied Physics, "A Way of Total Peace" Dec. 1940.

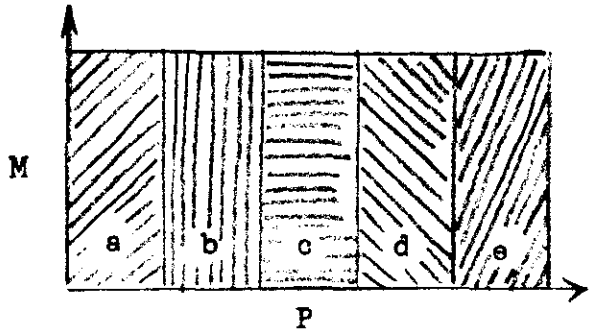

Figure 1A

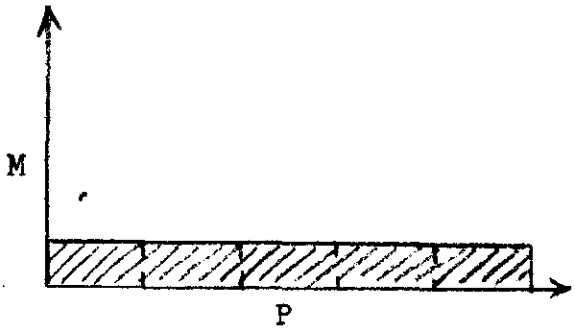

Figure 1B

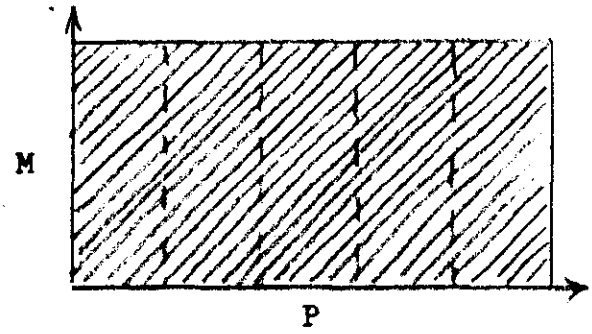

Figure 1C

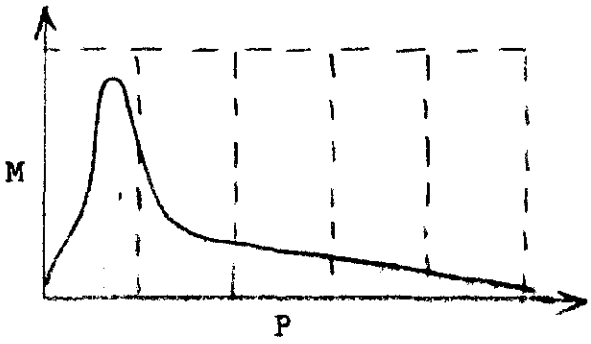

Figure 1D

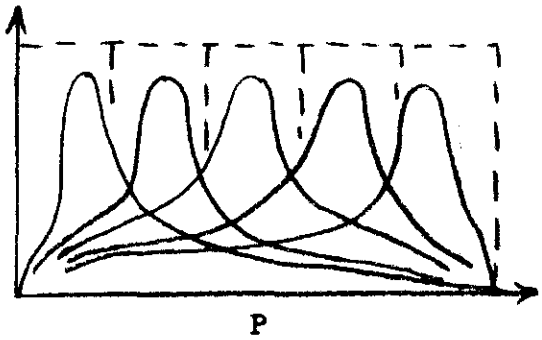

Figure 1E

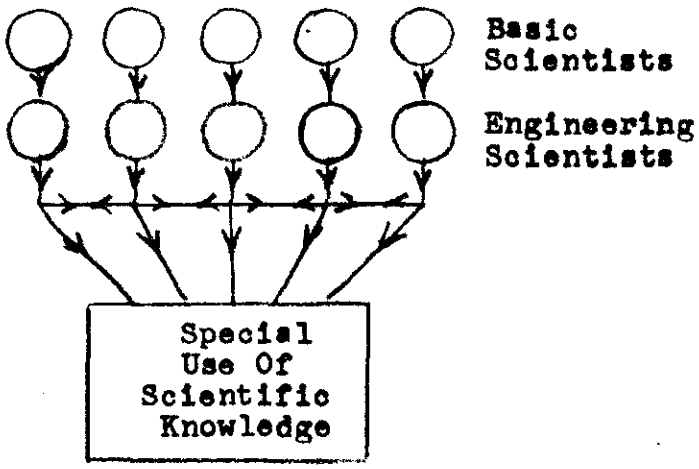

Figure 1F

M = A measure of one's specialization in the study of phenomena P.

P = Type of phenomena, varying from left to right, through physical, chemical, biological, psychological, and social phenomena.[1]

[1]Note: This is an over simplification for approximate discussion. In practise many phenomena are fixtures of the types specified here.

Figure 1 - Social Use of Scientific Knowledge

FUTURE PERSPECTIVE

The development of the historical perspective and present perspective has helped clear the way for future physico-mathematical study. Yet there appears to be a need for a balance obtainable through what I am calling the future perspective. It is possible that, if this balance is not maintained, that which has been achieved in the way of past and present perspective will become an opiate or will become meaningless. I find that some attitudes that existed prior to the founding of the Royal Society in 1660 are still with us today. It appears that these attitudes of using strong emotional appeal coupled with violence or threat of violence in the solution of the problems of society have forced scientists to turn to the physical sciences in order to avoid the violent attacks of people who object to the study of social problems. This has apparently resulted in a failure of the social sciences to achieve the degree of success needed to supplement the great advances made in the physical sciences. Apparently, the application of physical knowledge, such as electromagnetic theory, to industrial development has resulted in serious maladjustments in our society. These maladjustments appear to lay the basis for the destruction or radical change of our civilization.

This situation appears to put the physical scientist and the engineer in the position of accelerating the collapse

of our civilization through the failure of society to provide for the proper use of the products of physical science. There are organizations proceeding with useful research on important problems, but it is questionable as to whether or not they can cope with the problems with the speed and on the scale necessary to meet the present situation. This situation suggests that a tremendous effort should be made to increase the research in the social sciences.

Perhaps the adoption of some program or policy through which scientists in different fields would have a means of discharging their responsibilities is necessary. It appears that such a program would require some kind of overlapping of fields of specialization in order to achieve a fruitful cooperation and to give experts in one field confidence that the other parts of the whole problem, of which they are working on a small part, are being adequately investigated.

Furthermore, a satisfactory relationship between scientific research and the people must be established in a democracy. The position of the scientists and engineering scientists must be that of an advisory capacity in a true democracy. This brings up the problem of education and organizational procedure.

A comprehensive study dealing with both physical and social phenomena requires a synthesis that would be very difficult to achieve in an age of extreme specialization. The following is suggested as to how this perspective of the future could be maintained.

Figures 1A-1E illustrate some aspects of the problem of the attempt to obtain a synthesis in a situation where extreme specialization is necessary in order to make advances in our scientific knowledge of natural phenomena. The plotting of a measure of one's specialization against type of phenomena utilizes some of the ideas of Auguste Comte, Herbert Spencer, and Lester Ward[4] together with some of P.A. Sorokin's[5] criticism of their classifications of the sciences.

In figure 1A consider a case where an engineer (a) working on problems in which he is applying our knowledge of physical phenomena to the design of instruments for human use. If he assumes the responsibility of considering the related social problems he must consult a social scientist (c) or take time out from his primary work to study social phenomena himself. Usually he does not take time to study social phenomena himself,[6] With the exception of some phases of economics. If he consults with a social scientist there may be difficulty due to each specialist not knowing enough about the other's field to efficiently consider the problems.[7] If one person tries to spread the time usually spent in studying in one field over the whole range of natural phenomena, one would not know very much about any class of phenomena as illustrated in figure 1B. To become an expert in all fields as illustrated by figure 1C would require so much time that one would not be able to make very much use of one's knowledge after acquiring it.

These problems suggest a solution which may be already practiced in some fields, but not in others. An ideal set-up might be to have a certain number of basic scientists who specialize in narrow fields like figure 1A. In addition there might be a certain number of engineering scientists similar to the physical engineering scientist shown in figure 1D. These engineering scientists would have training based upon a specialized study in one field, but not as specialized as the basic scientists, combined with an elementary training in several other fields. Then committees of engineering scientists (physical, chemical, biological, social, etc.) might be more adequately prepared to apply the discoveries of the basic scientists to social use as illustrated by figure 1F.

When the engineering scientists arrive at recommendations, there must be educational procedures to disseminate the ideas. Also, the general public must know more about the scientific method. To avoid waiting a generation for each step forward, adult education must be adequately utilized. Organization must proceed along as democratic lines as are possible under the circumstances. Evolutionary change must be in progress all the time to avoid revolutionary changes in society.

There are some places where cooperation among specialists is already proceeding. Remarkable success has been obtained by the Tennessee Valley Authority in getting experts from many specialized fields to see the whole picture.[8] A committee of M.I.T. and Harvard faculty has been established to explore

the possibilities for cooperative research and action by social and physical scientists in the field of atomic energy.[9] With these and other signs of potential establishment of future perspective, it seems appropriate to conclude with the words of the Rev. Frank W. Sterrett:

> We must keep it clearly before us that our goal is not the more creating of material things, nor the contriving of new ways of enjoyment, but the making real, lasting and accessible to men of good will everywhere a life not soft and easy, but worthwhile in a world of friendly neighbors. 10
>
> Many a battle has been lost because men lacked confidence in the outcome. That has not been characteristic of the Engineer. He is accustomed to face hard tasks demanding his best. The rebuilding and the restoring of an ordered world present such a problem. Some of us will have a part in it, but we all can help by keeping clearly before us an understanding of a worthwhile purpose and faith in its conclusion. In such a view, it seems to me there is a continuing place of dignity for the engineer of tomorrow. 11

APPENDIX I

4. John E. Bently, "Visual outline of philosophy," Longmans, Green & Co., p. 109, 1939; Lichtenberger, "Development of Social Theory," The Century Co., p. 308, 1923.

5. P.A. Sorokin, "Contemporary sociological theories," Harper & Bros., 1928.

6. For a discussion of the failure of our educational system to resolve this problem, see Elton Mayo, "The social problems of an industrial civilization," Harvard Univ. Press, p. 120, 1945. "As a consequence we are technically competent as no other age in history has been; and we combine this with utter social incompetence."

7. Mayo, op. cit., 115. "We had not sufficiently realized the truth and relevance of A.N. Whitehead's assertion that there is no substitute for firsthand knowledge (Aims of education and other essays, p. 79). Nevertheless the theory that the meeting in conference of a sufficient number of eminent specialists drawn from widely different fields will in some fashion produce the firsthand knowledge required is still widely held, even in universities."

8. David E. Lilienthal, "TVA Democracy on the March," Pocket Books, pp. 73-82, 1945.

9. "Cambridge Conference of Natural and Social Scientists," Bulletin of the Atomic Scientists, vol. 2, nos. 9 and 10, p. 32, Nov. 1, 1946.

10. F.W. Sterrett, "Philosophical thoughts upon the life and work of the engineer in the advance of civilization," Newcomen Society, p. 18, 1941.

11. Ibid., p. 23.