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PROBLEMS OF THE RIGIDITY OF CLASSICAL DISCIPLINES AND OF SPECIALIZATION.

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PROBLEMS OF THE RIGIDITY OF CLASSICAL DISCIPLINES AND OF SPECIALIZATION: *

Abstract

The need for developing co-operation between different fields of specialization in science and engineers, is discussed, and the following approaches are briefly reviewed:

(1) Development of "engineering scientists."

(2) Encyclopaedic co-operation.

(3) Relationship - cyclical changes and trends.

(4) Common Philosophy.

(5) Common elements & forms.

(6) Transfer of techniques from one field to another.

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a. The need for developing co-operation between different fields of specialization in science and engineering.

The advances in technology resulting from the development of the physical sciences are causing changes in society which outstrip the development of the social sciences. The division of science into specialized fields restricts the scientists understanding of the social consequences of his work. The adoption of some program or policy through which scientists in different fields would have a means of discharging their responsibilities to society is needed. Such a program would require some kind of overlapping of fields of specialization in order to achieve a fruitful co-operation.

Consider a case where an engineer working on problems in which he is applying his knowledge of physical phenomena to the design of instruments for human use. If he assumes the responsibility of considering the social consequences of his inventions he must consult a social scientist, or take time out from his primary work to study social phenomena himself. Usually he does not take time to do this himself, 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. If he tries to spread the time usually spent in studying in one field over the whole range of natural phenomena, he would not know very much about any class of phenomena.

b. Outline of several approaches that have been considered as ways to deal with the problem.

(1) The development of "engineering scientists".

An ideal organization might be to have a certain number of basic scientists who specialize in narrow fields. In addition, there might be a certain number of"engineering scientists" who 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. This type of training may actually be in process on the job in industrial research to a greater extent than is realized in academic circles. The advanced engineering and advanced economic planning groups in industrial concerns may be carrying out the needed function of integration of specialized fields. In some cases, this may be accomplished by scientists and engineers from different fields working together, in other cases by men trained in one special field developing a broader knowledge in the process of dealing with industrial problems.

An example of the collective genius of engineers and scientists in developing a novel power transformer has been described by K.K. Pauluev.[1]

(2) Encyclopedic co-operation or integration among scientists.

The Unity of Science[2] movement related to the philosophy of logical-positivism is attempting to establish an integration of the specialized disciplines through a logical-mathematical orientation based primarily on the physical sciences.

(3) Developing a sense of relationship between different fields of human activity through emphasis on common or related cyclical changes and trends.

Two approaches have been used: (a) short term cyclical plus a long term trend and (b) long term cyclical change. The short term approach is exemplified by the course developed by Professor O. J. Lee.[3] The long term cyclical change is exemplified by the studies of Professor P. A. Sorokin[4] on the dynamics of civilizations in which art, philosophy, law, science, and technology change in different but related cycles.

(4) Integration through a common philosophy

Two examples are particularly significant: (a) The "Pragmatic" or "operational" philosophy which is more generally accepted in the United States, and (b) the dialectical materialist philosophy which is officially accepted in the Soviet Union. Both of these philosophies criticize the other and also point out the dangers of "idealism" as an integrating philosophy.

The philosopher Phillip Frenk[5] using an "operational" approach discusses many related problems including chapter on "Is Science becoming a bundle of incoherent specialities?" approach

of Bridgman, a concept is identical with the set of operations from which it has been derived.

The philosophy of dialectical materialism attempts an integration of fields of science by the abstraction of three general laws[6] plus the principle of criticism and self-criticism:

(a) The law of strife, interpenetration and unity of oppostics.

(b) The law of transformation of quantity into quality, and vice-versa.

(c) The law of the negation of the negation.

The relationship between philosophy and science in the U.S.S.R. is discussed by E. Ashby.[7]

(5) Analysis of common elements of different fields of science by observing common forms of feedback circuits.

The feedback circuits of mechanical and electrical engineering have been found to be similar to control systems in biological systems, phychology, and social systems. The finding of similar equivalent feedback circuits in electronic circuits and in psychology is discussed on an elementary level by W. Sluckin.[8] This integration of different fields through finding common principles helps to extend developments both in engineering and in the social sciences through the concept of the "homeostat" developed by W. Ross Ashby.[9] Processes similar to homeostasis have been found significant in psychiatry.[10] The Society for the Advancement of General Systems Theory has condicted some symposia in areas common to several fields of science.

(6) Application of techniques developed in one field of science to problems in a different field.

As an example, the mathematical techniques already developed for the physical sciences are being utilized in the analysis of biological and sociological problems as can be seen by the articles in the Journal of Mathematical Biophysics.

c. Conclusions

The need for breaking down the rigidity of classical discipline is not as important as developing a better understanding of the functions and relationship between academic science and industrial science. On an elementary level, academic fields of science can remain specialized, provided there is a more adequate communication to the younger scientists, students, and the general public of the integration going on in industrial research and the integration going on through interdisciplinary studies such as common feed-back circuits.

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