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SOCIO-ENGINEERING PROBLEMS

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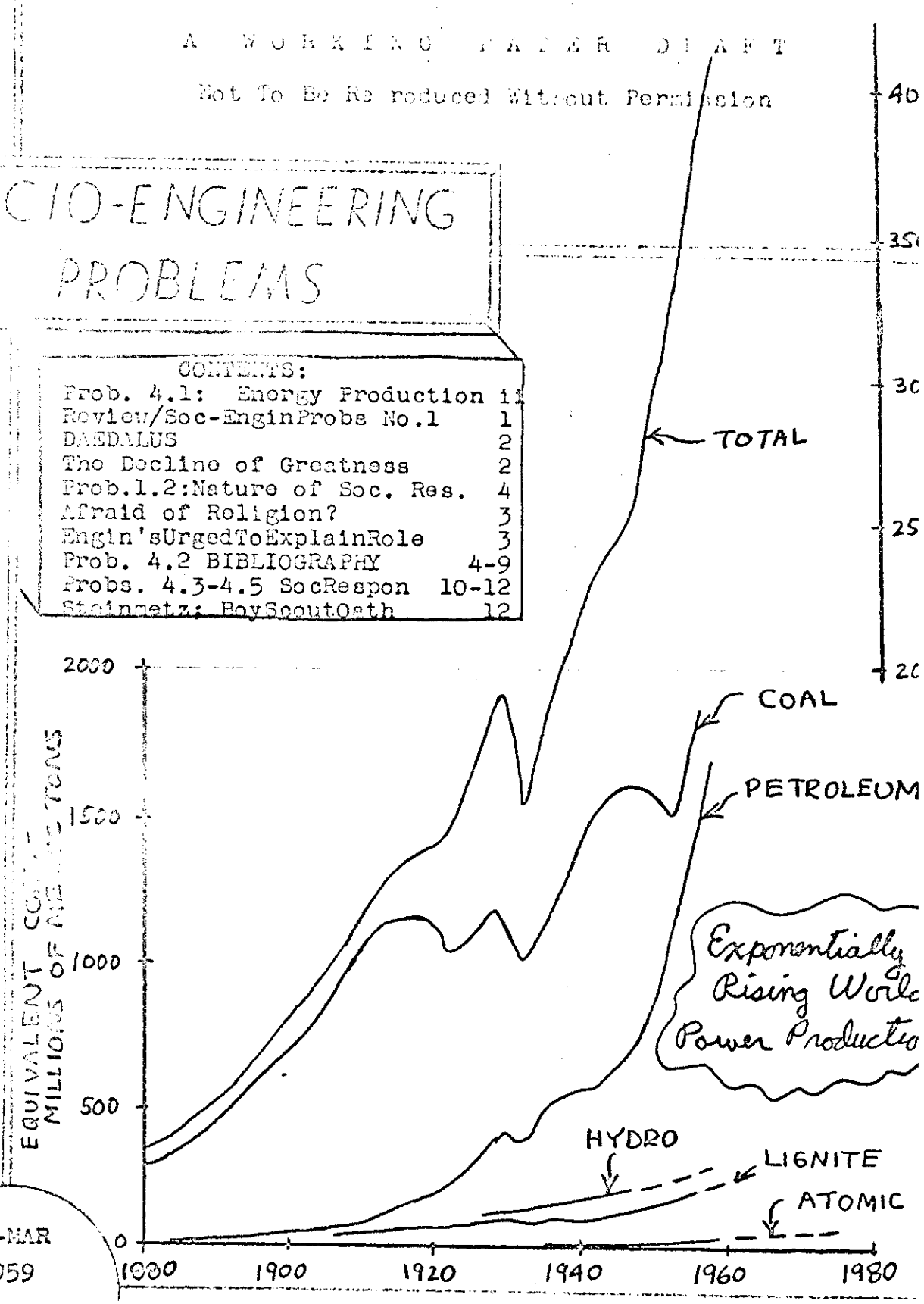

JAN-MAR
1959
No. 4

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SOCIO-ENGINEERING PROBLEMS

A series of working paper drafts on the subject of the social relations of engineering. This series of reports on ideas developed in the pursuit of my hobby of considering the potential analogies of various engineering concepts in the social sciences as a way of establishing a technique for engineers to discharge their responsibility for the social use of their ideas and inventions. The function of this newsletter is to provide a limited distribution of some preliminary ideas for discussion prior to editing for submission to established journals and engineering societies. In some cases no formal publication is planned, since this medium of communication will be used to suggest ideas to universities and research institutes who are better prepared to develop the ideas.

Frederick B Ward

Engineers' Council for Professional Development:

> "The engineer may be regarded, therefore, as an interpreter of science in terms of human needs and a manager of men, money, and materials in satisfying these needs."

This series deals with the function of the engineer as an"interpreter" on the assumption that other people are dealing with the management functions which many engineers acquire.

Problem 4.1: Are we increasing our knowledge of man and society fast enough to keep pace with the exponential rise in the annual production of energy? (COVER DIAGRAM)

The curves of world energy production are displayed on the cover of this issue to show how the curves are exponentially rising with time. Consideration of this fast rate of increase of world energy production raises questions as to whether mankind is also increasing the knowledge of man and society through the social sciences that is needed to harmoniously use this vast increase of our control over nature for the benefit of all mankind.

These curves are not guaranteed to be accurate, but have been spot checked for order of magnitude. These curves are an extension of those of Dr. Hogbom which were brought to my attention by Professor J. B. Condliffe. 1 I have just recently become aware that similar exponentially rising curves of the number of inventions were important

1. Dr. Hogbom "Report of the committee for the study of the problem of raw materials, Appendix L: Development of world production of raw materials," League of Nations Official Journal, 1937 II B 7, Off. No. A.27.1937 II B, Annex 1682, pp. 1249-1267, Dec. 1937.

in the development of a theory of social change by William Fielding Ogburn in his book Social Change published in 1922. 2 I am indebted to Dr. Mervyn L. Cadwallader for bringing Ogburn's theory to my attention 3 The curve marked "A Profile of the Number of Inventions and Discoveries" which I included in Socio-Engineering Problems No. 2, p. 1, was based upon curves of Pitirim A. Sorokin. 4

2. William F. Ogburn, Social Change, N.Y.: Viking Press, 1922.
3. Mervyn L. Cadwallader, "Some Problems in the Construction of Theories of Social Change," an unfinished paper presented for discussion at the Bay Area meeting of the Society for General Systems Research, March 20, 1959.
4. Pitirim A. Sorokin, Society, Culture, and Personality: Their Structure and Dynamics - A System of General Sociology. N.Y.: Harper and Bros., 1947. pp. 607-619.

REVIEW OF SOCIO-ENGINEERING PROBLEMS NO: 1.

This is a summary of comments, new references, applications of the material, and the formulation of additional related problems.

Problem 1.1: How can engineers develop some kind of perspective to give them a synthesis of the specialized fields of science needed for them to fulfil their function as an interpreter of science in terms of human needs?

I have found that Stuart Chase is doing some interesting work on developing a perspective for the layman. His recent book Some Things Worth Knowing is an important contribution toward establishing a perspective. 5 An extension of work like this would help

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

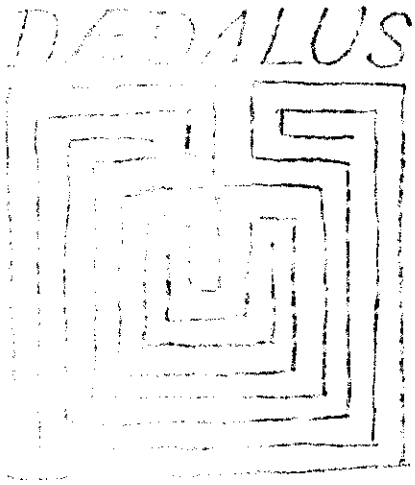
establish a suitable perspective for engineers.

Some criticism has been received for using a "matrix" representation in Fig 2B, p. 9, which does not have the precise properties of a matrix in mathematics. Note also that Fig. 1 - A Three-Dimensional Chart has no fundamental quality which makes it three-dimensional. Strictly speaking it is only a two-dimensional chart which is folded for convenience. If Fig. 1 is unfolded into a two-dimensional chart then each section could be expanded like the three-dimensional chart of biology published by Gerard. 6 In Gerard's chart of biology the dimension "Mathematics-Chemistry-Physics- - - -Philosophy-History" corresponds approximately to the Columns of Fig. 1. The dimension "Environment Relations-Function- - - - -Evolution" corresponds to dividing the level of biology into eight sub-levels. The extension of

6. R. W. Gerard "Concepts of Biology" Behavioral Science vol. 2, no. 2, April 1958, p. 196.

my general type of charts with detail similar to that of Gerard in connection with the text of Stuart Chase would be a useful elaboration of Stuart Chase's concept of a "generalist's guide."

Another important development is the announcement of Daedalus by the American Academy of Arts and Sciences. Starting with vol. 87, No. 1, of their Journal is a new series serving to give a perspective of the different fields of the arts and sciences.



I wish to congratulate the American Academy of Arts and Sciences for undertaking the publication of Daedalus. This publication should eventually answer part of problem 1.1.

Kirtley F. Mather in announcing the new DAEDALUS said "Thoughtful persons today are disturbed by the fragmentation of knowledge. From the founding of the academy in 1780, its Fellows have been "men of genius and learning," representative of all fields of intellectual endeavor. ..... Today natural pressures of specialization have distributed new knowledge into many channels that are deep, narrow, swift, and separated. Few intellectuals can see our whole culture in perspective. Recently the Academy has felt a growing responsibility to increase the integration of knowledge... ....."

Subscriptions at $4.50 per year through Wesleyan University Press, 356 Washington Street, Middletown, Connecticut.

Gyorgy Kepes choice of the cover design for Daedalus, the motif of the labyrinth seen from above, epitomizes what Daedalus may do:lift each of us above his cell in the labyrinth of learning in order that he may see the entire structure as if from above, where each separate part loses its comfortable separateness.

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THE DECLINE OF GREATNESS

Arthur M. Schlesinger, Jr. "The Decline of Greatness" The Saturday Evening Post, nov. 1, 1958, pp. 25, 68, 70-71.

This is a very significant article which deserves our careful consideration. Mr. Schlesinger starts out saying "Ours is an age without heroes -- and, when we say this, we suddenly realize how spectacularly the world has changed in a generation. Most of us grew up in a time of towering personalities. . . . . Some of these great men influenced the world for good, others for evil; but , whether for good or for evil, the fact that such had not died at birth made a difference, one believed, to everyone who lived after them.

Today no one bestrides our narrow world like a colossus; we have no giants w o play roles which one can imagine no one else playing in their stead. ....." He further states:

"Obviously society has had to evolve collective institutions to cope with problems that have grown increasingly complex and concentrated. But the collective approach can be overdone. If Krushchev worried because his collectivist society developed a cult of the individual, maybe we Americans should start worrying as our so-called individualist society develops a cult of the group? .....What began as a recoil from hero worship ends as a conspiracy against creativity. .....An age without great men is one which

acquiesces in the drift of history. Such acquiescence is easy and seductive; the great appeal of fatalism, indeed, is as a refuge from the terror of responsibility. Where a belief in great men insistently reminds us that individuals can make a difference, fatalism reassures us that they can't. .....If our society has lost its wish for heroes and its ability to produce them, it may well turn out to have lost everything else as well."

ARE AMERICANS AFRAID OF RELIGION?

The December 1958 issue of Cosmopolitan contains some interesting and thought provoking articles:

"If Christ Walked The Earth Today" pp. 29-33. Short statements by Norman Vincent Peale, Aldous Huxley, Carl G. Jung, Ralph W. Sockman, Pitirim A. Sorokin, George N. Shuster, Billy Graham, John Sutherland Bonnell, Richard Sullivan, and Gustave Weigel.

A. C. Mulcahey, "Are Americans Afraid of Religion?" pp. 54-58. Our churches receive financial and faithful support unheard of throughout the rest of the world; yet Americans are suspicious of any demonstrations of religious convictions in their everyday lives. Here are problems that concern churchmen and laymen alike.

ENGINEERS URGED TO EXPLAIN ROLE

From the New York Times, Tuesday, February 3, 1959, p. 14:
(For full text see Electrical Engineering April 1959, pp. 298-301)
Dr. James R. Killian, Jr. urged engineers yesterday to help end public confusion over the role of the engineer. . . . . .
Dr. Killian urged engineers to paint for the public an accurate picture of what the engineer does. He urged them to bring their point of view to national policy-making. . . . . .The engineering profession, he siad, has a mission and obligation to:
"Employ the art and science of engineering with zest and audacity to achieve a world in which people everywhere may lead free and abundant lives; to extend the recognition that engineering is a creative activity that augments man's dignity and understanding and that affords him intellectual adventure of the highest order.
"Stress those engineering aspects that enhance the quality of society; to recognize that outstanding accomplishments in engineering appeal deeply to the hopes and aspirations of men everywhere and contribute to the prestige and goodwill of nations.
"Recognize and seek rising requirements for excellence in education, the work and the professional standards of engineering; to create sound and correct public understanding of the work and function of engineers as professional men; to break down barriers separating engineers from sciences, humanities, and social sciences; to use the great opportunity inherent in engineering and science to promote international understanding and goodwill. . . . . .
"Thoughtful men now see another role for scientists and engineers -- a new and creative role that is still only dimly grasped," he said. "Science and engineering are a common language understood the world over. By exchanging scientific and engineering viewpoints and working on common problems men of all nations may be drawn closer together."

DIFFERENT VERSIONS OF MANUSCRIPT ON SOCIAL RESPONSIBILITY PREPARED FOR DIFFERENT POTENTIAL READERS

Problem 1.2: What is the nature of the social responsibility of engineers?

The first manuscript prepared on this problem is included in Socio-Engineering Problems No. 1, August 1958. This version included the present codes of ethics used in the engineering profession and also made reference to some of the common principles of the major religious faiths. Some abridgement was needed to reduce the material to the size suitable for use at the Western Joint Computer Conference. The different stages through which the manuscript went as different specifications were developed are stated as separate problems as follows:

Problem 4.2: How can the ideas of Socio-Engineering Problems No. 1 be restated with a better historical base? How can these ideas on the social responsibility of engineers be related to the problems of public understanding of science and engineering?

Outline:

Introduction: Recent articles in Computers and Automation, Lasswell's Social Planetariums, need for climate in which workers can trust scientists, humanistic sciences being extended by computers.

Art and Public Understanding: Filmstrip on the "Lost Symbols," Abstract art to represent problems of man and computer struggling to solve problems in a complex environment.

Historical Developments: History of human civilization marked by stages of man's striving to achieve higher ethical standards, correlation between aims of major religious faiths, crises in the industrial revolution of a century ago, conditions which sparked Karl Marx to develop a theoretical analysis, August Comte's sociology, classification of the sciences, history social responsibility in engineering, danger of technocrats, cooperation of specialists in the T.V.A., need for postwar social science research program to protect our democratic concepts, failure of some businessmen to apply the ethics of their religion to business practice, experiments in social responsibility and public education of the atomic scientists.

Engineering Ethics: Definition of engineering, "Faith of the Engineer," how does one interpret these codes of ethic?

A Perspective of the Sciences: Classification of the sciences, relationship of the special fields of arts and science on "skyscraper" type chart,

A Checking Chart Derived from the Classification of the Sciences: Two-dimensional chart showing extent of coverage or "completeness," relationship to Ward's chart of synthetic creations of nature, useage in particular analyses.

Figures on three-dimensional chart, electrical communication, and biology, and a checking chart by types of phenomena and types of activity.

An Example of a Checking Chart Applied to the Work of a Famous Engineer: Charles Proteus Steinmetz(1865-1923), electrical engineering and mathematics, political activities as Socialist, observations on implications of engineering work, support of large corporations as practical way to bring electric power to the people, idealism of Steinmetz.

Potential Use of Checking Charts by Ordinary Engineers: Devices such as the checking chart may be used by engineers who do not much spare time, sharing of responsibility, determining which organizations are working on the problems, journals and organizations useful to maintain perspective.

Conclusions: Interest in social responsibility is a healthy sign, engineers need some perspective to which they can correlate their own work, a three-dimensional chart has been proposed for this perspective, a two-dimensional form or "checking chart" is proposed for use by individual engineers, engineer has a responsibility to refer questions to management, social scientist, government agencies, and to the citizens at large, President Eisenhower's request for a science of Peace.

Appendix A: Common Ideal

Appendix B: "Faith of the Engineer"

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b) Historical References on Technology, Society, and the Social Sciences, Social Relations of Engineering.
c) References on the Last Decade of Social Responsibility in Engineering.
d) References of the last decade on Social Responsibility in Science.
e) Selected References on Engineering Ethics, Behavioral Sciences, and Social Responsibility.

The Bibliography for the above manuscript in reproduced here.

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After review of the manuscript outlined above, it appeared that it would be better if a historian could write about the historical development of the interest in social responsibility on the part of engineers. Then I could build upon a more rigorous base and deal only with the recent developments. After checking upon what historical studies were in process, it was concluded that no historical studies would be published in time for reference in a 1959 W.J.C.C. paper. This led to a restatement of the problem as stated below.

Problem 4.3: How can the idea of the social responsibility of engineers be developed/be restated briefly in a way that is based upon (a) historical sociology in general, and (b) recent papers such as the panel on the social consequences of automation at the 1958 W.J.C.C.?

Outline and Abstract:

A Checking Chart for the Use of Computer Engineers in Developing Social Responsibility.

Some recent papers on the social responsibility of computer scientists and the social problems of automation are reviewed. A classification of the sciences derived from the work of early sociologists is used to develop a simplified perspective for the engineer. This classification table is transformed into a "checking chart" for use by engineers in determining the extent to which the social problems relating to their work are being covered. This leads to a limited concept of social responsibility that is believed to be easier for the average engineer to take on as an obligation. Namely, the social responsibility of the engineer is to be a kind of coordinator to make certain that the social problems related to his physical engineering work are being studied and that there are provisions made by our society to explain the basic principles and significance of science to the voters in our democracy.

Introduction: Recent articles, W.J.C.C. panel on social consequences of automation, is there some order to these problems?

A Checking Chart Derived From a Classification of the Sciences: Historical sociology, fields of knowledge arranged in order of increasing complexity, basic activities arranged in order in which each stage is dependent on stages to left, primary and secondary influences.

An Example of a Checking Chart Applied to the Work of a Famous Engineer: Charles Proteus Steinmetz (1865-1923),, basic work in physics and chemistry applied to electrical engineering, political activities as Socialist, how engineering can bring benefits to the common people everywhere through capitalist development of large corporations

Example of 1958 WJCC Panel on Social Problems of Automation: Social Planeterium concept of Lasswell, suggestion by Schafer that scientists can establish climate in which workers can trust scientists, statement by Hurd that if automation is restricted to information processing automation extends man's thinking and results in no serious social problems. Illustration of these viewpoints on checking chart.

Potential Use of Checking Charts by Ordinary Engineers: The ordinary engineer who does not have much spare time on account of his basic engineering work and family responsibilities can find shortcuts to understanding the social implications of his work through devices such as the checking chart, sample chart.
Conclusions: Recent discussions are healthy sign, engineers can with a small effort contribute significantly to the protection and orderly growth of our civilization: (1) by insuring that our country supports research in the fields of art and science that are needed to solve the social problems accompanying the rapid technological advances, (2) by developing the mathematical and engineering tools need by social scientists.
References
Four Different Examples of Checking Charts

The above manuscript in making brief mention to early sociologists lacked a uniformity of scholarship and dealt with some problems that were too specific for a paper of this short length. The problem is restated below:

Problem 4.4: How can the checking chart for developing an analysis of social responsibility be derived more logically from a "generalist" description of culture?

Outline: A Checking Chart For The Use Of Computer Engineers In Developing Social Responsibility.

Introduction: Recent papers on Social Responsibility, need for working hypotheses as to the development of civilization, "Generalist" approach of Stuart Chase, spiral of culture, slices which form checking chart
Divisions of Human Activities: Survival, communication, organization, ideals, and proof, where do computers fit in?
Levels of Phenomena: Physical, chemical, biological, psychological, sociological.
"Spiral of Culture:" Spiral formed by human activities and levels of phenomena, incomplete list of stages in the spiral of culture.
A checking Chart for Social Responsibility: A slice of the spiral of culture.
An Example of a Checking Chart Applied to the Work of a Famous Engineer: Steinmetz.
Example of 1958 WJCC Panel on Social Problems of Automation: Checking chart illustrating the social planetaria.
Potential Use of Checking by Engineers of the Future
Conclusions

Discussion of the above manuscript led to the conclusion that it might well be of interest to research workers in the social sciences, but was not well suited to an engineering audience. Therefore the problem was restated as follows:

Problem 4.5: How can this analysis of the social responsibility of engineers and scientists be written in a way that distinguishes between the responsibilities of citizens in general and any special res onsibilities of specialists? How such material be writ'en for engineers rather than for historian or sociologists or generalists?

Abstract and Outline: The Social Responsibility of Engineers and Scientists.

Some rece.t papers on the social responsibility of com uter scientists and the social problems of automation are reviewed. The responsibility of citizens in a democracy is discussed. Then the additional responsibilities of specialists who have knowledge not readily accessible to the layman is reviewed. The hypothesis is proposed that the social responsibility of the engineer is to be a kind of coordinator to make certain that the social problems related to his physical engineering work are being studied and that there are provisions made by our society to explain the basic principles and significance of science to the voters in our democracy. To facilitate an engineer in analyzing his socia responsibilities, a simple checking chart is constructed. A sample case of the checking chart is discussed in the case of the development of a hypothetical computer and data communication system which eliminates the need for money. Here the chart is used to display the potential social problems and to point to the areas where social scientists may need to be consulted in regard to the consequent problems.

(For complete text refer to the Proceedings of the Western Joint Computer Conference, Mar 1959(in press))

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CHARLES PROTEUS STEINMETZ

Since preparing Socio-Engineering Problems No. 1, a new biography of Steinmetz has been published:

John Anderson Miller, P.E. Modern Jupiter - The Story of Charles Proteus Steinmetz. N.Y.: The American Society of Mechanical Engineers (1958), 228pp.

BOY SCOUT OATH OR PROMISE

"On my honor I will do my best: To do my duty to God and my Country, and to obey the Scout Law; To help other people at all times; To keep myself physically strong, mentally awake, and morally straight."

A few months ago I accepted the responsibility of being the scoutmaster of a boy scout troop in our neighborhood. It is a thrill to see boys develop to take on more responsibility and to develop their skills and self-confidence. As the boys repeat the scout oath at the scout meetings, I sometimes wonder if we adults are keeping faith with our boys. Are we doing our duty to God and our country? Are we studying the urgent problems of our civilization? Or are we shirking our responsibility to mankind by saying we are specialists and don't dare to speak up about problems which overlap several fields of competence?

April 26, 1959 Frederick L. Wood