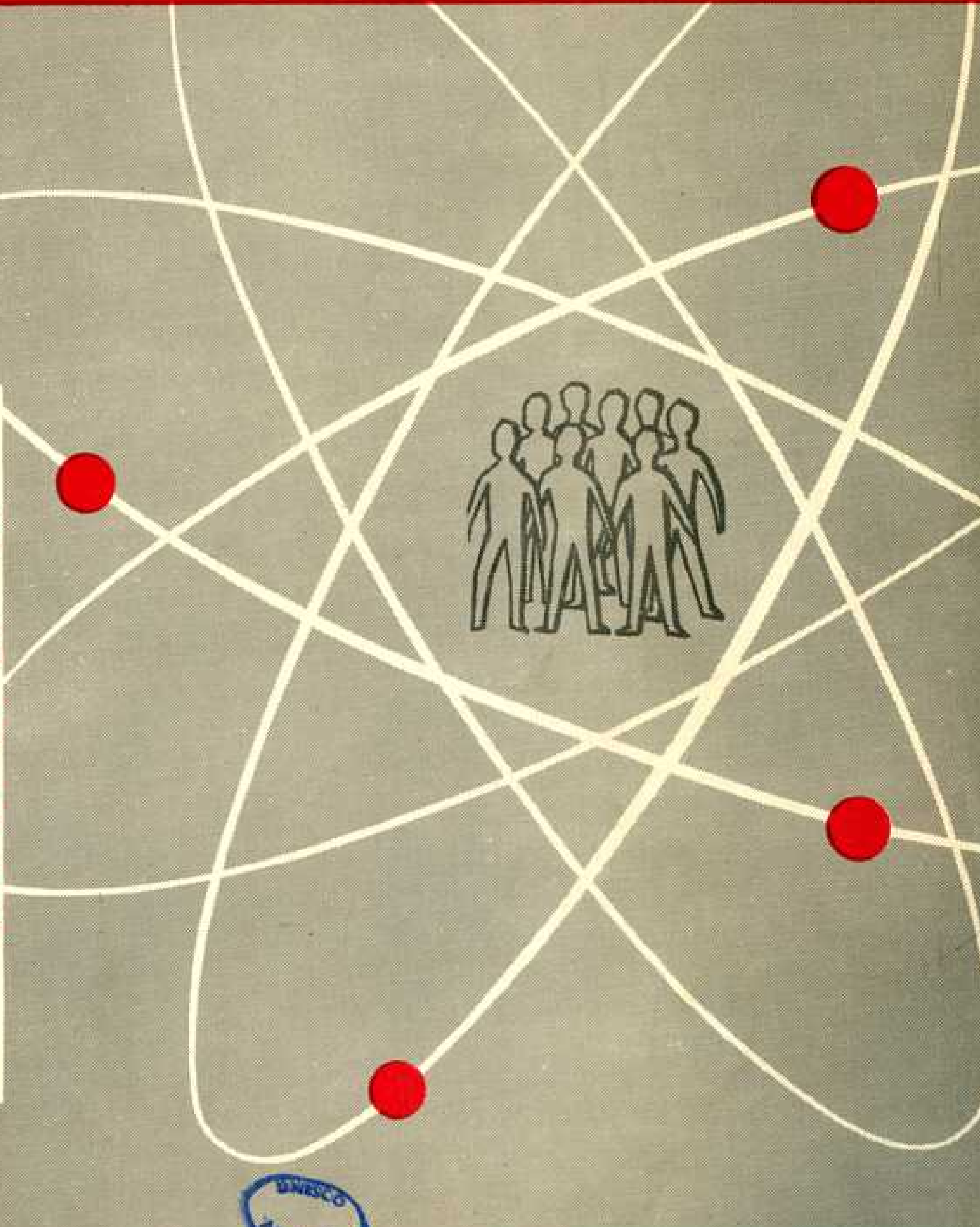
IMPACT *of science on society*



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FOREWORD

IMPACT has come into existence because we believe that there is more need than ever before to understand what is the impact of science on society. Its task is to collect information on the various aspects of the international and social implications of science and to present the material in the form of abstracts so that it is readily available.

This first issue contains an introductory statement on how science impinges on society, and a bibliography giving details of the main "historically important" literature in English. It is our aim to do the same for other countries in future issues. This is followed by current abstracts in the form of reports of addresses given by leading scientists in two countries – Denmark and the USA. In future issues scientists from other countries will similarly be reported.

We are concerned not only with the written and the spoken word, but also with the film and the exhibition. We are making arrangements for suitable abstracts to appear in relation to these two important media of mass communication.

As far as possible, essential bibliographical data are given for each item listed. We add a word of warning: orders for publications should be directed to booksellers, and not to UNESCO. However, readers who wish to obtain UNESCO publications should apply to their National Commissions for UNESCO, or directly to Unesco House, Paris.

We are conscious of the fact that in this Bulletin there will be many gaps and defects: for these we ask not only the indulgence of our readers in this experimental venture, but also their close collaboration. We should like comments, criticism and suggestions for material to he sent to us.

The Editor,
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The Impact of Science on Society

Science impinges on society in two main ways: technologically, by changing the material conditions of life, work and production; and intellectually, by changing the way in which men think. The former is the more striking, since at least in the more advanced countries everybody is in minute-to-minute contact with things that have arisen from scientific research. Clearly a high standard of living is dependent on the use of devices produced by scientific technology or the use of more traditional articles, now produced more cheaply and abundantly by science. Many of the problems that face the world today can be solved only with the aid of science. The problem of world food shortage - a doubling of output is required to give everybody a sufficiency - can be greatly alleviated and eventually solved by the proper application of science (*cf.* Russell, 1949).

The application of science does not merely solve a few problems; its cumulative effect changes the shape of social life, as can be seen by considering the consequence of the development of electrical science - the redistribution of industry, released by electric power from its former compulsory proximity to coal mine or wharf; the levelling up of amenities between town and country; the changes in world communications resulting from telegraph, telephone and radio (and the international political consequences of this); and many others. Some of the social effects create serious new problems - the threat of atomic war, technological unemployment, or the dislocation of traditional family life that has been produced by the car, the cinema, and the like.

The intellectual social effects of science are less obvious but no less real. The "idea of progress" - the idea that the world can be progressively improved if men act appropriately - is taken for granted today. Before the 17th century, it was virtually unknown. And Bury (1920) has shown that the origin and growth of this idea is largely attributable to the impact of scientific discovery on men's thoughts and the attitude of mind adopted by scientists. In many other ways the spread of the spirit of science can change - usually for the better - man's outlook on life.

It may well be that ultimately the intellectual impact of science will be far more important to humanity than its contribution to material welfare. But "man must eat before he can think", and in the present state of the world it is not practical politics to envisage the spreading of the scientific attitude to mankind as a whole. A necessary prelude is to feed the starving millions, and even in the advanced countries to provide those greatly improved conditions of life and leisure which, as history shows, are the necessary basis for scientific thinking. It is therefore natural that discussion about the social impact and scocial function of science concentrates mostly on the material and technological aspects. This need not damage the intellectual progress of science, since even from the most material point of view fundamental research pays the largest dividends.

In a conscious approach to the problems raised by the social impact of science, the basic types of questions to be answered are :

(1) What are the more important problems of material welfare today?

(2) What lines of research are most likely to contribue to their solution? (Of course, the results of fundamental research cannot be predicted *in detail,* but it is possible to make certain probable predictions about them).

(3) A discovery or invention seldom has only the effects that were intended. Hence the more general question that must be answered before taking decisions based on (2): What are the probable *total* social effects of a given scientific discovery or of a proposed line of investigation?

(4) What changes in the organization of scientific effort are required in order that the investigations suggested by (2) and (3) may be efficiently pursued and the results quickly applied?

(5) As a basis for answering (4), what is the present organization and how efficient is it? And more generally, what factors, social or individual, ultimately decide the course of scientific advance?

(6) What changes in general social organization are made advisable by the advance of science?

The bibliography which follows gives a survey of the main attempts to answer these questions in recent times. It makes no attempt at completeness. A number of historical works are included because it is clear that the answering of questions (3) and (5), and to a lesser extent the others, can be greatly helped by historical studies. Further bibliographies will be found in Baker (1942, 1945), Cohen (1949), U.S. Library of Congress (1945), and U.S. President's Scientific Research Board (1947), vols. 3 and 4.

1 ADVANCEMENT OF SCIENCE, BRITISH ASSOCIATION FOR. *Science and World Order*. The Advancement of Science. London, v.2 (5), 1942.

Transactions of a conference on "Science and World Order", organized by the Division for the Social and International Relations of Science. Main subjects treated: Science and Government; Science and Human Needs; Science and World Planning; Science and Technological Advance; Science and Post-War Relief; Science and the World Mind. Contributors include many international figures.

2 — *Scientific Research and Industrial Planning*. Advancement of Science, London, v. 3, p. 286-333, 1946.

Transactions of a conference. organized by the Division for the Social and International Relations of Science. It contains much useful discussion on: the relations of fundamental research to the community; government planning; and personnel problems.

ADVANCEMENT OF SCIENCE, BRITISH ASSOCIATION FOR. Papers read at the Annual Meeting in Newcastle, 1949.

3 Russele John *World Population and World Food Supplies*. Presidential Address. Advancement of Science, London, 1949.

A survey of the world food problem and of contributions that science has made, and can make, to food production.

4 — AUGER Pierre (UNESCO); Horder and Bledisloe (U.K.); Rivett, David (Australia) Ripley, R.O. (Canada). *Food and People*, public meeting held by the Division for Social and International Relations of Science. Nature, v.164, 4170, p.553-554 London, 1949.

This may be read as a useful supplement to the previous reference. Professor Auger referred in particular to the experiment in mass enlightenment on this topic which is being conducted by UNESCO.

5 Pomeroy, r.w. et al — *The Place of Nutrition of Livestock in Relation to Resources*, Discussion held by the Section of Agriculture, Nature, v. 164, 4172, pp. 641-642, London 1949.

The nutrition of livestock is considered from the point of view of the efficiency of conversion of food protein into meat protein, having regard to the current need in Great Britain for the most efficient use of animal feeding stuffs.

6 Higson, G.I. et al — *Chemistry and the Food Supply*, Discussion held by the Section of Chemistry. Nature, v. 164, 4171, p.597-598, London 1949.

This discussion is conceived as a further supplement to the same reference. Higson states that to provide everyone in the world with an adequate diet would mean doubling the present food supply which is a formidable if not impossible task.

7 Stamp, Dudley. *The Planning of Land Use*, Presidential Address to Section of Geography. The Advancement of Science, v. 6, 23, p. 224-233, London 1949.

Previous reviews of land use in Great Britain are brought up to date and the author's earlier conclusion confirmed that there is room both for proper rehousing and the conservation of land for home food production. The author calls for a detached scientific approach to the work of planning land use.

8 Comber, N.M.. *Farming, Science and Education*, Presidential Address to the Section of Agriculture. The Advancement of Science, v.6, 23, p. 291-302, London 1949.

The author emphasizes the importance in industrialized countries of the inclusion in general education of instruction in the basic processes of agriculture. He discusses also the relationship between agricultural advisory services and agricultural education, and agricultural education as such.

9 Fleming, Arthur P.M. *Bridging the Gap between Science and Industry*, Presidential Address to Section of Engineering. The Advancement of Science, v.6, 23, p.244-248, 1949. Report, Nature, v.164, 4170, p.565-566, 1949; editorial comment p.547-548.

The importance is emphasized of reducing the time lag at every step between the discovery of a new idea and its ultimate conversion into a usable product. Technical education facilities are discussed. It is argued that since the development engineer's function is to negotiate the transition from laboratory to works, he should preferably have had research experience as well as practical training knowledge.

10 BAKER, JOHN R. *The Scientific Life.* London, Allen and Unwin, 1942.

Describes, with historical examples, the attitudes of some great discoverers to their work. Argues that any form of planning would be dangerous to science (meaning chiefly fundamental science), because: (1) scientific inspiration is essentially an individual matter, (2) planning of any type would restrict the individual's freedom and so have an ill effect on his work, (3) the results of fundamental research are unpredictable, and (4) chance and accidental discovery play a large part in research. Concludes: "Let us have one plan only: the plan to choose as our investigators those active, independent, untamed people who, by a combination of alert and prepared minds, intense enthusiasm, luck, fools' experiments, and more ordered schemes of their own, are capable of making real discoveries". In regard to function of science, puts emphasis almost entirely on intellectual values - especially the joy which the research worker finds in his work. Makes some suggestions for a larger number of people to share this joy. There is a useful bibliography of 146 items.

11 — *Science and the Planned State.* London, Allen and Unwin, 1945.

A sequel to Baker (1942), which mainly expands the argument on the same points, giving especially fuller treatment of the value of science as an end in itself and to freedom of enquiry. Also adds a number of further points, including a very adverse discussion of science in the U.S.S.R., and a definition of the duties of scientists to society as (1) "to make the greatest possible contribution to demonstrable knowledge", (2) to preserve the scientific heritage, (3) to encourage as many others as possible to take part in research, (4) to help them to do so, (5) in politics to encourage the use of scientific methods of discussion and especially to "raise his voice against all irreversible decisions", (6) to "use their influence against the idea that the interests of the common man are paramount", and (7) to avoid cruelty to animals in experiments and "to educate the public in the matter of the treatment of animals generally". There is a bibliography of 110 items.

12 BAXTER, JAMES PHINNEY. *Scientists against Time.* New York, Little, 1946.

The official history, written by the President of Williams College, of what scientists, organized in the Office of Scientific Research and Development (US) did to help win the war. Recounts the history of the new weapons developed but also shows how co-operative planning produced these new developments.

13 BERNAL, J.D. *The Social Function of Science.* London, Routledge, 1939.

The broadest survey of the subject yet made, from the point of view of one who is definitely dissatisfied with the present situation. Part I, What Science Does, contains chapters: 1, Introductory; 2, Historical; 3, The existing organization of scientific research in Britain; 4, Science in education; 5, The efficiency of scientific research; 6, The application of science; 7, Science and war; 8, International science. Part II, What Science Could Do, contains: 9, The training of scientists; 10, The reorganization of research; 11, Scientific communications; 12, The finance of science; 13, the strategy of scientific advance; 14, Science in the service of man; 15, Science and social transformation; 16, The social function of science. There are several appendices which include; statistical and financial data concerning universities, scientific societies, government aided research, industrial research, and war research; a description by M. Ruhemann of the attitude to and organization of science in the U.S.S.R.; etc.

The author is the outstanding exponent of the thesis that in present conditions the main social function of science is the improvement of material welfare, though it is recognised that the most important instrument for this is not applied science but the fundamental science that lies behind it. He advocates a high degree of central planning, and believes that this can increase rather than diminish the freedom and initiative of the individual research worker. Planning for applied science is sketched mainly in terms of desired practical results; for fundamental research mainly in terms of filling gaps in knowledge and directing effort into promising fields.

14 — *The Freedom of Necessity.* London, Routledge and Kegan Paul, 1949.

The author's beliefs about the social function of science are here set in a wider context and more attention than formerly is given to intellectual effects of science. The book covers too wide a range of themes to be effectively abstracted here.

15 BURY, J.B. *The Idea of Progress.* London, Macmillan, 1920.

An outstanding historical essay on the intellectual social effects of science. The idea of progress – that the world goes on progressing towards a better state, or at least can be progressively improved if men act appropriately – was virtually unknown before the 17th contury. Bury shows that the origin of the idea and its growth through several stages was largely produced by the intellectual effects of scientific discovery and the attitudes of mind adopted by scientific men.(*Cf.* Zilsel 1945).

16 BUSH, VANNEVAR. *Endless Horizons.* Washington, Public Affairs Press, 1946.

A collection of the author's writings. Chapters 3-8 give the main substance of his Report to the President (indexed below under "U.S. Office of Scientific Research and Development"). Other chapters cover various aspects of the social relations of science, such as control of atomic energy and the need for patent reforms.

17 CALDIN, E.F. *The Power and Limits of Science.* London, Chapman and Hall, 1949.

A collection of essays, one of which deals with "social functions" of science. The author gives clear definitions of the scope and aims of "science", "technology", "pure science", and "applied science", and makes a plea for more exact use of such terms. The remaining essays are devoted to the methods of science, and the relation of science to moral practice, rational life, beauty and wisdom.

18 CHARLES, J. A. *Progress Reports from Home and Abroad.* Physiotherapy, v.35, 11, p. 182-188, 1949.

An analysis by the Deputy Chief Medical Officer, British Ministry of Health, is given of developments in the provision of medical care in France, Sweden, the U.S.A. and Great Britain, with a section on hospital costs. The latter increased three-fold in Sweden and Great Britain between 1939 and 1947; and ten-fold in the U.S.A. and Great Britain since 1888.

19 CHILDE, V. GORDON, *Man Makes Himself.* London, Watts, 1936.

20 - *What Happened in History.* Harmondsworth, Penguin, 1942.

Though concerned with many other topics, these two books are relevant to the present subject in that they (1) demonstrate the effects of technology on social progress and of social structure on technological progress in the comparatively simple conditions of the eras between the beginning of humanity and the end of classical civilization, and (2) offer much of interest on the social status and social conditioning of fundamental science in Egypt, Babylon, Greece and Rome, giving the best short account of the beginnings of science viewed in a social context.

21 CLARK, G.N. *Science and Social Welfare in the Age of Newton.* London, Oxford University Press, 1937.

Written largely as a reply to Hessen (1931), this book agrees that social influences are important in moulding the science of Newton's time and Newton's own work, but among relevant social influences it also brings in art, religious feeling, etc., while it gives more emphasis to the scientist's desire to know and to the internal continuity of scientific progress. There are interesting points on the relation between scientific activity and changes in price-level, on the creation of the first good technical textbooks, etc.

22 COHEN, I. BERNARD. *Science, Servant of Man,* London, Sigma Books, 1949

Demonstrates by means of selected case histories that fundamental research gives higher practical dividends in terms of material welfare than does applied research. In concluding chapter, expresses himself against planning of fundamental research, but actually calls for some degree of planning in the form of (a) increased public expenditure, (b) public expenditure consciously directed to fill gaps in knowledge, and (c) educational improvements. Contains a very extensive and very useful bibliography of works on or relevant to the social functions of science.

23 CONANT, JAMES B. *On Understanding Science.* New Haven, Yale University Press, 1947.

Concerned with the need to promote among laymen a better understanding of the spirit and method of science, not merely a knowledge of its results. Sketches a method of doing so by teaching spirit and method through selected case histories.

24 CROWTHER, J.G. *Soviet Science.* London, Kegan Paul, 1936.

An eye-witness account by one who spent much time there. Describes the underlying philosophical and ideological basis according to which the organization of science is designed in the U.S.S.R.; considerable detail on organization and planning; accounts of work done and in progress at many institutes and laboratories; a few pages on Soviet interpretations of the history of science.

25 - *British Scientists of the Nineteenth Century.* London, Routledge, 1937, (1935 under the title, *British Physicists of the Nineteenth Century)*, Harmondsworth, Penguin, 2 vols., 1940, 1941.

Biographies of Humphry Davy, Michael Faraday James Prescott Joule, William Thomson (Lord Kelvin), James Clerk Maxwell, and (1941 edition only) William Henry Perkin, which discuss their work in its relation to their social environments. Though the impact of their researches on society receives attention, the main emphasis is on the way in which the social environment conditioned the nature of their researches.

26 - *Famous American Men of Science.* London, Secker and Warburg, 1937; Harmondsworth, Penguin, 2 vols., 1944.

Biographies of Benjamin Franklin, Joseph Henry, Thomas Alva Edison, and Josiah Willard Gibbs, treated in the same manner as Crowther (1935).

27 - *The Social Relations of Science.* London, Macmillan, 1941.

The only full scale attempt to date (at least in English) of a general history of science showing how the social environment conditioned its development. The last few chapters combine historical with contemporary date to draw conclusions about the working conditions in which discoveries are made, the nature and conditions of research in industry, in the universities, personal and social motives for research, finance of research, planning (with special reference to the U.S.S.R.), American scientific organization, the frustration of science, etc. There is an interesting account of the renewal of interest in the social relations of science in this century, especially in the 1930's.

28 - and WHIDDINGTON, R. *Science at War.* London, H.M. Stationery Office, 1947.

Aspects of the story of the part played "by British scientists in dealing with some of the endless succession and variety of scientific problems, which the war presented with such urgency for solution". There is a section on "Operational Research", one of the chief scientific features of the war.

29 DAMPIER, WILLIAM CECIL. *History of Science and its Relations with Philosophy and Religion.* 4th edition, New York, Macmillan, 1949.

"In converting the third into the fourth edition of this book, most of the subjects treated under the heading '1930 to 1940' have been distributed among earlier chapters. Some new work, especially in England and America, done to solve definite war problems, has led incidentally to an increase in scientific knowledge. An attempt has been made to describe the more important published discoveries" (from the Preface to the 4th edition)

30 DARLINGTON, C.D. *The Conflict of Science and Society.* London, Watts, 1948.

Regards the relation between science and society as entirely one of conflict, with science continually revolutionising the conditions and conventions of society, and society continually trying to prevent it from doing so. In "society" is included most of the organizational apparatus of science - universities, periodicals, academies, etc.

31 DAVIS, JOSEPH S. (ed. by) *Carl Arlsberg: Scientist at large.* Stanford University Press, 1948.

Carl Arslberg, who died in 1940, was an American administrative scientist in the tradition of Joseph Henry; he was director of the U.S. Department of Agriculture's Bureau of Chemistry, a director of the Food Research Institute of Stanford University, and he was connected with the Institute of Pacific Relations. Written as a tribute to his memory, this book will be of interest to anyone studying the administrative problems involved in organizing scientific research.

32 FARRINGTON, B. *Science and Politics in the Ancient World.* London, Allen and Unwin, 1939; second impression, 1946.

The title sufficiently indicates the theme. Suggests that political opposition killed the promise of pre-Socratic science and the attempted revival of its outlook by Epicurus and Lucretius. Main consideration is given to the last two and to the political implications of their philosophy.

33 - *Greek Science, its Meaning for Us*. Harmondsworth, Penguin, 2 vols. 1944, 1949.

A short history of Greek science considered in relation to such social influences as effects on thought of acquaintance with and interest in techniques, class divisions, slavery, etc.

34 - *Head and Hand in Ancient Greece.* London, Watts, 1947.

Four essays on various aspects of the relations between Greek science and Greek society. Of special importance are the first two, concerned, respectively, with: the character of early Greek science and the social background which produced it; and the struggle between craft tradition and philosophical tradition in Greek medicine.

35 FINDLAY, ALEXANDER. *Chemistry in the Service of Man*, 7th edition, London, Longmans Green, 1947.

An exposition of the technological benefits which have been derived from chemistry. There is little on social effects in the broader sense, but much material which would be basic to any discussion of these.

36 FURNAS, C.C. *The Next Hundred Years.* London, Cassell, 1936.

A general survey of modern technology and those parts of science most relevant to it, of probable lines of development, and of the social consequences to be expected therefrom.

37 Great Britain: Privy Council. Comittee on Scientific Manpower (Chairman, J.A. Barlow). Report: *Scientific Manpower*. London, H.M. Stationery Office, 1946.

Estimates Britain's deficiency in scientific manpower as at least 10,000 in 1950 and 26,000 in 1955. Proposes that output of science graduates should be doubled, and gives arguments to show that this is possible. Makes proposals for expansion which the various universities should undertake, and suggests foundation of at least one new university. During period of shortage assesses priorities for use of manpower as (1) teaching and fundamental research, (2) civil science, both Government and industrial, (3) defense science.

38 GREGORY, RICHARD. *Discovery, or the Spirit and Service of Science*. London, Macmillan, 1916; new edition, Harmondsworth, Penguin, 1949.

One of the earliest modern attempts to explain the nature and social function of the general public, this book is now, of course, out of date, largely because discussion has since greatly sharpened the issues. But it can still be read with delight, and not without instruction, by those who are interested in the impact of science on society.

39 — *Science in Chains.* London, Macmillan, 1941.

A description of what befell science in Nazi Germany.

40 FRANK, PHILIPP. *Modern Science and its Philosophy.* Harvard University Press, 1949.

A study of the evolution of the present-day philosophy of science, presented from a critical as well as an historical point of view. The author discusses also the relations between science and political and religious thought.

41 GIEDION, SIEGFRIED. *Mechanization Takes Command.* New York, Oxford, 1948.

"Taking no stand either for or against mechanization as such, Dr. Giedion traces the manner in which mechanization has come to pervade our life, from the egg-beater and vacuum cleaner to scientific management and master-pieces of fine art. Through a study of humble objects he reveals the hidden influence over man of a mechanically produced environment". There are sections on "Springs of Mechanization", "Means of Mechanization", "Mechanization Encounters the Organic", "Mechanization Encounters Human Surroundings", "Mechanization Encounters the Household, "The Mechanization of the Bath".

42 HEATH, H. FRANK, and HETHERINGTON, A.L. *Industrial Research and Development in the United Kingdom: a Survey.* London, Faber and Faber, 1946.

Describes organization and achievements of research in most industries : relevant government actions and agencies; other institutions (e.g. universities) affecting industrial research; general factors affecting industrial progress.

43 HESSEN, B. *The Social and Economic Roots of Newton's Principia,* in Science at the Cross Roads by Bukharin et al. London, Kniga, 1931.

Paper presented at an International Congress of the History of Science. It sets out the view that the development of astronomy and mechanics in the later 16th and 17th centuries was largely controlled by the economic needs of the rising commerce and industry of nascent capitalism, and that Newton's work represents the culmination of this movement and is the answer to a host of technological problems arising from these economic developments. The intention was largely polemical and the case was overstated, but this essay was nevertheless the jumping off ground for a large part of modern historical study of the social relations of science.

44 HILL, D.W. *Co-operative Research in Industry.* London, Hutchinson, 1947.

"This book sets out to describe what co-operative research is, how it is now organized and in what way it may contribute to the solution of some of the pressing problems confronting us". After general chapters covering the social impact of industrial research and the growth of its organization, chapters are devoted to: an outline of the functions, economics and problems of co-operative research in general: the recent history and existing state of co-operative research in Britain, the British Empire and the U.S.A., respectively, much detailed information being given; and to the future of co-operative research, including problems of appropriate size of laboratories, co-ordination (between related industries, nationally, internationally), staffing, finance, etc.

45 HOGBEN, LANCELOT. *Science for the Citizen.* London, Allen and Unwin, 1938; 2nd edition, 1940.

Primarily an attempt to teach science to the layman, this work is enlivened with historical illustrations in which the relations between science and social environment (including the satisfaction of material needs) are continually emphasised. There are also occasional references to problems of the social impact of science today.

46 HOUGHTON, WALTER E. *The History of Trades: its Relation to Seventeeth Century Thought.* Journal of the History of Ideas, New-York, v. 3, p. 51, 73, 190–219, 1942.

Describes the wide interest in 17th century England in the compiling of histories (i.e. descriptions) of trades with a view to improving them. Sets out evidence to show that this interest was an important factor in promoting the outburst of scientific activity at that period.

47 - *The English Virtuoso in the Seventeenth Century* Journal of the History of Ideas, New-York, v. 3, p. 51–73, 190–219, 1942.

Defining the virtuoso as a man of the gentlemanly or aristocratic classes who studied art, literature, antiquities or parts of natural science (chiefly natural history) as gentlemanly accomplishments and ends in themselves without reference to utilitarian aims, the author describes the origin and growth of the virtuoso movement in England in relation to the society of the time, surveys its characteristics at its peack and its influence on the development of science, and finally describes its decline.

48 HUXLEY, JULIAN. *Scientific Research and Social Needs,* with an introductory chapter by Sir William Bragg, and discussions with H. Levy, Sir Thomas Barlow and P.M.S. Blackett. London, Watts, 1934.

A general survey of the scientific activity going on in Britain at the time, treated mainly in terms of application to promote material welfare. Discussions raise and survey some of the more important general problems of the social function of science. Chapter XI, in the form of a discussion with Blackett, contains a discussion on the relations between pure and applied science, the motives of scientists, and similar topics.

49 - *Soviet Genetics and World Science:* Lysenko and the Meaning of Heredity. London, Chatto and Windus, 1949.

A study of the Russian genetics controversy and its wider implications. It opens with an explanation of the principles of Mendelism, then examines the differences between this theory and the creed of Michurinism as interpreted by Lysenko, and offers ideological reasons why the latter has been given official approval in Russia Extensive quotations from the Russian literature are provided and also references to the major papers on the controversy published in America and Britain.

50 LANGDON-DAVIES, JOHN. *Russia Puts the Clock Back.* London, Victor Gollancz, 1949.

A presentation of the key facts of the Russian genetics controversy.

51 LAWRIE, JAMES P. (ed. by) *Science and Technology in the Soviet Union.* published by Science Services Ltd. for Marx House, London, 1942.

Report of a symposium. Information on social function and organization of science in the U.S.S.R. is contained particularly in articles by J.D. Bernal on Physical Science in the U.S.S.R. and M. Ruhemann on the Scientist in Soviet Society.

52 LEONARD, J. NORTON. *Tools of Tomorrow,* London, Routledge, 1935.

A general survey of modern technological advance with predictions of future trends, together with present and future probable social implications and some discussion of resistances to technical innovation.

53 LILLEY, S. Can Prediction Become a Science. *Discovery,* 7, p. 336-40, 1946.

Points out that many of the problems raised by the impact of science on society (e.g. technological unemployment) make it necessary to develop a science for predicting technological change and its social consequences. Assesses the degree of some past attempts at prediction and discusses the conditions necessary for the creation of a science of technological prediction sufficiently accurate to be of practical value.

54 - *Men, Machines and History.* London, Cobbett, 1948.

A history of tools and machines considered in relation to the development of society from the invention of agriculture to 1945. Attempts to show how technological progress repeatedly transforms the nature of society and how conversely the social structure sometimes encourages, sometimes discourages technological advance. Develops the concept of the "relative invention rate" - an attempt at a quantitative evaluation of the rate of technical progress at any time - and shows how this index can be correlated with the main social changes of history.

55 - *Social Aspects of the History of Science.* Archives Internationales d'Histoire des Sciences, v. 28, p.376-443, 1949.

Suggests that solution of contemporary problems of the social relations of science will be facilitated by historical study of similar relations in the past. Mentions briefly the ways in which science affects society (a) through technology and (b) through changing intellectual outlook, but postpones detailed discussion of these to a later work. Discusses with detailed examples the causal relationships affecting the progress of science: (I) internal continuity and consistency of science, (II) influences derived from contemporary economic and technological developments. (III) influence of social structure, (IV) political influences, (V) general intellectual influences, (VI) the influence of religious beliefs. Ends with proposals for increasing and encouraging the historical study of the social relations of science.

56 LOVELL, BERNARD. *Science and Civilization.* London, Nelson, 1939.

A short general account of the interaction between science and society, and the interpretation of science in its social context.

57 MASSACHUSETTS INSTITUTE OF TECHNOLOGY, *Mid-Century Convocation.* Technology Review. M.I.T. v. 51 (7), 1949.

This issue is devoted to a report of the proceedings when, in 1949, the Massachusetts Institute of Technology held its Mid-Century Convocation on the Social Implications of Scientific Progress. "It was the occasion for nearly three dozen eminent scholars to examine the material, spiritual, and intellectual aspects of Twentieth Century progress which has been dominated very largely by science and technology". One chapter gives a summary of panel discussions on how science has affected men's way of life.

58 MAYO, ELTON. *The Social Problems of an Industrial Civilization.* Harvard University Press, 1945.

The Department of Industrial Research of the Graduate School of Business Administration of Harvard University was formed in 1926 to organize and direct research concerned with workers and their work in a modern industrial plant. Its inquiries, being more clinical than experimental, have been conducted not in laboratories but in plants where the "total situation" of an individual worker could be studied in his concrete environment both physical and social. Mayo's recurrent theme is that "The consequences for society of the unbalance between the development of technical and of social skill have been disastrous. If our social skills had advanced step by step with out technical skills, there would not have been another European war". Or again, "The democracies have attained a high level of technical competence and are justly proud of the achievements of 'Science'. Yet physics, chemistry, biology, are wholly unaware of the part they have played in the destruction of society".

59 MEES, C.E. KENNETH (with the co-operation of John R. Baker). *The Path of Science.* New York, Wiley, 1946 .

A general discussion, partly historical of the social function of science. Most valuable in discussion of industrial research and particularly of internal laboratory organization, teamwork, etc.

60 MERTON, R.K. *Science, Technology and Society in Seventeeth Century England*, Osiris, v. 4, p. 360-632, 1938.

The most comprehensive study in existence (at any rate in English) of the way in which science in a given period was influenced by its social environment. With a wealth of documentation and statistics, it shows how (a) the Puritan religious movement, (b) the economic needs of early capitalism, and (c) various minor social factors provided specially favourable conditions for the growth of science in the later two-thirds of the 17th century in England.

61 MORGENTHAU, HANS J. *Scientific Man vs Power Politics.* Chicago, University of, Chicago Press, 1946.

The eight chapter headings are "The dilemma of scientific man", "The age of science and the social world", "The repudiation of politics", "The science of peace", "The chimera of the natural sciences", "The irrationality of scientific man", "The moral blindness of scientific man", and "The tragedy of scientific man".

62 MUMFORD, LEWIS. *Technics and Civilization.* New York, Harcourt, Brace & Co., 1934.

Mumford writes in his chapter on "objectives", "During the last thousand years the material basis and the cultural forms of Western Civilization have been profoundly modified by the development of the machine. How did this come about ? Where did it take place ? What were the chief motives that encouraged this radical transformation of the environment and the routine of life: What were the ends in view: What were the means and methods: What unexpected values have arisen in the process? These are some of the questions that the present study seeks to answer"...

"Mechanization and regimentation are not new phenomena in history: What is new is the fact that these functions have been projected and embodied in organized forms which dominate every aspect of our existence....."

63 NATHANSON, JEROME (ed. by). *Science for Democracy.* Conférence on the Scientific Spirit and the Democratic Faith, New York, King's Crown Press, 1946.

Papers presented at the third annual Conference on the problem of harnessing science to democracy. Contents include: Science and Human welfare, (P.B. Sears); The Gentlemen talk of Science, (R.S. Lynd); Freedom and Abundance, (K.F. Mather).

64 NEEDHAM, J., and DAVIES, J.S. (ed. by). *Science in Soviet Russia.* London, Watts, 1942.

A joint work of several authors giving a rapid survey of Soviet science with some incidental account of the social attitude to it and of organization and planning.

65 OGBURN, WILLIAM F. (ed. by). *Technology and International Relations*, University of Chicago Press, 1949.

"The period after a great war is an occasion for changes in the fundamental policies of one nation to another". This is an inquiry regarding these basic elements of policy "as they may be affected by the new and revolutionary technological and scientific developments". There are chapters on "Introductory Ideas on Inventions and the State" (Ogburn); "The Process of Adjustment to New Inventions" (Ogburn); "Technology and the Growth of Political Areas" (Hornell Hart); "The Steam and Steel Complex and International Relations" (A.P. Usher); "Aviation and International Relations" (Ogburn); "Atomic Energy and International Relations" W.T.R. Fox); "The Mass-Communications Inventions and International Relations" (Robert Leigh); "New Techniques of War and National Policies" (Bernard Brodie); "Modern Technology and the World Order" (Quincy Wright).

66 POLANYI, M. *The Contempt of Freedom.* London, Watts, 1940.

One of the main statements of the point of view that science should be autonomous and not required to serve any social function (other than the acquisition of new knowledge). Chapter 1, "The rights and duties of science", is a review of Bernal (1939), which sets out the main arguments of his opponents. A chapter on "Collectivist Planning" deals with and presents arguments against the central planning of science.

67 Royal Society of London. *Report on the Needs of Research in Fundamental Science after the War.* London, Royal Society, 1946.

Sets out estimates of post-war financial needs of fundamental research in great Britain. Estimated requirements (excluding capital costs, cost of large apparatus and salaries of academic staff who also do research), is given at £1,000,000 at pre-war value of the pound, against a pre-war average of £366,000. Breakdowns by subjects and in other ways are given. More detailed proposals include suggestions for the setting up of institutes to cover neglected fields (e.g. terrestrial ecology, general microbiology, etc.). Within each branch of science the gaps in knowledge are spotlighted and suggestions made for encouraging the work that could fill them.

68 SCIENTIFIC WORKERS, ASSOCIATION OF. *Planning of Science* London, A.Sc.W., 1943.

Report of a conference. First session: Central Planning of Science, mainly in relation to the War. Second session: Local Organization, including several contributions from the point of view of rank-and-file scientists. Third session: Determining the Future, including future social needs, the role of science in satisfying them, organizational *desiderata* to enable it to fulfill this role, central planning proposals, etc.

69 - *A Post-War Policy for Science.* London, Garden City Press, 1944.

Proposals of the re-organization of science "for full satisfaction of human needs".

70 - *Science and Human Welfare.* London, Temple Fortune Press, 1946.

Report of a conference. Discussion covers most aspects of the social function of science and the organizational problems connected with it. Includes brief surveys of situations and needs in China, South Africa, Holland, France, Canada, and U.S.A, with, of course, more detailed attention to Britain. Several speakers considered implications of recent scientific developments in medical research, agriculture, atomic energy, etc. A further group of speeches was devoted to the responsibilities of scientists in modern society; and yet another group to the international organization of science, and international problems, including the atomic bomb.

71 - *Science and the Nation.* London, Pelican Books, 1947.

A number of un-named authors ("united in a desire to see the quickest possible applicat tion of scientific and technical advances for the benefit of man kind") describe what science might do, in a planned Socialist economy, for British industry, agriculture, Social Service and education.

72 SHRYOCK, RICHARD H. *American Medical Research.* New York, Commonwealth Fund, 1947.

A history of the various social influences that have moulded American medical research in the past, with chapters on the present situation, including a survey of the various proposals recently made for improving the organization and efficiency of medical research.

73 SIGERIST, HENRY E. *Civilization and Disease.* Ithaca, Cornell University Press, 1944.

A good general survey, mostly historical, of the relations between medicine (including medical research) and society.

74 *Social Relations of Science,* Supplement to Nature, v. 141, 1938.

An editorial and collection of short opinions by 40 leading scientists on a proposal to establish in Britain a Society for the Study of the Social Relations of Science.

75 *Society for Freedom in Science, Objects of the* 2nd edition, Oxford, 1946.

The object of the Society is stated to be to oppose the views that: "(1) Science had its origin in efforts to satisfy the material needs and desires of ordinary life, (2) The legitimate purpose of science is to meet these material needs and desires on an expanding scale, (3) Scientists cannot be left free to choose their own subjects of research, but must submit to central planning so that their work will be specifically devoted to human material needs and desires".

Occasional pamphlets published by the Society for Freedom in Science are :

76 N° 1. Is the progress of science controlled by the material wants of man? F. Sherwood Taylor. 1945.

77 N° 2. Rights and duties of science. M. Polanyi. 1945.

78 N° 3. Free science. Warren Weaver. 1945.

79 N° 4. The planning of science. M. Polanyi. 1946.

80 N° 5. The future of science and technology. N.S. Hubbard. 1946.

81 N° 6. The foundations of academic Freedom. M. Polanyi. 1947.

82 N° 7. Science pure et science appliquée, à la lumière de l'histoire des sciences. J. Pelsencer. 1948.

83 N° 8. Soviet Science. 1948. From PRAVDA (translated).

84 N° 9. Papers on the Soviet genetics controversy. 1949.

85 STAMP, JOSIAH *The Impact of Science upon Society,* Presidential address to the British Association for the Advancement of Science Blackpool, 1936. Annual Report 1936

Mainly concerned with problems of technological unemployment and capital obsolescence resulting from technological innovation and with problems of mutually adjusting the rates of technological advance and social change in order to reduce friction. Includes an appeal for an increase in the efforts devoted to biological and social sciences, relative to the physical sciences, in order to provide the knowledge required for this adjustment. In general suggests that the problem can be solved scientifically; "if the impact of science brings certain evils they can only be cured by more science".

86 STERN, BERNHARD J. *Frustration of Technology.* Science and Society, New-York v. 2, p. 1, 1937.

An account, partly historical, partly contemporary, of the various influences and interests which have impeded the advance of technology (*cf.* article by same author in Technological Trends, U.S. National Resources Committee, 1937.)

87 - *Society and Medical Progress.* Princeton University Press, 1941.

Discussion of the relationships between medicine and society. Using mainly the historical method, the book covers topics which are sufficiently indicated by the chapter headings: 1, the long road to medical science; 2, the scientific foundations of medicine; 3, the role of medical schools; 4, the development of the modern hospital, 5, urbanization and its effects; 6, income and health; 7, the conquest of famine; 8, medical advances and social progress; 9, resistances to medical change; 10, medical progress and social change: a summary.

88 STRUIK, DIRK JAN. *Yankee Science in the Making.* New York, Little, 1948

Discusses developments in the natural, physical and engineering sciences in New England from the time of the Pilgrim Fathers to the beginning of the Civil War. This is not a mere catalogue of dates and facts, Struik always concerns himself with the broad over-all pattern of scientific development and with the interrelationships between science, literature and social and political ideas in the different periods discussed.

89 UNITED KINGDOM, Select Committee on Estimates. Third Report: *Expenditure on Research and Development* London, H.M. Stationery Office, 1947.

A survey of the organization and particularly the finance of state science in Britain. Expenditure for research in the Ministry of Supply and Admiralty is given at £60 million, and that for all other purposes at about £19 million.

90 - COLONIAL OFFICE. *Colonial Research, 1948-1949.* (Cmd. 7739). London, H.M.S.O., 1949.

Includes the annual reports of the Colonial Research Council; the Colonial Products Research Council; the Colonial Social Science Research Council; and the Committee for Colonial Agriculture, Animal Health and Forestry Research; the Colonial Insecticides Committee and Colonial Economic Research Committee. The report as a whole provides a useful review of current and proposed research in British Colonial territories. Regional institutes of social and economic research are recommended by the Social Science Research Council, and the place of existing (Uganda and West Indies) and proposed (West Africa) institutes are discussed.

91 U.S. NATIONAL RESSOURCES COMMITTEE. Science Committee: *Research - a National Resource* Washington, U.S. Government Printing Office, 1938-41.

The first comprehensive investigation of research in the U.S.A.

Vol. I. *Relations of the Federal Government to Research.* Investigates the situation for both natural and social sciences. Contains recommendations on improvement of methods of recruiting and training Government research workers; methods of contracting out work to other agencies; aid (financial if necessary) to international meetings of scientists; avoidance of bias produced in research by subjection to policy-making; encouragement by Government of non-government research; organization of central councils to co-ordinate governmental and non-governmental research.

Vol. II. *Industrial Research.* Prepared by a committee appointed by the National Research Council. "The report discusses the nature, extent and welfare of industrial research, but does not attempt a catalog of new wealth coming from laboratories". Recommendations include: large industrial firms not having research facilities to investigate possibilities of providing them, and smaller ones of establishing them or using co-operative facilities; companies in prepared and preserved food fields to consider joint support of biological research; liberal publication policy; various recommendations on relations of Government to industrial research. Includes an important article by Charles M. Stine on fundamental research in industry.

Vol III. *Business Research.* Prepared by a committee under the direction of the Social Science Research Council. Gives "a qualitative description of the varied activities carried on in business which provide, through increased knowledge of economic, psychological and cultural facts and principles, a better utilization of the human and material resources of the nation in which business is engaged". Specially useful to the study of the organization and administration of science are chapters on the position of research in company organization, staff, methods, facilities and budgets.

92 — Subcommittee on Technology: *Technological Trends and National Policy, including the Social Implications of new Inventions,* Washington, U.S. Government Printing Office, 1937.

An attempt to evaluate the social effects of technological change and to predict future technological progress with a view to assessing its social effects. Specially noteworthy general articles are: "The Prediction of Inventions", by S.C. Gilfillan (assessment of previous attempts at prediction and principles for future prediction); "Social Effects of Inventions", by S.C. Gilfillan (covering a wide range of social effects); "Resistances to the Adoption of Technological Innovations", by Bernhard J. Stern. Then follow articles by specialists, assessing the present situation and predicting future technological trends and their social consequences for the following spheres: agriculture, mineral industries, transportation, communications, power, chemical industries, electrical goods industries, metallurgy, construction industries.

93 U.S. OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT; *Science, the Endless Frontier,* a Report to the President, by Vannevar Bush. Washington, U.S. Government Printing Office, 1945.

Based on the work of several committees, the report gives answers to four questions put by the President: "(1) What can be done consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge; (2) with particular reference to the war of science against disease, what can be done now to organize a program for continuing the future of the work which has been done in medicine and related sciences? (3) What can the Government do now and in the future to aid research activities by public and private organizations? (4) Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what was done during the war?" At the outset, Dr. Bush says that "new impetus must be given to scientific research in this country" at once and "such new impetus can come promptly only from the government". The report lays particular stress on American comparative neglect of fundamental or basic research in favour of application. Also emphasised is the shortage, actual and prospective, of scientific man-power, and proposals are made for a great extension of scholarships and fellowships. The report notes with regret the absence of any national policy or central policy-making body for science. Discusses need for a new governmental agency "adapted to supplementing the support of basic research in colleges, universities, and research institutes, both in medicine and in the natural sciences, adapted to supporting research on new weapons for both services, or adapted to administering a program of science scholarships and fellowships". Outlines the structure of a National Research Foundation to fulfill these and other needs.

94 U.S. PRESIDENT'S SCIENTIFIC RESEARCH BOARD. *Science and Public Policy,* a Report to the President, by John R. Steelman (Chairman). Washington, U.S. Government Printing Office, 1947.

Vol I. *A Program for the Nation.* The need of the U.S.A. for a great extension of scientific activity is discussed under the headings, "Military Importance" and "Science for Prosperity". It is stressed that the country has previously neglected fundamental research in favour of application, and that the former must now be greatly increased. Much statistical information is given, e.g., expenditures for 1947 (excluding atomic energy) in millions of dollars are given as: total 1,160; fundamental, 110; applied research and development, 1,050 - or distributed by agencies as Federal Government, War and Navy Departments, 500; other departments, 125; industry, 450; university, 45; other 40. A budget for 1957 is proposed as: fundamental research 440; health and medical research, 300; non-military development, 1,000; military development, 500, Man-power problems are discussed briefly and the organization of control and finance touched on. Bush's suggestion for a National Science Foundation (see U.S. Office for Scientific Research and Development, 1945) is taken up in modified form.

Vol II. *The Federal Research Program.* Describes the general organization and finance of Federal research, and then in greater detail the objectives and organization of research in each department or agency, with indications of research projects actually in being or contemplated for the near future.

Vol. III. *Administration for Research.* Proposals for future organization of Federal research. Much higher degree of planning than previously is proposed, but stress is on "planning for research", not "planning of research", with safeguards to protect freedom of action of the individual. More detailed problems of organization within departments and within laboratories are discussed, and also personnel problems. Among the appendices is a most interesting and useful sample survey of opinions of scientists about their work, the satisfaction it gives, its social function, possibilities of improving organization and finance, etc. There is an 80 page bibliography on "the Administration of Research", which covers many aspects of the social relations of science.

Vol. IV. *Manpower for Research.* Detailed facts and statistics about the shortage of scientific man-power and its causes, with recommendations for the future. Appendices discuss the educational system in detail. There is a short bibliography on scientific personnel.

Vol V. *The Nation's Medical Research.* Surveys both organization and scientific content of present medical research and makes recommendations for their improvement, including increased finance, stimulation of more fundamental research, a higher degree of co-ordination and planning etc.

95 U.S. TEMPORARY NATIONAL ECONOMIC COMMITTEE. Investigation of Concentration of Economic Power, Monograph 22: *Technology in Our Economy.* U.S. Government Printing Office, 1941.

A mass of factural and statistical information about the place of technology in the economy of U.S.A. and about the social effects of technological changes. An important section on how research is affected by the concentration of economic power.

96 WESTINGHOUSE EDUCATIONAL FOUNDATION, Pittsburg, Pa. *Science and Life in the World;* 3 vols., New York, McGraw, 1947.

The addresses given by two dozen leaders in science and technology at the Westinghouse Centennial Forum, May, 1946. Some of the chapters cover historical aspects, showing what science has brought about. Others show how science may further the advance of civilization, especially if an ethical approach is used in planning scientific advance.

97 WIGNER, EUGENE PAUL, (ed. by) *Physical Science and Human Values; a Symposium.* Princeton University Press, 1948.

Papers by leading scientists presented at a Conference on "Physical Science and Human Values" at Princeton, N.J., 1946; also the informal discussions and comments that followed these papers. Discuss such questions as "the Social responsibilities of science", "How do the discoveries of modern science affect our ideas of human values?", "Will government imposed secrecy tend to stifle the development of science?", and "What is the philosophical basis of freedom in science".

98 ZILSEL, E. *The Origin of William Gilbert's Scientific Method.* Journal of the History of Ideas, New-York v. 2, p. 1-31, 1949.

Seeks to show that the experimental method of Gilbert arose from his close contacts with craftmen and his interest in and knowledge of craft methods, and particularly from the work of Robert Norman the compass maker. In these terms, Gilbert's great contribution to science, viewed sociologically, was his bringing together of the craft scholarly traditions which had hitherto been kept apart by social divisions.

99 - *The Sociological Roots of Science.* American Journal of Sociology. New-York. v. 47, p. 544-52, 1942.

A discussion of many of the sociological factors involved in the creation of modern science. Main stress is laid on the rise of experiment among the superior craftsmen before it appeared among the scholars, on the subsequent combining of the craft experimental tradition with the scholarly tradition to yield true experimental method, and on the social changes - rise of capitalism, growing importance of trade and industry, and consequent decline of rigid divisions between craftsman and gentleman - which made this combination possible.

100 — *The Genesis of the Concept of Physical Law*. The Philosophical Review, New-York v. 51, p. 245-79, 1942.

The terms "natural law" and "physical law" are clearly metaphors, but the ideas they denote have been of great importance in the development of science. The author seeks to show that: (a) the terms arise from the concept of laws, in the sense of legal commands, imposed on nature by God, this concept being in turn derived from human law; (b) the idea of "physical law" did not appear till the 17th century; (c) its appearance was the result of the change from the customary law of feudalism to the statute law of the monarchies of early capitalism, this last providing the analogy of God laying down laws to be obeyed by natural objects.

101 — *The Genesis of the Concept of Scientific Progress*. Journal of the History of Ideas, New-York v. 6, p. 325-49. 1945

Defines the "ideal of scientific progress" as comprising "(1) the insight that scientific knowledge is brought about step by step through contributions of generations of explorers building upon and gradually amending the findings of their predecessors; (2) the belief that this process is never completed; (3) the conviction that contribution to this development, either for its own sake or for public benefit, constitutes the aim of the true scientist". Seeks to show that this idea had its origin among the superior craftsman of the 16 th and 17th centuries, and was absorbed into modern science by the breakdown of barriers between craftsman and scholar which resulted from social changes in these times. *Cf*. Bury (1920).

102 ZNANIECKI, FLORIAN *The Social Role of the Man of Knowledge*. New York, Columbia University Press, 1940.

"The development and popularization of modern physical and biological sciences have markedly affected the composition and structure of many social groups, either directly by changing traditional beliefs or indirectly by the technological applications of those sciences .... Are the systems of knowledge which scientists build and their methods of building them influenced by the social patterns with which scientists are expected to conform as participants in a certain social order and by the ways in which they actually realize those patterns?

The book has sections, among others, on technological leaders, technological experts, secularization of schools and scholars, the discoverer of truth, the systematizer, etc...

SCIENCE AND SOCIETY

LECTURE DELIVERED BY Dr. P. BRANDT-REHBERG, PROFESSOR OF ZOO-PHYSIOLOGY, TO STUDENTS AT THE UNIVERSITY OF COPENHAGEN, 5 NOVEMBER 1949.

At a meeting arranged by the Danish Students' Council, Professor Rehberg began a talk on "Science and Society", saying :

The question I am going to speak about today, Science and Society, and more specifically the duties of the scientist towards society, is comparatively new. Before the war, most scientists felt that they had complied with their duties towards society if they conscientiously stuck to their studies, paid their taxes, and obeyed the traffic rules. Few scientists understood that they had far greater duties than the common citizen, and a world war had to be fought and an atom bomb dropped before they understood that this was actually the case.

Maybe, I had better state here that by scientists I understand only the natural scientists, said Prof. Rehberg. After defining at some length what was understood by the scientific method itself, he continued:

There are in general two kinds of natural scientists, those working with pure sciences (fundamental research) and those working with applied sciences. Most of those in the latter category are in reality only scientific workers, men and women who have learned scientific methods and apply them to problems of more or less immediate significance to a particular branch of science, or to another activity useful to mankind. Naturally, the difference between the two kinds of scientists is not sharp. The same scientist can work with pure, as well as applied, science, and very often problems from applied science will inspire the pure scientist in his research. That the scientist who works for an industry or on a special problem for the State has duties towards his employers is a matter of course and recognized by everyone. But if you ask about the duties of the pure scientist, the answer is not so easy. What are the duties of the pure scientists in the present world situation? Have they special duties towards mankind and, consequently, towards the society in which they live; The pure sciences form the basis on which all other science rests. Each step forward within the pure sciences can, and probably will, end sooner or later to practical application. Nobody can say when this will happen and whether the influence will be large or small. It might be small, but it might also have such significance that it can benefit all mankind or destroy civilization. The achievements of science during the last war, and above all, the release of atomic energy (which is a scientific result originating from the purest of all sciences, theoretical physics), have convinced many scientists that scientific work carries the biggest responsibility towards humanity.

The common citizen is also becoming more and more aware of the influence science has on his life. If, before the war, you had asked the man-in-the-street how he felt about science, the answer would probably have been that science was good because it worked for human welfare. Now, the answer is more doubtful. Lots of people are ready to reproach science for many of the ills which are at present tormenting humanity. Even such an outstanding man as Aldous Huxley places the responsibility not only for war, but also for unemployment and economic crises on science. They declare: science ought to be stopped; mankind would be better off without science. This attitude is unjust. The truth is that without applied science the larger part of mankind would either die of hunger, or as victims of epidemics, in a few months. The tragic thing, however, is that exactly the same scientific results which bring so much good to man, and to which in many cases he actually owes his very existence, can, with a little deviation, be used against him. Take atomic energy, for instance. If we are going to apply atomic energy for the good of mankind, we are compelled to follow a procedure more than 90 percent of which is identical with the one used for the production of the atom bomb. Or take the chemicals with which you kill weeds in the fields. Dependent on how they are used, the same chemical can kill crops instead of improving them. In a similar way, we have the choice between applying the knowledge we have acquired in the field of bacteriology either to combat bacteria and infectious diseases, or to wage a bacteriological war.

It is of no use to cry "Stop science!" We can not erase from our consciousness all the knowledge which has been gained through centuries. This knowledge is the common heritage of all, and it is mankind as a whole, and not especially the scientists, who will have to decide whether this knowledge is going to be used for the benefit, or for the destruction, of humanity. Men are not governed by scientists. They are, on the whole, governed by men elected by themselves. It is in the hands of these men, the politicians, that we have placed our destiny. It is to be regretted that the politicians usually know almost nothing about science, and equally regrettable that most scientists do not want anything to do with politics, which they consider an inferior form of human activity. It is a tragedy that this should be so, because it is on these two forms of activity, politics and science, that the fate of mankind depends. If we cannot fuse these two forms of activity, the outlook for mankind will not be too bright. The question is, how can we get science and politics on speaking terms. The responsibility for this rests mostly on scientists. The politicians may, in this respect, be considered ignorant innocents. Therefore, one of the bigger responsibilities resting with scientists is to inform the public, in general, and the politicians, in particular, about scientific methods and what the achievements in the various branches of science may mean to society. To evaluate the effect of a new scientific discovery on society is very difficult and we must admit that most scientists, because of their specialization, are so near-sighted when they get outside their own field that they are hardly better off than the politicians in this respect.

It is indispensable that attempts be made to find a rational solution to this problem and that the sociologists begin a comprehensive study of the impact of scientific discovery on society, as help to the politicians. And it ought to be the duty of every scientist to understand clearly himself and help clarify for his fellow-citizens the scope of this problem. Education of this kind requires popularization of science. The fact that UNESCO has established a special division to deal with the popularization of science is a very welcome one. In my view, all scientists ought to support this initiative, and not consider popularization as unworthy and a waste of their time.

Prof. Rehberg went on to consider how a scientist could help disseminate science; passively, through interviews with science writers, and, actively, by inviting laymen to visit his laboratories, by writing articles in the press, giving lectures at meetings and talks over the radio. He then mentioned the rights and duties of scientists as outlined by the Committee on Science and Its Social Relations (CSSR). In commenting on the views of the CSSR, he dealt with the question of science and political ideologies. ("According to its nature, science must be opposed to the authoritarian principle. Science cannot submit to an authoritarian dictation and will only be possible in an authoritarian State if its rulers are wise enough to understand this", he said).

Prof. Rehberg concluded by saying that to contribute to peace is, of course, the first social duty of the scientist. But how can the scientist contribute to peace? To get an opinion on this, CSSR has put two questions to a number of scientists. More than seventy replies have been received, most of them optimistic. They underline that science is international, just as the phenomena of nature are international. Thunder and lightning are the same in the Soviet Union and the United States. It is, therefore, natural for scientists to study the phenomena on an international basis, and lack of national and racial prejudices is the norm among scientists. And yet, is it? Many scientists are not much freeer from prejudices than others, and I doubt whether in national crises they would be able to look upon the supposed enemy with less prejudice than other people do. It would be desirable that their training in unprejudiced thinking could be transferred from their branch of science to other fields, but I doubt that many would be able to do this unless they train themselves to use a scientific way of thinking on the problems of society. From the answers received by CSSR, there appears to be considerable disagreement as to the desirability of scientists actively dealing with politics. Some stressed that only through their scientific work can they serve society and peace, whereas others considered positive political activity necessary to disseminate understanding of the unprejudiced thinking which is the mainspring of science itself.

I will not deny that I subscribe to the latter viewpoint. I believe in the value of the closest possible contact between science, politicians, and the people. For two reasons: partly because I believe that in this way we can best secure understanding of the demands of science in economic as well as idealistic respects, which is a somewhat selfish consideration, but still more because I believe that the scientific way of thinking can weave into public life a pattern of broadmindedness which may be of the greatest significance to social developments.

It will probably take some time before we get "scientific ambassadors" in all ministries and departments, as has been suggested by some, but I hope that you, when you leave the University and go out into practical life, will take along with you so much understanding of the nature of science that wherever you will be working, you can act as the scientific woof which will secure that the unprejudiced scientific way of thinking will make progress in the handling of public affairs.

FOOD FOR TWICE AS MANY

SPEECH DELIVERED BY Dr. S. TOVBORG JENSEN, PROFESSOR OF CHEMISTRY AT THE DANISH AGRICULTURAL HIGH SCHOOL, ON 8 MARCH, 1950

The commemoration speech at the Danish Agricultural High School was given by Professor S. Tovborg Jensen, who spoke on the problem of FOOD AND PEOPLE. He began by mentioning that many people were now of the opinion that the reason why the ancient civilizations of the Mediterranean and the Near East disintegrated was wasteful cultivation and abuse of arable land with resultant erosion. The erosion phenomenon was one of the most spectacular arguments developed by people prophesying that some years from now there would not be food enough for the rapidly growing world population. Three things had to be done if we were to secure enough food for the people of the world: (1) erosion had to be stopped; (2) arable land could in many places be greatly increased by draining, embanking, irrigating, etc.; and (3) better use could be made of the land already being cultivated by more rational treatment of the soil, increased fertilisation, and use of better-yielding strains of crops.

Professor Tovborg Jensen then mentioned examples of methods of combating erosion and the experience gained from new irrigation methods, and said: The most important means, however, is better utilisation of the land which is already under cultivation. In large parts of the world the harvest today is absurdly small, and in most cases this is due to wasteful cultivation.

In a report to the United Nations last summer, Dr. J.N. Ray (India) pointed out that the wheat harvest in India, even in the irrigated districts, is seldom higher than 1,000 kilos (grain) per hectare (1 Ha. - 2.4711 acres). In districts where there is no irrigation, the harvest is far less. In Denmark, the approximate harvest per hectare is 3,000 kilos, and last year, a farm at Taastrup had 7,800 kilos p.Ha. The arable land in India is abused in so far as its production of possibilities are very badly utilised. At the same time, the population of the country, 400 million, is undernourished or starving. The reason for this sad fact, according to the Ray report, is mainly the lack of nitrogen fertilizer, which India cannot afford to import, although it could be produced in practically unlimited quantities in the nitrogen factories which, in other parts of the world, are now closed down and kept in reserve with potential war production in view. If such production began, the nitric acid produced would not be used for artificial fertilizers, but for the production of explosives.

The example mentioned here from India is glaring but in no way unique. Wasteful cultivation and abuse of arable land is unhappily still the rule in most places, although it ought to be the exception. The productive capacity of the arable land in these places is diminishing slowly but surely. Erosion starts and spreads, which means that production drops still more. We are here in one of the vicious circles which it is important for us to break. There is no doubt that this is technically possible. If it does not happen, it is only because factors of quite another kind intervene in a disturbing manner. If all the knowledge and technique we now dispose of were applied and the arable land everywhere used as well as it is in Holland - which is probably the country using its arable land better than anywhere else in the world today - our planet could easily feed a population twice as large as the present one, and on a higher standard.

TEN MILLION SCIENTISTS

ADDRESS GIVEN BY EDMUND W. SINNOTT, RETIRING PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AT THE DECEMBER 1949 MEETING OF THE AAAS IN NEW YORK

Mr. Sinnott began by stating that there is far too little popular understanding of what really is the true spirit and significance of science. Science might break down, but in can also build. Science requires freedom, open-mindedness and tolerance. It fosters goodwill and rational judgment. At the same time, it nourishes deep-seated convictions, especially as to the orderliness of the universe. It is a certain cure for boredom and indifference, since science is a great and exciting adventure.

If, therefore, many more people could participate in scientific work as amateurs, science would greatly benefit.

But, you will say, such direct participation is limited to the small minority of practicing scientists, men who have spent years in specialized training for their profession, and there is small place in it for laymen. But perhaps we should take a somewhat less exalted view of scientific research. We are so familiar with its highly technical aspects - the use of electron microscopes, mass spectrometers, radioactive isotopes, and the scores of other elaborate tools of our profession, together with the mathematical subtleties necessary for an interpretation of the results obtained with them - that we sometimes forget the still vast areas where facts and principles of great scientific value may be discovered with no more complex tools or techniques than are at the command of any intelligent layman. Even to list all these would be impossible here. The exact distribution of plant and animal species, the records of flowering dates through the years, the analysis of tree-ring chronology, the variability of wild species, bird censuses and the records of bird migrations, the study of peat borings, the collection and identification of fossils, the distribution of minerals, detailed local weather observations, records of meteorites and of variable stars, time - lapse photography, problems of radio transmission - these are but a few of the many fields open to study by the amateur scientist. Let us not disparage such work as "anecdotal", as "mere" natural history, simply because experiment and complex apparatus play a relatively minor part in it. Intelligent observation is at the bottom of all research and opportunities for this are almost limitless. There is ample room in science for the efforts of a vast body of enthusiastic laymen.

Science has much to gain from such a mass participation in its work. Consider the great contributions to astronomy made by that indefatigable band of men and women who form the American Association of Variable Star Observers. Think of the revolution in our knowledge of bird migration resulting from the work of hundreds of devoted amateur bird-banders in recent years. The broad base on which such studies can be pursued through lay participation is far beyond the possibilities of any small professional group and constitutes a resource which is too often neglected. The amateur can also contribute in other ways. His fresh viewpoint and freedom from bias have often led to discoveries which his more inhibited professional brother had overlooked. Let us not forget that Franklin, Darwin, Mendel and many others whose names stand high in the history of science were largely self-trained amateurs.

But though science would gain much from a wider participation of laymen in its work, the gain to the laymen themselves would be much greater still. Science for every one is a liberating experience. One of the happiest men I ever knew was an amateur botanist whose ambition it was to obtain a specimen of every species of the genus *Potamogeton* and to learn its distribution. This led him on extensive collecting trips and to correspondence and exchange with friends the world around. It added not a little to our knowledge of aquatic plants, but to him it was also an absorbing adventure. How stimulating it would be if such an experience could be duplicated many thousand fold ! To a jaded generation, feverishly seeking distraction in so many artificial ways, such activities would be healing and invigorating, a means to that sane and rational attitude which will help avoid the dilemma we have been discussing. If this attitude could be shared by a host of men and women, less intensively prepared than we are but no less truly explorers along the frontier of scientific adventure, mankind would be the better for it.

A not inconsiderable beginning toward such an end has already been made, and many amateurs are now industriously at work in the front lines of science. For mutual stimulation and exchange of ideas they are gathered into a host of organizations, ranging from the most unpretentious bird and nature clubs to societies essentially professional in character. An important function of many of these groups is to bring professionals and laymen together and thus to give the amateur the benefit of the wisdom of his more experienced colleagues. Our own Association and most of its affiliated societies include many amateurs in their membership. How many of these lay scientists there are in this country we have no means of knowing, but it must run to many thousands and their activities are varied. Something over ten years ago the Carnegie Corporation and the American Philosophical Society set up a Committee on Education and Participation in Science which surveyed the activity of over 700 lay amateur scientists in the Philadelphia region and helped organize a number of research projects for them. Out of this came an important volume, "The Amateur Scientist", by the secretary of the committee, Mr. W. Stephen Thomas. The war unfortunately prevented a further extension of this promising experiment.

The great programs of adult education are important means of stimulating amateur science, and one of the major tasks of the various state Academies of Science, affiliated with our Association, is to promote such education. But to gain a far wider participation by laymen in scientific work we shall doubtless have to begin with children and young people rather than adults. To this end the hundreds of science clubs, organized under the auspices of Science Service, are of great value in stimulating young people to an active interest in the sciences as a supplement to their classroom work. The nation-wide Science Talent Search is another important means of attracting into science some of the best of our youngsters. It is a hopeful sign, too, that science teaching in our secondary schools is attracting more attention than ever before through the efforts of various agencies. Our own Cooperative Committee on the Problems of Teaching yesterday held an important symposium on trends in modern research, primarily for the information and stimulation of teachers.

We should not forget other means of educating laymen, young and old, than these more formal ones. The modern museum serves more and more as a center to awaken interest in science and to disseminate knowledge about it. Newspapers and magazines are also a most important source of popular scientific information. The science news writer is therefore assuming a particularly serious responsibility in this matter, for much of what laymen learn about science now comes through his hands. The Westinghouse Award for Science Writers, administered by our Association, is providing an important means of raising the quality of their contributions.

But only a small beginning has been made, after all. Amateur scientists still are few and are often regarded with bewilderment by the unregenerate. Much missionary work must be done before a rabid Dodger fan will buy a vasculum and set out to collect the flora of Flatbush ! Certainly most people will continue to find their relaxation and stimulus in other ways than ours, but I am sure there is a respectable minority who, if they could be introduced to one of those fields where the amateur scientists are working so well, if they could once savor the delight of learning at first hand something new about Nature, would forsake the lesser satisfactions which now they seek. Surely if a small fraction of the enthusiasm and intellectual effort now devoted to the game of bridge, for example, could be mobilized for scientific work, what important results might follow ! Is it too much to expect that in this wide land ten million men and women - one person out of every fifteen - might thus learn to devote a share of their leisure to the actual practice of the absorbing arts of the amateur scientist ? You may think this an altogether unrealistic proposal, but if it could be attained, or even approximated, I believe that the change which it could accomplish would profoundly influence us all for good. We recognize our many grievous deficiencies. We need more tolerance, more good will to our neighbors near and far, more sturdy convictions, even a deeper love of freedom. We need to meet our problems with reason and sanity. We need a mental tonic in days of depression and despair. These goals are preached and plead for by our most devoted and enlightened leaders everywhere. We try in many ways, through school and church and public exhortation, to arouse our fellows to the need for a new spirit in the world. Such efforts accomplish much and should be pressed far, but they often seem discouragingly inadequate. The great resurgence for which we have so hoped is hard to bring about, and if it comes may well arrive too late. But where a frontal attack of this sort may fail, perhaps more can be accomplished by indirection. If a great host of our fellows would once become deeply concerned, even in a humble way, with that vocation which is ours; if they once could share the absorbing interest which comes from dealing with Nature at first hand and pushing out even a little way into the unknown; if they could learn the delight of comradeship in that high adventure, then those qualities so greatly desired and so needful for us all would come of themselves. They would appear as natural by-products of scientific activity and not solely as a result of persuasion and propaganda. One would cultivate a distant friend not simply as a dutiful gesture of international good will, but for the very practical purpose of exchanging specimens of *Coleoptera* or records of meteorite showers. In the excitement of a joint project to explore a new fossil bed, the question of whether one's colleagues were of a different race or creed would lose its significance. Good will would come in full measure as a necessary consequence of working together. A man absorbed in the problems of bird banding or tree-ring analysis does not have to be preached to about the value of a hobby as a means of keeping him out of the hands of a psychiatrist. Any one who has had the experience of marshalling scientific data and rigorously drawing sound conclusions from them will not easily fall a victim to wishful thinking or clamorous falsehood or to the urge to follow strange new gods of any kind.

I do not maintain that all that is needed to make any one an angel of light is for him to get a scientific hobby, but there are few therapeutic measures one can think of which would be better restoratives, physically or mentally, for the ills of today. Has not the time come when as professional scientists and good citizens we should turn our attention more vigorously to this problem ? Our great Association has been dedicated for more than a century to the advancement of science. In the past this has been thought of chiefly in terms of research carried on by professional scientists. Should we not recognize more fully than we have done the immense possibilities for progress which are open in many fields of science if we can enlist a host of new colleagues to help explore them? And especially is it not our duty to exploit the great resources of the sciences not only for the discovery of truth and the increase of human comfort and safety but as a means for enriching and strengthening the spirits of men and breaking down barriers which now divide them? Science like most human activities has wrought many ills, but it has within it qualities of beneficence which, once understood and widely practiced, can help to save the world. I commend to my successors in this high office the task of giving our Association a continuing leadership in this great ministry of science to mankind. For such a campaign the regular professional army is not enough. We need volunteers, too, and many of them. Let us undertake, for our good and theirs, to mobilize a great body of recruits. Let us aid in directing their energies into the high adventure with the universe which science is. Let us help develop the brotherhood of men through the brotherhood of science.

THE ENCOURAGEMENT OF SCIENCE

ADDRESS DELIVERED BY Dr. J. ROBERT OPPENHEIMER, DIRECTOR, INSTITUTE FOR ADVANCED STUDY, PRINCETON, NEW JERSEY, AT THE AWARDS BANQUET OF THE SCIENCE TALENT INSTITUTE IN WASHINGTON, MARCH 6, 1950.

Dr. Oppenheimer said that science has profoundly altered the conditions of Man's life, both materially and spiritually. It has changed the form in which practical problems of right and wrong come before us; it has changed the focus of moral issues, both for the individual and for governments. It has given us new methods for defining the meaning of problems that face us and for judging whether or not our solutions are just. Technology, born of science, has enabled mankind to deal with the issues of slavery as a moral issue. Today, poverty is an evil in the sense that it lies within human hands and human hearts to abate it. Science can provide us, for the first time in history, with the means of abating hunger for everyone on earth.

After pointing out that perhaps nowhere has the impact of science more clearly altered the specific terms of a great political issue than in the effects of scientific development on warfare, in that war today has become something very different from what it was a century ago, he said, we need to recognize the new situation as new; we need to come to it with something of the same spirit as the scientist's, when he has conducted an experiment and finds that the results are totally other than those he had anticipated. Science has greatly extended the range of questions in which man has a choice; it has extended man's freedom to make significant decisions. Is there anything, he asked, in the methods of science itself, or in the spirit of science, which can help in the making of these decisions? To what extent is there a play on the word *science* which can mislead us and take us up false roads when we speak of the science of human relationships? Is there anything we can learn from the relevance of science to politics?

He pointed out that we must recognize important and basic differences between problems of science and problems of action, as they arise in personal or in political life. Political decisions are unique acts. In politics there is little that can correspond to the scientist's repetition of an experiment. An expirementthat fails in its purpose may be as good or better than one that succeeds, because it may well be more instructive. A political decision cannot be taken twice. All the factors that are relevant to it will conjoin only once. The analogies of history can provide a guide, but only a very partial one.

There are formidable differences between the problems of science and those of practice. They show that the method of science cannot be directly adapted to the solution of problems in politics and in man's spiritual life. Yet there is a relevance of a more subtle, but by no means trivial kind.

Dr. Oppenheimer then quoted from an unpublished letter written in the middle of the year 1799 by Thomas Jefferson to a young man who had enquired of him as to the usefulness of his studies of science. It was in that year that Napoleon abolished the Directory, and the year before Jefferson was elected, for the first time, as President of the United States. Dr. Oppenheimer commends two sections from this letter :
The first :

"I am among those who think well of the human character generally. I consider man as formed for society, and endowed by nature with those dispositions which fit him for society. I believe also, with Condorcet, as mentioned in your letter, that his mind is perfectible to a degree of which we cannot as yet form any conception. It is impossible for a man who takes a survey of what is already known, not to see what an immensity in every branch of science yet remains to be discovered, and that too of articles to which our faculties seem adequate".

and the second :

"... and it is still more certain that in the other branches of science, great fields are yet to be explored to which our faculties are equal, and that to an extent of which we cannot fix the limits. I join you therefore in branding as cowardly the idea that the human mind is incapable of further advances. This is precisely the doctrine which the present despots of the earth are inculcating, and their friends here re-echoing; and applying especially to religion and politics; 'that it is not probable that anything better will be discovered than what was known to our fathers'. We are to look backwards then and not forwards for the improvement of science, and to find it amidst feudal barbarisms and the fires of Spital-fields. But thank heaven the American mind is already too much opened, to listen to these impostures; and while the art of printing is left to us, science can never be retrograde; what is once acquired of real knoledge can never be lost. To preserve the freedom of the human mind then and freedom of the press, every spirit should be ready to devote itself to martyrdom; for as long as we may think as we will, and speak as we think, the condition of man will proceed in improvement. The generation which is going off the stage has deserved

will of mankind for the struggles it has made, and for having arrested that course of despotism which had overwhelmed the world for thousands and thousands of years. If there seems to be danger that the ground they have gained will be lost again, that danger comes from the generation your contemporary. But that the enthusiasm which characteriees youth should lift its parracide hands against freedom and science would be such a monstrous phenomenon as I cannot place among possible things in this age and this country".

Dr. Oppenheimer went on to ask what are these lessons that the spirit of science teaches us for our practical affairs? Basic to them all is that there may be no barriers to freedom of enquiry. Basic to them all is the ideal of open-mindedness with regard to new knowledge, new experience and new truth. Science is not based on authority. It owes its acceptance and its universality to an appeal to intelligible, communicable evidence that any interested man can evaluate. There is no place for dogma in science. The scientist is free to ask any question, to doubt any assertion, to seek for any evidence, to collect any error.

Science is not skepticism. It is not the practice of science to look for things to doubt. It was not by a deliberate attempt of skepticism that physicists were led to doubt the absolute nature of simultaneity, or to recognize that the ideas of strict causality embodied in classical physics could not be applied in the domain of atomic phenomena. There is probably no group of men who take more for granted in their daily work than the scientists. Common sense, and all that flows from it, are their principal basis for what they do in the laboratory and for what they make of it on paper. But for scientists it is not only honorable to doubt, it is mandatory to do that when there appears to be evidence in support of the doubt. In place of authority in science, we have and we need to have only the consensus of informed opinion, only the guide of example. No scientist needs to order his colleagues to use a new field of experiment or to enter a new field of discovery. If he has done this, it will be an invitation to his fellows to follow.

These then are some of the attitudes of mind, these are some of the disciplines of spirit which grow naturally in the scientist's world. They have grown there in part as a result of a humane and liberal tradition in political life, and in part as a cause of that. The open mind, the reliance on example and persuasion, rather than on authority, these are the heritage of the centuries in which science has altered the face of the earth. Science can help in diverse ways in preserving and extending this heritage. Its very universality speaks across frontiers to make truth manifest in lands otherwise darkened; its material applications create the preconditions in leisure, in education, in means of communication - for the converse of men with each other. Science provides the material and the intellectual basis for a world in which example and understanding can help all men to improve their lot and fulfill their hopes.

SUBJECT INDEX

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Mrs. Williams-Ellis has produced a Report which is useful because books of the kind under review are needed for children speaking many languages and having many backgrounds; because education authorities who want to discuss the basis of such books before commissioning them should have, after reading this report, a clearer view about whom to approach and what standards to adopt before "approving" a book; and because authors and publishers will understand more clearly the nature of their tasks.

THE THEORY AND PRACTICE OF POPULAR SCIENCE.

This Report was written by Dr. David S. Evans, a young scientist of Welsh birth, now working at the Radcliffe Observatory, Pretoria, Union of South Africa. He was formerly advisory editor of the British science magazine DISCOVERY. His publications include the book "Frontiers of Astronomy".

The "Theory and Practice of Popular Science" is based on an article under the same title published in 1948 by Pilot Press, London, in its review, "Pilot Papers". It has been revised to bring it up to date and adapt it to a circle of readers broader than the purely British one for which it was originally written . It represents an attempt to survey the field of popularization of science and to assess the problem as a whole in relation to the times in which we live.

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This first issue contains an introductory statement on how science impinges on society, and a bibliography giving details of the main 'historically important' literature in English. This is followed by current abstracts in the form of reports of addresses given by leading scientists in two countries - Denmark and the United States of America. These are: 'Science and Society' by Dr. P. Brandt-Rehberg; 'Food for Twice as Many' by Dr. S. Tovborg-Jensen; 'Ten Million Scientists' by Dr. Edmund W. Sinnott; 'The Encouragement of Science' by Dr. J. Robert Oppenheimer.

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Yours truly,

The Editor.

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