THE SOCIAL FUNCTION
OF SCIENCE

By

J. D. BERNAL, F.R.S.
Birkbeck College, University of London

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CHAPTER XVI

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At the end of our inquiry we come closer to being able to define what is the contemporary, and what may be the future, function of science in society. We have seen science as an integral part both of the material and economic life of our times and of the ideas which guide and inspire it. Science puts into our hands the means of satisfying our material needs. It gives us also the ideas which will enable us to understand, to co-ordinate, and to satisfy our needs in the social sphere. Beyond this science has something as important though less definite to offer: a reasonable hope in the unexplored possibilities of the future, an inspiration which is slowly but surely becoming the dominant driving force of modern thought and action.

THE MAJOR TRANSFORMATIONS OF HISTORY

To see the function of science as a whole it is necessary to look at it against the widest possible background of history. Our attention to immediate historical events has, up till very recently, blinded us to the understanding of its major transformations. Mankind is, after all, a late emergence on the scene of terrestrial evolution, and the earth itself is a late by-product of cosmic forces. Up till now human life has only undergone three major changes: the foundation first of society and then of civilization, both of which occurred before the dawn of recorded history, and that scientific transformation of society which is now taking place and for which we have as yet no name.

Society and Civilization.—The first revolution was the foundation of society, by which man became different from the animals and found, through the new habit of transmission of experience from generation to generation, a means of advance altogether faster and more sure than the haphazard evolutionary struggle. The second revolution was the discovery of civilization, based on agriculture, and bringing with it a manifold development of specialized techniques, but above all, the social forms of the city and trade. Through these mankind as a whole was removed from parasitic dependence on nature and a certain section of mankind liberated altogether from the task of food production. The discovery of civilization was a local event. It had acquired nearly all its essential features by the sixth
millennium B.C., but only at its centre, somewhere between Mesopotamia and India. We cannot trace in the succeeding thousands of years right up to the Renaissance and the beginning of our own times any substantial change in the quality of civilization. The whole of this period of recorded history marks only relatively small cultural and technical changes, and these, for the most part, of a cyclic character. Culture after culture rises and decays, but each one, though different, is not essentially in advance of the one before. The real imperceptible advance is only in area. Every breakdown of the civilization internally and through barbarian invasions meant in the long run, after a period of confusion, the spread of that civilization to the barbarians. By the end of the period all the easily cultivated lands of the world were civilized.

The Scientific Revolution: The Role of Capitalism.—It is apparent to us now, though it was certainly not then, that by the middle of the fifteenth century something new was beginning. We have come to look on the Renaissance as presaging the rise of capitalism, but it was not until the eighteenth century that any fundamental change was generally recognized. By then, through the application of science and invention, new possibilities were available to mankind which were likely to have an even larger effect on its future than those of agriculture and the techniques of early civilization. It is only recently that we have been able to separate in our minds the development of capitalist enterprise from that of science and the general liberation of human thought. Both seemed to be inextricably connected parts of Progress, but at the same time, paradoxically, their appearance was greeted as evidence that man was returning to his natural state, freed from the arbitrary restrictions of religion or feudal authority. We now see that though capitalism was essential to the early development of science, giving it, for the first time, a practical value, the human importance of science transcends in every way that of capitalism, and, indeed, the full development of science in the service of humanity is incompatible with the continuance of capitalism.

The Social Implications of Science.—Science implies a unified and co-ordinated and, above all, conscious control of the whole of social life; it abolishes, or provides the possibility of abolishing, the dependence of man on the material world. Henceforth society is subject only to the limitations it imposes on itself. There is no reason to doubt that this possibility will be grasped. The mere knowledge of its existence is enough to drive man on until he has achieved it. The socialized, integrated, scientific world organization is coming. It would be absurd, however, to pretend that it had nearly arrived or that it will come without the most severe struggles and confusion. We must realize that we are in the middle of one of the major transi-
tion periods of human history. Our most immediate problem is to ensure that the transition is accomplished as rapidly as possible, with the minimum of material, human and cultural destruction.

The Tasks of Science in the Transition Period.—Although science will clearly be the characteristic feature of the third stage of humanity, its importance will not be fully felt until this stage has been definitely established. Belonging to an age of transition we are primarily concerned with its tasks, and here science is but one factor in a complex of economic and political forces. Our business is with what science, here and now, has to do. The importance of science in the struggle, moreover, depends largely on the consciousness of this importance. Science, conscious of its purpose, can in the long run become a major force in social change. Because of the powers which it holds in reserve it can ultimately dominate the other forces. But science, unaware of its social significance, becomes a helpless tool in the hands of forces driving it away from the directions of social advance, and, in the process, destroying its very essence, the spirit of free inquiry. To make science conscious of itself and its powers it must be seen in the light of the problems of the present and of a realizable future. It is in relation to these that we have to determine the immediate functions of science.

Preventible Evils.—We have in the world to-day a number of palpable material evils—starvation, disease, slavery, and war—evils which in previous times were accepted as part of nature or as the actions of stern or malevolent gods, but which now continue solely because we are tied to out-of-date political and economic systems. There is no longer any technical reason why everyone should not have enough to eat. There is no reason why anyone should do more than three or four hours of disagreeable or monotonous work a day, or why they should be forced, by economic pressure, to do even that. War, in a period of potential plenty and ease for all, is sheer folly and cruelty. The greater part of disease in the world to-day is due directly or indirectly to lack of food and good living conditions. All these are plainly remediable evils, and no one can feel that science has been properly applied to human life until they are swept off the face of the earth.

But that is only the beginning. There are a number of apparently irremediable evils, such as disease or the necessity for any kind of unpleasant work at all, which we have very good reason for believing could be dealt with if a serious and economically well-supported scientific drive were made to discover their causes and eliminate them. The starving of research of potential human value is but one step removed from the starving of man.
Discovery and Satisfaction of Needs.—These are all, however, but negative aspects of the application of science. It is plainly not enough to remove as much of present evil as lies in our power. We must look to producing new good things, better, more active and more harmonious ways of living, individually and socially. So far science has hardly touched these fields. It has accepted the crude desires of a pre-scientific age without attempting to analyse and refine them. It is the function of science to study man as much as nature, to discover the significance and direction of social movements and social needs. The tragedy of man has too often lain in his very success in achieving what he imagined to be his objects. Science, through its capacity for looking ahead and comprehending at the same time many aspects of a problem, should be able to determine far more clearly which are the real and which the phantastic elements of personal and social desires. Science brings power and liberation, just as much by showing the falsity and impossibility of certain human aims, as by satisfying others. In so far as science becomes the conscious guiding force of material civilization, it must increasingly permeate all other spheres of culture.

Science and Culture

The present situation, where a highly developed science stands almost isolated from a traditional literary culture, is altogether anomalous and cannot last. No culture can stand indefinitely apart from the dominating practical ideas of the time, without degenerating into pedantic futility. It need not be imagined, however, that the assimilation of science and culture is likely to take place without very serious modifications in the structure of science itself. Science of the present day owes its origin and much of its character to the precise needs of material construction. Its method is essentially a critical one, the ultimate criterion being experimental, that is, practical verification. The really positive part of science, the making of discoveries, lies outside scientific method proper, which is concerned with preparing the ground for them and with establishing their reliability. Discoveries are usually unthinkingly attributed to the operations of human genius which it would be impious to attempt to explain. We have no science of science. Another aspect of the same defect of present-day science is its inability adequately to deal with phenomena in which novelty occurs and which are not readily reduced to any quantitative mathematical description. The enlargement of science to cover this defect is needed for its extension to social problems, and will be more so the more science becomes assimilated with general culture. The dryness and austerity of science, which had led to its
widespread rejection by those of literary culture and, among scientists themselves, to every kind of irrational and mystical addition, is something which must be removed before science can fully take its place as a common framework of life and thought.

To a certain extent this transformation will represent a fusion of existing tendencies inside and outside of science. Particular scientific disciplines; the dispassionate assembling of evidence; the means of dealing with multiple causation, each factor having a definite quantitative part to play in the final result; the general understanding of the elements of chance and statistical probability, will tend to become the background of every kind of human action. At the same time, history, tradition, literary form, and visual presentation will come more and more to belong to science. The world picture presented by science which, though continually changing, grows with each change more definite and complete, is bound to become in the new age the background of every form of culture. But this change by itself is not sufficient, the transformation of science and not the mere assimilation of other disciplines is required for the new tasks which science will have to face.

The Transformation of Science

The stages of scientific advance have marked a progress from the large and simple to the small and complex. The first stage of science, that of the description and ordering of the available universe, is already essentially completed. The second stage, understanding the mechanics of this universe, is on its way to completion, for already we can see in principle the general scheme of this explanation. There remain unknown, and indeed in part necessarily unknowable, possibilities beyond this, though we can already glimpse a little of this future development. It is quite clear that, if humanity does not in the near future destroy that elaborate co-operative effort, which distinguishes civilization from the previous purely biological existence of man, it will have to tackle a universe which will itself become more and more a human creation. Already the chief difficulties both in the theory and practice of science lie in the problems that human society has created for itself in economics, sociology, and psychology. In the future, as the simpler conquest of non-human forces is brought to its completion, these problems will become increasingly important.

The Problem of the Origin of New Things.—This process will bring new aspects into evidence. The more thought deals with the problems of a rapidly developing society, in part consciously motivated, and in part moving by the indiscernible interaction of the different
forces working within it, the more the methods of coping with
problems will need to be modified in order to deal with the novel and
the unexpected. The first sciences to emerge into rationality were
those of the simplest operations—mechanics, physics, and chemistry.
Our pattern of rationality is founded on the study of systems where
everything is uniform and nothing really new happens. In biology
already this mode of thought is beginning to break down. The theory
of evolution not only marks an advance in our understanding of nature
but is also a critical step in our method of thinking, because it involves
the recognition of novelty and history in science. Men have, it is true,
studied history already for millennia, but in a very different spirit from
that of science. Indeed, they have gone so far as to deny that history
could be a science at all because of the very possibility of novelty in
it. But there is no intrinsic reason why science should not learn
to deal with the novel elements in the universe, which, after all, are
as characteristic of it as the repetitive and regular ones. Science has
not done so up till now because it has not had to. Now for the first
time the problem is fairly presented. If we are to master and direct
our world we must learn how to cope not only with the orderly but
also with the novel aspects of the universe, even when their novelty
is of our own making.

_Dialectical Materialism._—Karl Marx was the first to realize this
problem and to suggest how it might be solved. He was able to draw
from the study of economics, in the place of the superficial regularities
that sufficed for the orthodox school, a profound realization of the
developments of new forms and of the struggles and equilibria from
which still newer forms derived. We have here the beginning of a
rational study of development as such, but it is one in which it is no
longer possible rigidly to separate the observer from the observed,
and which consequently identifies the student with the forces he is
studying. In the turmoil and struggle which our social and political
world is passing through, these ideas are rapidly winning their way
even into the camp of their most violent enemies. They have found
their justification, not only in predicting but also in moulding human
development, a task which would have been impossible within the
limits of a science based on the conception of an ordered and invariable
world.

Now as science itself has proceeded almost entirely by the method
of isolation, the Marxist method of thinking has often appeared to
scientists as loose and unscientific, or, as they would put it, meta-
physical. Isolation in science, however, can only be achieved by
a rigorous control of the circumstances of the experiment or applica-
tion. Only when all the factors are known is scientific prediction,
in the full sense, possible. Now it is quite clear that where new
things are coming into the universe all the factors cannot be known, and that therefore the method of scientific isolation fails to deal with these new things. But from the human point of view it is as necessary to be able to deal with new things as with the regular order of nature. Science is perfectly right in restricting itself to the latter. It is wrong only if it implies that outside this regular order the human mind is helpless, that if something cannot be dealt with "scientifically," it cannot be dealt with rationally.

The Extension of Rationality.—The great contribution of Marxism is to extend the possibility of rationality in human problems to include those in which radically new things are happening. It can only do so, however, subject to certain necessary limitations. In the first place, the degree of prediction where new things are concerned can never be of the same order of exactitude as in the regular and isolated operations of science. Exact knowledge, which has been looked on as an ideal, is, however, not the only alternative to no knowledge at all. There are even very large regions inside science itself where exact knowledge is impossible. The whole trend of modern physics has, for instance, shown that it is hopeless to expect it in atomic phenomena. But there the difficulty is circumvented by relying on the exactness of the statistical knowledge of a large number of events. In a similar way, the exact dates and localities of the critical changes, the wars and revolutions which affect human society, are unpredictable, but here statistical methods are not fully applicable, there being only one human society. Nevertheless, the intrinsic instability of certain economic and technical systems is something which can be generally established, and their breakdown becomes, within a wide range of years, inevitable.

The Trend of the Future.—There can be no question, even to those completely unaware of the methods by which the Marxist predictions are reached, that the Marxists have some way of analysing the development of affairs which enables them to judge far in advance of scientific thinkers what the trend of social and economic development is to be. The uncritical acceptance of this, however, leads many into believing that Marxism is simply another providential teleology, that Marx had mapped the necessary lines of social and economic development which men willy-nilly must follow. This is a complete misunderstanding. Marxist predictions are not the result of working out such a scheme of development. On the contrary, they emphasize the impossibility of doing this. What can be seen at any given moment is the composition of the economic and political forces of the times, their necessary struggle and the new conditions which will be the result. But beyond that we can only foresee a process which has not ended and will necessarily take on
new and strictly unpredictable forms. The value of Marxism is as a method and a guide to action, not as a creed and a cosmogony. The relevance of Marxism to science is that it removes it from its imagined position of complete detachment and shows it as a part, but a critically important part, of economic and social development. In doing so it can serve to separate off the metaphysical elements which throughout the whole course of its history have penetrated scientific thought. It is to Marxism that we owe the consciousness of the hitherto unanalysed driving force of scientific advance, and it will be through the practical achievements of Marxism that this consciousness can become embodied in the organization of science for the benefit of humanity.

Science will come to be recognized as the chief factor in fundamental social change. The economic and industrial system keeps, or should keep, civilization going. The steady process of technical improvement provides for a regular increase in the extent and commodity of life. Science should provide a continuous series of unpredictable radical changes in the techniques themselves. Whether these changes fit in or fail to fit in with human and social needs is the measure of how far science has been adjusted to its social function.

For the full value of these seminal ideas we must wait until the ending of the struggle, which, though it may seem to us interminably drawn out, will appear in history as an episode, though a great and critical one. Then mankind will come into its material heritage, and, far from needing science less, will make even greater demands on it to solve the greater human and social problems which have to be faced. To meet this task science itself will change and develop, and in doing so will cease to be a special discipline of a selected few and become the common heritage of mankind.

Science as Communism.—Already we have in the practice of science the prototype for all human common action. The task which the scientists have undertaken—the understanding and control of nature and of man himself—is merely the conscious expression of the task of human society. The methods by which this task is attempted, however imperfectly they are realized, are the methods by which humanity is most likely to secure its own future. In its endeavour, science is communism. In science men have learned consciously to subordinate themselves to a common purpose without losing the individuality of their achievements. Each one knows that his work depends on that of his predecessors and colleagues, and that it can only reach its fruition through the work of his successors. In science men collaborate not because they are forced to by superior authority or because they blindly follow some chosen leader, but because they realize that only in this willing collaboration can each man find his
goal. Not orders, but advice, determines action. Each man knows that only by advice, honestly and disinterestedly given, can his work succeed, because such advice expresses as near as may be the inexorable logic of the material world, stubborn fact. Facts cannot be forced to our desires, and freedom comes by admitting this necessity and not by pretending to ignore it. These are things that have been learned painfully and incompletely in the pursuit of science. Only in the wider tasks of humanity will their full use be found.