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## THE IMPACT OF SCIENCE UPON SOCIETY<sup>1</sup>

By Sir JOSIAH STAMP

SCIENTISTS see very clearly how, if politicians were more intelligent, if business men were more disinterested and had more social responsibility, if governments were more fearless, far-sighted and flexible, our knowledge could be more fully and quickly used to the great advantage of the standard of life and health—the long lag could be avoided, and we should work for social ends. It means, says Mr. Julian Huxley, “the replacement of the present socially irresponsible financial control by socially responsible planning bodies.” Also, it obviously involves very considerable alterations in the structure and objectives of society, and in the occupations and preoccupations of its individuals. Now a careful study of the literature of planning shows that it deals mainly with planning the known, and hardly at all with planning for changes in the

known. Although it contemplates “planned” research, it does not generally provide for introducing the results of new research into the plan, and for dealing with the actual *impact*—the unemployment, redirection of skill and location and the breaking of sentimental ties that distinguish men from robots. It seems to have not many more expedients for this human problem than our quasi-individualist society with its alleged irresponsibility. It also tends to assume that we can tell in advance what will succeed in public demand and what will be superseded. There is nothing more difficult, and the attempt to judge correctly under the intellectual stimulus of high profits and risk of great losses is at least as likely to succeed as the less personally vital decision on a committee. Would a planning committee, for example, planning a new hotel in 1904, have known any better than capitalist prevision that the fifteen bathrooms then considered adequate for social demand ought really to have been ten

<sup>1</sup> Concluding part of the address of the president of the British Association for the Advancement of Science, Blackpool, September 9, 1936.

times that number if the hotel was not to be considered obsolete thirty years later? Prevision thought of in terms of hindsight is easy, and few scientists have enjoyed the responsibility of making practical decisions as to what the public will want far ahead. They, therefore, tend to think of prevision in terms of knowledge and appreciation of particular scientific possibilities, whereas it involves unknown demand schedules, the unceasing baffling principle of substitution, the inertia of institutions, the crusts of tradition and the queer incalculability of mass mind. Of course, in a world where people go where they are told, when they are told, do what they are instructed to do, accept the reward they are allotted, consume what is provided for them and what is manifestly so scientifically "good for them" these difficulties need not arise. The human problem will then be the "Impact of Planning." I am not here examining the economics of planning as such, but only indicating that it does not provide automatically the secret of correct prevision in scientific innovation. When correct prevision is possible a committee can aim at planning with a minimum disturbance and wastage (and has the advantage over individuals acting competitively), but for such innovation as proves to be necessary it does not obviate the human disturbance or radically change its character. The parts of human life are coordinated and some are more capable of quick alteration than others, while all are mutually involved. One may consider the analogy of a railway system which has evolved, partly empirically and partly consciously, as a coordinated whole. Suddenly the customary speed is radically changed, and then it may be that all the factors are inappropriate—distance between signals, braking power, radius of curves, camber or super-elevation, angles of crossings, bridge stresses. The harmony has been destroyed. Especially may this be the case if the new factor applies to some units only, and not to all, when the potential density of traffic may be actually lessened. The analogy for the social system is obvious, and its form of government matters little for the presence of the problem, though it may be important in the handling of it.

I have spoken as though the normal span of life of men and machinery themselves provides a phase to which scientific advance might be adjusted for a completely smooth social advance. But this would be to ignore customs and institutions, even as we see in federal America, Australia and Canada, constitutions which lengthen that phase and make it less amenable as a natural transition. At one time we relied on these to bring about the economic adjustment necessary. But technical changes take place so rapidly that such forces work far too slowly to make the required adaptation. Habits and customs are too resistant to change in most national societies to bring about radical

institutional changes with rapidity, and we patch with new institutions and rules to alleviate the effects rather than remove the causes of maladjustments. The twenty-mile speed limit long outstayed its fitness, and old building restrictions remained to hamper progress. Edison is reported to have said that it takes twenty-five years to get an idea into the American mind. The Webbs have given me a modal period of nineteen years from the time when an idea comes up as a practical proposition from a "dangerous" left wing to the date when it is effectively enacted by the moderate or "safe" progressive party. This period of political gestation may be a function of human psychology or of social structure. We do not know how ideas from a point of entry permeate, infiltrate or saturate society, following the analogues of conduction, convection or lines of magnetic force.

Our attitude of mind is still to regard change as the exceptional, and rest as the normal. This comes from centuries of tradition and experience, which have given us a tradition that each generation will substantially live amid the conditions governing the lives of its fathers and transmit those conditions to the succeeding generation. As Whitehead says: "We are living in the first period of human history for which this assumption is false." As the time span of important change was considerably longer than that of a single human life, we enjoyed the illusion of fixed conditions. Now the time span is much shorter, and we must learn to experience change ourselves.

I have so far discussed modification of impact to meet the nature of man. Now we must consider modifying the nature of man to meet impact.

Sociologists refer to our "cultural lags" when some of the phases of our social life change more quickly than others and thus get out of gear and cause maladjustments. Not sufficient harm is done to strike the imagination when the change is a slow one, and all the contexts of law, ethics, economic relations and educational ideals tend towards harmony and coordination. We can even tolerate by our conventions gaps between them when preachers and publicists can derive certain amusement and profit from pointing out our inconsistencies. But when things are moving very rapidly, these lags become important; the concepts of theology and ethics, the tradition of the law, all tend to lag seriously behind changes brought about through science, technical affairs and general economic life. Some hold that part of our present derangement is due to the lack of harmony between these different phases—the law and governmental forms constitutionally clearly lag behind even economic developments as impelled by scientific discovery. An acute American observer has said that "the causes of the greatest economic evils of to-day are to be found in the recent great multiplication of interferences by government

with the functioning of the markets, under the influence of antiquated doctrines growing out of conditions of far more primitive economic life." It would be, perhaps, truer to say that we are becoming "stability conscious" and setting greater store, on humanitarian grounds, by the evil effects of instability.

In the United States it would be difficult to find, except theoretically in the President, any actual person or instrument in the Constitution having any responsibility for looking at the picture of the country as a whole, and there is certainly none for making a coordinated plan. Indeed, in democracy, it is difficult to conceive it, because the man in public life is under continual pressure of particular groups, and so long as he has his electoral position to consider, he can not put the general picture of progress in the forefront. Whitehead declared that when an adequate routine, the aim of every social system, is established, intelligence vanishes and the system is maintained by a co-ordination of conditioned reflexes. Specialized training alone is necessary. No one, from President to miner, need understand the system as a whole.

The price of pace is peace. Man must move by stages in which he enjoys for a space a settled idea, and thus there must always be something which is rather delayed in its introduction and the source of sectional scientific scorn. If every day is "moving" day, man must live in a constant muddle, and create that very fidget and unrest of mind which is the negation of happiness. Always "jam to-morrow"—the to-morrow that "never comes." If we must have quanta or stages, the question is their optimum length and character, not merely the regulation of industry and innovation to their tempo, but the education of man and society to pulse in the same rhythmic wave-length or its harmonic.

In some ways we are so obsessed with the delight and advantage of discovery of new things that we have no proportionate regard for the problems of arrangement and absorption of the things discovered. We are like a contractor who has too many men bringing materials on to the site, and not enough men to erect the buildings with them. In other words, if a wise central direction were properly allocating research workers to the greatest marginal advantage, it would make some important transfers. There is not too much being devoted to research in physics and chemistry, as modifying industry, but there is too much relatively to the research upon the things they affect, in physiology, psychology, economics, sociology. We have not begun to secure an optimum balance. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences or possibly, if resources are limited, a transfer ought to be made from one to the other.

Apart from the superior tone sometimes adopted by

"pure science" towards its own applications, scientific snobbery extends to poor relations. Many of the hard-boiled experimental scientists in the older and so productive fields look askance at the newer borderline sciences of genetics, eugenics and human heredity, psychology, education and sociology, the terrain of so much serious work but also the happy hunting ground of "viewey" cranks and faddists. Here the academic soloist is still essential, and he has no great context of concerted work into which to fit his own. But unless progress is made in these fields which is comparable with the golden ages of discovery in physics and chemistry, we are producing progressively more problems for society than we are solving. A committee of population experts has recently found that the expenditure on the natural sciences is some eight to ten times greater than that on social sciences. There is hardly any money at all available for their program of research into the immense and vital problems of population in all its qualitative and quantitative bearings. An attack all along the front from politics and education to genetics and human heredity is long overdue. Leisure itself is an almost unexplored field scientifically. For we can not depend wholly on a hit-and-miss process of personal adaptation, great though this may be. There must be optimal lines of change which are scientifically determinable. We have seen in a few years that the human or social temperament has a much wider range of tolerance than we had supposed. We can take several popular examples. The reaction to altered speed is prominent. In the "Greevey Papers," it is recorded that the Knowsley party accomplished twenty-three miles per hour on the railway and recorded it as "frightful—impossible to divest yourself of the notion of instant death—it gave me a headache which has not left me yet—some damnable thing must come of it. I am glad to have seen this miracle, but quite satisfied with my first achievement being my last." In the British Association meeting for 1836, an address on "Railway Speeds" prophesied that some day fifty miles an hour might be possible. Forty years ago we may remember that a cyclist doing fifteen to eighteen miles an hour was a "scorcher" and a public danger. Twenty-five years ago, thirty miles an hour in motoring was an almost unhealthy and hardly bearable pace. To-day the fifties and sixties are easily borne, both by passenger and looker-on. Aeroplane speeds are differently judged, but at any rate represent an extension of the tolerance. Direct taxation thirty years ago in relation to its effect on individual effort and action seemed to reach a breaking-point and was regarded as psychologically unbearable at levels which to-day are merely amusing. The copious protection of women's dress then would have looked upon to-day's rationality as suicidal lunacy. One hesitates to say, therefore,

that resistances to scientific changes will be primarily in the difficulty of mental and physical adjustments. But there can be little doubt that with the right applications of experimental psychology and adjusted education, the mind of man would be still more adaptable. Unfortunately, we do not know whether education as an acquired characteristic is in any degree inheritable and whether increasing educability of the mass is a mere dream, so that we are committed to a Sisyphean task in each generation. Nor do we know whether this aspect is affected by the induced sterility of the age. It may not be a problem of changing the same man in his lifetime, but of making a larger difference between father and son. The latest teachings of geneticists hold out prospects for the future of man which we should like to find within our present grasp, and recent successful experiments with mammals in parthenogenesis and eutelenesis bear some inscrutable expression which may be either the assurance of new hope for mankind or a devil's grin of decadence.

What is economics doing in this kaleidoscope? The body of doctrine which was a satisfactory analysis of society twenty-five years ago is no longer adequate, for its basic postulates are being rapidly changed. It confined itself then to the actual world it knew and did not elaborate theoretical systems on different bases which might never exist. It is, therefore, now engaged in profoundly modifying the old structures to meet these new conditions. Formerly it assumed, quite properly, a considerable degree of fluid or competitive adjustment in the response of factors of production to the stimulus or operation of price, which was really a theory of value-equilibrium. Wherever equilibrium was disturbed, the disturbance released forces tending to restore it. To-day many of the factors formerly free are relatively fixed, such as wage levels, prices, market quotas; and when an external impact at some point strikes the organism, instead of the effect being absorbed throughout the system by adjustments of all the parts, it now finds the shock evaded or transmitted by many of them, leaving the effects to be felt most severely at the few remaining points of free movement or accommodation. Unemployment is one of these. The extent to which this fact throws a breaking strain upon those remaining free points is not completely analyzed, and the new economics of imperfect competition is not fully written out or absorbed. The delicate mechanism of price adjustment with the so-called law of supply and demand governed the whole movement, but with forcible fixation of certain price elements consequences arise in unexpected and remote quarters. Moreover, the search for a communally planned system to secure freedom from maladjustments involves a new economics in which the central test of price must be superseded by a statistical

mechanism and a calculus of costs which has not yet been satisfactorily worked out for a community retaining *some* freedom of individual action and choice. The old international currency equilibrated world forces and worked its way into internal conditions in order to do so. But the modern attempt to prevent any internal effect of changes in international trade, or to counteract them, and the choice of internal price stability at all costs against variable international economic equations, has set economic science a new structure to build out of old materials. At this moment when elasticity is most wanted, stability leading to rigidity becomes a fetish. The aftermath of war is the impossibility of organizing society for peace.

The impact of economic science upon society to-day is intense and confusing, because, addressing itself to the logic of various sets of conditions as the likely or necessary ones according to its exponents' predilections, it speaks with several voices, and the public are bewildered. Unlike their claims upon physics and mathematics, since it is dealing with money, wages and employment, the things of every day, they have a natural feeling that it ought to be easily understandable and its truth recognizable. Balfour once said, in reference to Kant, "Most people prefer a problem which they can not explain, to an explanation which they can not understand." But in the past twenty years, the business world and the public have become economics-conscious and dabble daily in index numbers of all kinds and the paraphernalia of foreign exchange and statistics of economic life. The relativity of economic principle to national psychology baffles the economists themselves, for it can be said truly at one and the same time, for example, that confidence will be best secured by balancing the budget, and by not balancing it, according to public mentality. The economics of a community not economically self-conscious are quite different from those of a people who watch every sign and act accordingly. Thus the common notion that economics should be judged by its ability to forecast (especially to a particular date) is quite fallacious; for the prophecy, if "true" and believed, must destroy itself, inasmuch as the economic conduct involved in the forecast is different after the forecast from what it would have been before. The paradox is just here, for example: if a people are told that the peak of prices in a commodity will actually be on June 10, they will all so act that they anticipate the date and destroy it. Economics, thoroughly comprehended, can well foretell the effects of a tendency, but hardly ever the precise date or amount of critical events in those effects. The necessity for a concentration upon new theoretical and analytical analysis, and upon realistic research, is very great. But so also is the need for wide-spread and popular

teaching. For a single chemist or engineer may by his discovery affect the lives of millions who enter into it but do not understand it, whereas a conception in economic life, however brilliant, generally requires the conformity of the understanding and wills of a great number before it can be effective.

But not alone economics: if the impact of science brings certain evils they can only be cured by more science. Ordered knowledge and principles are wanted at every point. Let us glance at three only, in widely different fields: man's work, man's health, man's moral responsibility. The initial impact of new science is in the factory itself. The kind of remedy required here is covered by the work of the National Institute of Industrial Psychology. Some of this improves upon past conditions, some creates the conditions of greater production, but much of it combats the evils arising from new conditions created by modern demands, speed, accuracy and intensity. It invokes the aid of many branches of science. It is the very first point of impact. Yet its finance is left to personal advocacy, and commands not 10 per cent. of the expenditure on research in artificial silk, without which the world was reasonably happy for some centuries. We can judge of the scope of this by the reports of the Industrial Health Research Board. Again, the scientific ancillaries of medicine have made immense strides. Clinical medicine as an art makes tardy, unscientific and halting use of them. The public remains as credulous as ever, their range of gullibility widened with every pseudo-scientific approach. (We do not know what proportion of positive cases can create the illusion of a significant majority in mass psychology, but I suspect that it is often as low as 20 per cent.). For a considerable range of troubles inadequately represented in hospitals, the real experience passes through the hands of thousands of practitioners, each with too small a sample to be statistically significant, and is, therefore, wasted from a scientific standpoint. Half-verified theories run riot as medical fashions, to peter out gradually in disillusionment. If the scattered cases were all centralized through appropriately drawn case-histories, framed by a more scientifically trained profession, individual idiosyncrasy would cancel out, and mass scrutiny would bring the theories to a critical statistical issue of verification or refutation in a few months. This would be to the advantage of all society, and achieve an even greater boon in suggesting new points for central research.

A suggestion has been made for an inventions clearing house, to "cooperate the scientific, social and industrial phases of invention, and to reduce the lag between invention and application," managed by a committee of scientists and a committee of indus-

trialists and bankers. The proposal came to me from New York, but London was to be the home of the organization, which was to adopt a code of ethics in the interests of inventors, industry and *social progress*. This brings me to my third example, the field of ethics, which needs the toil of new thought. The systems of to-day, evolving over two thousand years, are rooted in individualism and the relations between individuals. But the relations of society to-day are not predominantly individual, for it is permeated through and through with corporate relations of every kind. Each of these works over some delegated area of the individual's choice of action and evolves a separate code for the appropriate relationship. The assumption that ethical questions are decided by processes which engage the individual's whole ethical personality is no longer even remotely true. The joint stock company may do something, or refrain from doing something, on behalf of its shareholders, which is a limited field of ethics, and may but faintly resemble what they would individually do with all other considerations added to their financial interests. The whole body of ethics needs to be reworked in the light of modern corporate relations, from Church and company, to cadet corps and the League of Nations.

In no case need we glorify change: but true rest may be only ideally controlled motion. The modern poet says:

The endless cycle of idea and action,  
Endless invention, endless experiment,  
Brings knowledge of motion, but not of stillness.

But so long as we are to have change—and it seems inevitable—let us master it. T. S. Eliot goes on:

Where is the wisdom we have lost in knowledge?  
Where is the knowledge we have lost in information?

My predecessors have spoken of the shortcomings of the active world—to me they are but the fallings short of science. Wherever we look we discover that if we are to avoid trouble we must take trouble—scientific trouble. The duality which puts science and man's other activity in contrasted categories with disharmony to be resolved, gaps to be bridged, is unreal. We are simply beholding ever-extending science too rough round the edges as it grows.

What we have learned concerning the proper impact of science upon society in the past century is trifling, compared with what we have yet to discover and apply. We have spent much and long upon the science of matter, and the greater our success the greater must be our failure, unless we turn also at long last to an equal advance in the science of man.