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Science as a Social Institution

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☞ The last dozen years have seen the rise of a great new concern with the interaction between science and society. On all hands, inside and outside the university, there have been efforts to study the many events that constitute this relation and to entrust these studies to various departments in universities. Some persons have gone so far as to call the study of science in human affairs a separate discipline. I have watched this movement at first hand while attending special discussions about it at conferences and committee meetings across the country, from Low Library at my own university to San Francisco and Berkeley, with notable stopovers in Washington and at Oak Ridge, Tennessee.

The upshot of my observations is that if we are in earnest about a new discipline, or even about a better understanding of science, what we need first is some discipline in our minds, at least on a few points. Present-day discussions of science and society seem to me full of loose terms and unexamined assumptions. This excess is understandable, but none the less regrettable. It is true that we are hampered by the clutter of events and by the confused feelings arising from them. Some persons are haunted by Hiroshima and the discovery that there exists a moral and political world markedly different from the world of science; others are caught up in the arguments about the proliferation of nuclear weapons; still others worry about the politics of scientific research and its support; while

many ponder and discuss the infatuation with computers or the utopia of complete control over human heredity and destiny by applying recent biochemical discoveries. These and other topics that will readily come to mind have swamped the first essays of academic thought at treating science as a social institution.

These things being so, I should like to suggest a few difficulties and a few implications that seem to me to stand at the threshold of any useful discussion of science as it manifests itself today. These prerequisites are not a description of the subject, nor the subject itself, but rather an obstacle to be stepped over before we can reach it.

I

To make those difficulties clear, I shall first use some neglected facts of history in order to define what we should mean when we use the word science. But even before that definition, I would ask you to realize that when we bring into one view the large realities of science and of society, we are dealing with a connection that is not only new, but unpredictable—a relation not inherent in the idea of society itself. Dr. Rabi intimated as much in his opening remarks. There have been and are societies without science. Hence the relation between science and society differs from that which we find, say, between crime and society, or the individual and society. For we can assume that the very nature of society implies possible violations of its terms and thus makes crime a natural consequence. Similarly, there is a necessary opposition between individual action and social ends. Society *means* the public good prevailing over private desire. Since those relations are inherent and inevitable, they were noticed early in history. They have generated a tradition of analysis and theory that we can rely on, however much each generation modifies it. Such a tradition we lack entirely when we come to the problem or problems of science and society.

To this obvious historical fact, I would add another, less obvious. Nearly all modern discussions of science in print or *in vivo* perpetually confuse science with technology, taking it for granted that the two are one, and of identical effect. When people today say "science" most of them mean machines, medicine, cyclotrons, jet planes, space flights, pictures of the other side of the moon, ideas about evolution, and the discoveries of biochemistry in genetics. They

mean also mass production, urbanization, and the fluoridation of the water supply. They mean statistics, and what is rather foolishly called "the new math." They probably also mean the Nobel Prize as against the Pulitzer Prize, and a bell-shaped curve as against the Ten Commandments.

In other words, they are mixing three distinct things: one, science as a form of thought and a method of inquiry; two, technology and the industrial life that goes with it; and three, the confused, excited, and admiring awareness of so many wonderful things happening all at once. This confusion is misleading in two ways. It takes for granted the belief that technology is upsetting human habits for the first time in history, that technological change is unprecedented. And again, which is more important, it obscures the social effects in daily life of science as a world-view. In short, the use of the compound science-and-technology (which often makes me think of the English king, William-and-Mary) destroys at the outset any hope of understanding what is new in our situation, and how we might better guide its diverse elements.

II

If science is indeed an institution, its domain and its activity, which we feel rightly to be new and little-known, require definition, like any other constituent of society. Now, technology is very old indeed, and it is not an institution. It is rather a diffused set of habits and instruments whose first impact on society has always been disturbing and often disruptive. Just think—to exchange caves for buildings, stone tools for metal ones, hunting and fishing in a nomadic way for settled agriculture and domestication; to see the world really turned upside down by the improvement of sailing in the fifteenth century; to undergo the revolutions of the enclosure system, the factory system, the new crop-raising of "Turnip" Townsend and Robert Bakewell, and—greatest of all—to see the railroad usher in a new mobility and a new measure of time and space—these were as amazing and upsetting as anything we are experiencing. That last upset, by the railroad, was in truth the violent start of our present feeling of instability in material things. But precisely because technological change has serious emotional and intellectual consequences, we must keep it separate from the

emotional and intellectual consequences of science properly so called.

Here someone may object that by now science and technology are one. Most manufacturers maintain research laboratories, and simultaneously a good deal of pure science from the universities is turned to practical account. This is true. These unions occur and are productive. But the very fact that it is necessary to join the establishments and relate their activities shows that the radical difference between science and technology persists, and must persist. A different kind of interest animates the inventor and the scientist; their genius is different, and these two interests and geniuses create and resolve different problems.

On this point, let me quote as authoritative a few lines from a recent legal brief that was laid before the National Labor Relations Board:

Basic research is purely exploratory. It amounts to a search for new scientific knowledge. It can have no practical result. It can never be applied to commercial or non-commercial activities without further *applied research*. As a matter of fact, it may be never applied practically to a material purpose or activity.

And the brief-writer, having apparently a low opinion of the commissioners' powers of understanding, goes on:

Basic research cannot be applied to a practical material purpose or activity unless some additional applied research is conducted. Further research (applied) is necessary to adapt, convert and/or develop the result of the basic research for the purpose of converting it to a material end such as manufacture or construction. A practical application of the result of basic research may never occur. When it does, in most cases it takes years for the result of basic research to be applied commercially.

From this pleasant iteration of one good idea in different forms, an art that the lawyer shares with the musician, we can see that the writer means what he says—and I hope that we believe him.

Science as a distinct intellectual and professional enterprise—that is to say, as a social institution—is of recent date. During the great ages of technological invention, there were no scientists as such, and consequently no organized body exercising a moral and intellectual influence that could be called scientific. In those early

days, while the inventors seemed cranks, the men of science were theologians like Roger Bacon, painters like Leonardo, soothsayers like Kepler, philosophers like Pascal and Descartes, poets like Davy and Goethe, and so on. It is customary, of course, to date from the work of Copernicus and Galileo the first great shock administered by scientific thought, because their discoveries had religious implications. But to so date it is to misconceive the society in which the shock occurred. It was a society in which heresy was familiar; these new ideas were shocking, but not more so than others that we have forgotten. It was a society in which, among the few who were literate, still fewer took part in cosmic speculations. I am reluctant, therefore, to accept the notion that here was the beginning of science as an institution, true though it is that here was the beginning of science as a great enterprise.

The advent of science as a social institution, as I see it, should not be dated any earlier than the eighteen-eighties, at the end of the hundred years of controversy about evolution, which proved to be the great popularizer of science. It was only in the eighties of the last century that science and the scientist became recognized elements in the ordinary life of Western nations. It was only in the nineties that these elements entered as a matter of course into the universities.

To be sure, as our distinguished colleague Marjorie Nicolson has made plain, the seventeenth and eighteenth centuries were deeply moved by the implications of the Newtonian world-machine and the philosophy of materialism that seemed to go with it. But this mental agitation was still abstract. It was Thought for Thinkers. Science was not the common form of unquestioned belief for the multitude that it has now become.

To grasp how this result came about we must recall one more generality from modern history. The rapid conquest of the Western mind by science after the mid-nineteenth century—I mean science as the exclusive form of truth—was aided by a number of other great changes going on at the same time: the secularization of life, which had begun with the Reformation; the urbanization and mobilization of men since the industrial revolution, which was technological and not scientific; and, finally, the rise of the individual and the mass against authority—an impulse we find variously expressed in such movements as democracy, utilitarianism, posi-

tivism, statistics, and (to use a single general term) the sociological outlook.

Science as an institution is therefore a new structure supported by several older and very solid buttresses. Technology is of course one of these. Its present power over our minds comes from its supposed oneness with science and from its inherent and obvious effectiveness: it works. Secularism, rediscovered most lately by *Time* magazine under Nietzsche's formula "God is dead," is another buttress. It also clearly favors the steady imperialism of science, by which I mean the willingness of masses and elite alike to have science extend its works to all parts of human affairs without exception.

Urbanization and the increase in population, coupled with the doctrines of liberalism and utilitarianism, likewise support the institution of science, by making it evident that the first task of men is to provide material goods for the many. This, we know, is a task for engineering, but we confusedly expect it from science. No matter what we think, numbers and things are steadily in the forefront of our consciousness, and if we have any heart at all or any brains we do not wish it otherwise. Men must live before they can pursue any higher object. And this practical state of mind prepares us to receive as exclusively valid a world-view in which numbers and things are the only entities deemed real.

To point out this connection, which is not logical but historical, is not to suggest that science is not valid in its own terms. Stressing the connection simply makes clear how science has won its place and its strength as a social institution without ever deliberately seeking its own establishment, and certainly without using political arts or force of arms to secure it.

Despite this strength and this high place, science as an institution is ill-understood—that is our excuse for such a discussion as this. Science has had but few interpreters from within, because scientists are properly busy at other occupations; and of those few not all have been good or exact expositors. The works of pure science meanwhile remain impenetrable to the great mass, which is one reason why the mass takes the products of technology as a substitute—as a sample and often as a proof. The people are resigned to living under a mystery that they approve of and take pride in.

III

Yet the observer of the current scene is bound to add that the people feel less and less happy about their lot. The present facts, notions, hopes, and predicaments among which the world tries to chart its course produce, together with old inherited traditions, a turbulence that more and more people find more and more intolerable. Not only the sheltered and the sensitive, but also the ordinary citizen and the simple journalist, concur in calling our time one of the most wretched imaginable, a judgment that is confirmed by our best artists without exception.

This misery is paradoxical. Our world knows itself to be remarkable, worthy of admiration, close to reaching the ancient goals of abundance and power and knowledge; and at the same time it confesses itself profoundly disturbed, convinced of its powerlessness, appalled at the nearness of doom, and (what is worse) intellectually and morally distraught by the very ideas that were supposed to afford unified explanation and clear understanding.

This paradox was noticed by a few observers almost at the outset of the institutionalizing of science. In the eighties Nietzsche put it with his usual clarity:

Investigators invariably postulated that the salvation of mankind depended upon insight into the origins of things. Now, the more we examine into origins, the less do they concern our interests. On the contrary, all the valuations and interestedness that we have placed upon things begin to lose their meaning, the farther we go back and approach the things themselves.¹

What Nietzsche is saying defines for the student of modern science a very large number of problems. If science is an institution called upon, like all others, to justify itself, and if its rise and its links with other institutions are indeed such as I have tried to sketch, then the first questions to be asked are those whose answers will help to solve the Nietzschean riddle. What is it in science that makes us so unhappy? Why is this amazing creation of man so alien to man himself? Or rather—and this is the program I consider pre-

¹Oscar Levy (ed.), *The Complete Works of Friedrich Nietzsche* (London and New York, various dates), IX, 51.

requisite to a solidly based study of science as an institution—*wherein does this creation of man's mind turn against man's interests?*

Such a program naturally goes beyond the limits of the present discussion, but perhaps a brief outline can be drawn. I submit that it should properly fall into two parts: one, what are the assumptions of the institution of science which, when translated into belief and action, become hurtful to man? And two, what are the methods which, when carried over or imitated outside science proper, contribute to the mental distress or positive discomfort of man?

As one example of the assumptions absolutely essential to science and hurtful outside it is that of purposelessness. It is, I think, an empirical observation that, in proportion as modern man has been persuaded of his purposelessness, he has become wretched, resentful, and uncontrollably vindictive. The several brands of existentialism, the philosophy of the absurd, and the generalized sense that anti-social violence is a logical and fit corollary of our best knowledge, suggest that the institution of science is secreting into the larger society something akin to a poison.

Nor is this all. The anti-purpose assumption of science, so successful for discovery and prediction, goes with the assumption of thoroughgoing materialism and determinism. Here let me say dogmatically, since I lack the time to demonstrate it, that the principles of indeterminacy and of heuristic conceptualism accepted by modern theorists of science do not alter in any respect the mechanical determinism of science as a functioning institution in the laboratory. No scientist defining a physical "system" or constructing a model for investigation will allow that anything but matter or energy is at work within it—nor should he. The result of his proper assumption of materialism and determinism is that the citizens of the Western world are persuaded that they themselves are moved by material forces over which they have no control; that they are resultants and products; in a word, that their behavior is not an activity but simply a process, like the movement of the planets around the sun. They do not act, create, initiate, exert will, but simply react.

This rooted belief has passed into common speech: "What's your reaction?" People accordingly attribute their actions or those of others to their glands or their unconscious; they explain character

by heredity or physical types. And in such remarks as "my psyche won't let me"; "I don't know what makes him tick"; "his subconscious stands in his way" conversation reflects the acceptance of mechanism as a universal explanation. We read about the *mechanism* of artistic creation, of social cohesion, or of whatever else interests the twentieth century. No longer agents in their own eyes, men are puppets.

Such buried assumptions naturally have far-reaching results. Under modern theory, responsibility for crime has shifted, first, from the individual to society; then, since society is made up of individuals, responsibility has shifted from society into nothingness. Reputable authorities contend that an up-to-date criminology is impossible if any idea of responsibility enters into it. What the expert studies is pure interaction; that is, he equates the social world completely with the scientist's world in which only blind processes occur. This amounts to saying that the moral component of life has been eliminated. What used to be the *conditions* of choice and willful action are now thought of and felt as the *causes* of mechanical action. I suspect, though I cannot affirm it with finality, that this substitution is the root idea contained in the term "behavioral science." From psychology to sociology the latest student of behavior presupposes that laws await his discovery on exactly the same terms as in physical science: he wants explanations that exclude purpose or intention. Indeed, his purpose as a "scientist" is to show the absence of purpose in all of man's behavior.

So much by way of illustrating how the assumptions of science work after their transfer from the laboratory to society and the minds of men. When we turn to the methods of the institution of science, we are not surprised to see that their effect has been similar. The chief method of science is analysis—breaking down or cutting up experience for minute study leading to the formulation of relationships. The formulation is best made through numbers aided by symbols, or, failing this, through verbal abstraction. All true science is generality. In accordance with this productive method, the remainder of culture has become increasingly abstract, quantitative, and analytic. In the increasing generality of our thought the individual disappears as he already tends to do physically in the population of our cities. He becomes not merely a unit in the mass, but a statistical unit, shorn of his unique features.

Analysis has still another destructive weapon, specialism. Specialism is the institutional counterpart of analysis, and on the face of it a very sensible one. To be sure, everyone is now aware of the main drawbacks of specializing. As a thoughtful engineering dean recently asked himself,

Who speaks for man? Philosophers have tried, especially during the time since physical and chemical knowledge have been used to reduce man to a noble set of biochemical events. I will not try to argue here for the philosophy of holism. Rather I will assume that we all have an intuition that there are ways in which a live functioning organism is different from the collection of systems which our specialized branches of knowledge suggest that it is.²

We may all at times have that intuition, but for most men today that intuition of wholeness in man or in anything else is suspect. And the better the thinker the more likely he is to harbor that suspicion. Any other mode of thought looks like old superstition, like exploded error, which our ill-disciplined feelings ought not to commit any longer: feeling whole and distinct from brute matter is an illusion, and hence a weakness of the flesh that we should fight against. Or to put our mental and moral situation somewhat differently, with us self-consciousness has reached that extreme of analysis where the conscious mind tells itself that conscious mind is but a sort of mirage surrounding the solid core of biochemical events.

Here again the social consequences follow or fill out the pattern produced by the other scientific assumptions. Our faith in the method of analysis leads us to distrust the stuff of experience itself. Nothing is what it seems, because on analysis it turns out to be something else. Common sense is deemed an old delusion, and so are the human relations embodied in the ancient words *love, hate, desire, revenge*, and the rest. Their true, their scientific explanation lies in the abstractions of, let us say, game theory. The substance, in short, passes over into the discourse about substance. Thus learning becomes information theory; language, communication theory; social intercourse, role theory—the last often described as something even less genuine: role *playing*. Nothing is accorded reality,

² W. J. Hennessey, "Bioengineering—A New Professional Partnership" (speech delivered in Philadelphia, Jan. 29, 1966).

because, as I have said, the stuff of experience has been analyzed away; it has evaporated.

Each of those new formulations, of course, seeks to be quantitative; and on its way to that goal it drains out the contents of experience to arrive at pure form. The facility with which this procedure wins widespread assent, not as simply an intellectual scheme, but as an image of our inner life, is undoubtedly a cause, if not the main cause, of the accompanying cries of pain and of self-contempt. For we are not yet completely anesthetized. We still suffer at being drawn and quartered by the conflict between our emotional dependence on the institution of science and the emotional dependence on the older traditional institutions of society.

IV

It follows that a first study of the institution of science, its assumptions and method, should, for the very sake of science, take on one task beyond the obvious ones of defining the scope and power to be accorded the institution itself. That further task is to trace the ways by which the scientific essence comes to pervade and dominate society. Here I think the role of language, and particularly of imagery, is all-important. It is by images and clichés that we drill ourselves into belief, and finally charge beliefs with emotion. Consider, for example, how the familiar attribution of thought to digital computers reinforces the dogma of man-machine, machine-man. That is an illustration from technology. From science we may consider the metaphor popularized by the biochemists that genetic transmission is a "code" which, according to one distinguished scientist, "gives information equivalent to a thousand books consisting of sixty-four three-letter words"—clearly a very polite code that avoids four-letter ones. All these rather hasty analogies, this bad poetry, lends color and strength to the fundamental doctrine that there is no difference between process and activity, between conscious and inanimate nature. DNA processes are accepted as being the exact equivalents of verbal or literary activities. Knowledge equals chemical reaction equals purposeless matter in motion.

If you think about that equation for a moment, you will see that what it states is that there is no difference between meaning and no-meaning—a curious triumph for the equal sign. Since we know from science that in the universe there is no-meaning, the extension

of that proposition to every department of life necessarily ends in the self-negation of mind, which obviously implies the self-negation of science.

This predicament, all would agree, is rather more unsettling than the vague question heard now and then, whether the institution of science is to be our servant or our master. What our inquiry forces us to ask instead is the more exact question, whether a bias toward science in everything is itself a rational scientific attitude. It seems clear that we trifle with words, and at the same time fail in our duty as social critics, when we measure every tendency by its conformity with the one institution of science. We see books pouring out entitled *Law in a Scientific Age*, *Drama in an Age of Science*, *Criminology after the Scientific Revolution*, and so on—all trying to adapt modern society and its oldest institutions to the one peculiar institution that we revere. But we are far from living in a scientific age in the sense intended by these authors. What we are living in is a society overawed by one of its most admirable and dangerous institutions. Needless to say, it is not the scientists who are causing the world's difficulties and miseries. Unlike the oppressive creeds of the past, science is not to be fought by enlightenment or counter-propaganda. It *is* enlightenment. It has no propaganda. There is in pure science nothing to fight. On the contrary, there is a treasure to preserve. But there is around it an institution to understand and to control. If we postpone the task or fumble it, we may wake up to find that the pressures accumulating within mankind under its present unendurable strains will explode into a chaos where, for a longer or a shorter time, neither science nor social order will find a place.