

Modern Science and Moral Values:
Some Lessons of the History of Science

The word "modern" is of early Renaissance coinage. Its original meaning, to think, to act in a modish, mannerish way soon yielded to the meaning to think in a novel way, the way determined by the attitude of late Renaissance toward the world. It was an attitude dominated by the wish to reshape society as much as to transform the face of the earth. It should therefore seem natural that the first programmatic exposition of this "modern" attitude should appear in the form of a Utopia. Its author, Thomas Moore, was the finest product of Renaissance, standing poles apart from Machiavelli, an equally famous embodiment of the freshly new, so-called modern attitude. If there is a saving grace in Machiavelli's Prince, it is in his apparent unawareness of the principle that knowledge is power in the modern sense. Although Machiavelli claims that the prince should feel free to use any means, because to quote Machiavelli's very words, the end justifies the means, he nowhere suggests that among those means there might be some very powerful ones, the fruits of the systematic study of nature. If Machiavelli was a scientist it was only in the sense that he made the most of the systematic exploitation by the prince of the weaknesses of human nature in the interest of the political state.

Unlike Machiavelli, Moore had a vision of the modern state of man, in which the knowledge of nature had a very important part. Social life, agriculture, industry, commerce, transportation, medical care, education are in Moore's Utopia based on a systematic utilization of all available knowledge. In principle this difference between Machiavelli's and Moore's "modern" approach is important, but in practice it should not seem so. The science of the 1510's, when both the Prince and the Utopia were composed, was not yet science in the modern sense. But both in the Prince and the Utopia there was a timeless aspect. It concerned man's morality. The prince of Machiavelli was set free of any moral constraint. He could use ^{without any restraint} all his tools, which happily did not include tools created by science

the men living in Moore's Utopia were the other extreme; by nature they were such as to never abuse of the tools of their carefully cultivated knowledge. Far more realistic was the engineer-artist, without whom the Renaissance would be inconceivable. I mean Leonardo da Vinci, who, to mention only an example, destroyed the blueprints of a ship capable of moving under water. In his judgment such a ship, a submarine in short, would, if constructed, become a deadly threat for any and all seaports in the world. So it had to be scrapped in blueprint. Such was the first interaction between modern science and moral values.

If Machiavelli lived a hundred years later, say around 1600, he would have emphasized that a political leader should not only be extremely unscrupulous in exploiting human weakness, but also extremely attentive to what science can offer for a more efficient way of waging war. Had he lived around 1600, Machiavelli would have urged his prince to pay utmost attention to books written by first-rate scientists on military science. On the top of the list there would have been the magnificently illustrated work of Simon Stevin, De arte belli, or on the art of making war. Today, Stevin is better remembered for doing what Galileo did not do, namely, for dropping balls from the top of a tower to observe the rate of fall of bodies of widely differing weights.

Galileo was far more sophisticated; he let balls roll down on boards of various inclination to test his law of free fall. It first saw print in a book which started with the praise of the art of engineering in the military arsenal of the Venetian Republic. Unlike Leonardo, Galileo expressed no fear that science might be used in an unethical way. In this respect, too, his thinking was worlds removed from that of Bacon, the first and for two centuries the last statesman to see the enormous impact of science on the political arena.

He also clearly perceived that the impact carried with itself a moral conflict for which he had two solutions. One had to do with the practice, the other with principles. The former is found in his New Atlantis, or the description of a new

society led by scientists and by science. To prevent abuse of scientific discoveries, Bacon, the politician, made scientists work under strict security controls. The principles on which the relation of modern science and moral values were to be based, according to Bacon, (he used the word modern with distinct preference), were the principles of Christian religion, with its emphasis on conscience, personal responsibility, objective moral order, and eternal destiny for the individual. All this is clear from Bacon's great work, On the Advancement of Learning.

6 What makes The Advancement of Learning a really significant work is Bacon's discussion of the questions why science came to a standstill among the Greeks and what justifies the "modern" approach to science and to its method. Bacon's answer to both questions was tied to the Christian belief in Creation. In the absence of a belief in creation and in Creator, the Greeks failed to perceive that the understanding of nature could not be achieved through apriori consideration. On the other hand, the rationality of the Creator and the basic difference between Creator and creature gave the basis for a program, which consisted of a slow, laborious experimental exploration of the laws of nature.

Anchored in this perspective, the work of the scientist could naturally be viewed as a special service of the Creator in general and of Christian religion in particular. All the important creators of classical science, Galileo, Descartes, Boyle, Hooke, Pascal, and Newton viewed scientific research in this perspective, which meant, of course, that scientific work was under the control and guidance of the value judgments of Christian ethics. Since this ethics was, in principle at least, universally shared in 17th-century Europe, the relation of modern science and ethical values seemed to present no problem on the level of principles.

Yet, this seemingly harmonious edifice that housed both science and ethics under the same roof, already showed some cracks before it had been completed by Newton. The kind of distinction which Galileo claimed to exist between primary and secondary qualities logically led through the empiricism of Locke to the

claim that only quantities represented topics for objective knowledge. Books that were about other topics than quantities were to be burnt, to recall the famous advice of Hume. The books he meant were, above all, books on metaphysics. Thrown in for good measure were the books on ethics, since an objectively valid ethics cannot be construed without metaphysics.

While Hume and Kant tried to save traditional ethics as a practical commodity, though not as an objective validity, the radical wing of the French Enlightenment had no patience for such half-way measures. The results can be read in De la Mettrie's Man as a Machine, in Condorcet's plan for a judiciary system based on probability calculus, and in d'Holbach's System of Nature. In the latter, ethics is defined as the line of least resistance vis à vis the forces of nature. It was against this soulless mechanistic world view that young Goethe revolted. Since he was unable to distinguish between quantitative, Newtonian science and purely quantitative philosophy, he revolted not only against the latter but also against the former.

For the rest of his life Goethe could not disentangle himself from the trap he set for himself. Nor did he realize that his was the same noble but tragic mistake that marred Socrates' heroism. In order to justify the saving of his soul at the price of letting his body be destroyed, Socrates proposed that the quantitative science of Anaxagoras and of the atomists be replaced by a qualitative science, in which not the quantitative correlations of things are investigated but the purposes and goals for which things presumably exist. The result was the Aristotelian physics, the prototype of Goethe's physics. Neither contained one tolerably correct page. The source of this disaster in both cases was the same, namely, the failure to perceive that quantitative science, the only possible type of exact science, was one thing, the philosophical generalization of it was another. The former was a necessity, the latter was a disease.

As a physicist proud of my profession, I am pleased to recall that the ones who noted this most emphatically during the 19th century were the last great

figures of classical physics, Faraday, Helmholtz, Maxwell, Kelvin, to mention only a few. They fought tooth and nail the contention of 19th-century materialism that the determinism of Newtonian physics had eliminated freedom and moral responsibility. This is not the place and time to quote their words. A good sample of them is in my Relevance of Physics, a book in which I tried to show that the creators of exact science had until this century been very conscious of the fact that the method of exact science is relevant only within a restricted field. That method can deal only with what is quantitative in things and processes including humans. The substance of this can be formulated as follows: quantities tell us something about everything but very little about anything.

Our century is different from the 19th century also in that the voice of those scientists who insist on the limits of the quantitative method is increasingly drowned out by the voice of those who preach the gospel of the universal and exclusive applicability of quantitative method. They were troubled only momentarily by Hiroshima and by the refusal of most atomic powers to accept strict international control of all atomic stockpiles. The bomb showed that while the power of science in creating tools is practically unlimited, science itself could not provide the ethical values, ethical norms, ethical insights, and last but not least, the ethical strength to use its tools properly. The refusal of international control of atomic energy and the rush of several countries to make atomic weapons showed that all the science of the atomic age did not produce a mankind which would naturally, or instinctively, do what is good and proper.

Our generation is a particularly good illustration of this natural, ethical impotence. We are, indeed, in an especially deep confusion and ignorance about what is morally good. Blindfolded by the mirage of logical positivism, many in our generation have declared that the problems of value judgments are pseudo-problems. This is, of course, true as long as one is in mad pursuit of what Whitehead once called the mirage of perfect vocabulary. It is a vocabulary in

hich there is no partial overlap of the extent of meaning covered by any two words. Such a dictionary will contain only words but no definitions and explanations, as these are based on the partial overlap of meanings defined by words. Actually, such a dictionary would consist only of the endless list of numbers that are integers. The dictionary will not even include much mathematics, the ideal language of logical positivists. It certainly will not include ethics. Yet, it certainly would be foolish not to talk about ethics only because it cannot be spoken of in the easy terms of integers or in the somewhat less easy terms of mathematics.

That logical positivism leads to a foolish blind alley was unwittingly indicated by Wittgenstein, the chief idol of logical positivists. He did so, interestingly enough, in connection with the question of ethics. On the one hand, he desperately clung to the truth of an absolutely valid ethics, on the other hand, he decried any talk about it. Here are his very words: "This running up against the limits of language is Ethics. I regard it as of great importance that one should put an end to all the twaddle about ethics—whether it is a science, whether values exist, whether the Good can be defined, etc. In ethics people are forever trying to find a way of saying something which, in the nature of things, is not and can never be expressed. We know a priori; (and therefore) anything which one might give by way of definition of the Good—it can never be anything but a misunderstanding."

The mystical inclinations of Wittgenstein are well known. It is also known that genuine mystics were unanimous in asserting that language cannot express their deepest experience. Yet, should we write off all they said about it as mere twaddle? The consistent silence advocated by Wittgenstein about ethics can easily lead to what Samuel Butler aptly described in his Erewhon, in the section, the "Colleges of Unreason." There, in the world of pure machines, a general ban was declared on what they called "this goddamn gift of language."

No wonder. The richness of language and our inextricable need of that

richness is a perennial rebuttal of the cultural Gleichschaltung which is being planned in many quarters in the name of science. Their aim is reduction, not unification. The latter is or rather should be based on the recognition that in order to unite things they must be different and should retain their differences. This is particularly important to note in an age in which so much has been said about the tragedy of two cultures, the culture of scientists and the culture of humanists. Healing that split cannot be done by the reductionist program of Snow's Two Cultures, in which not only scientists are presented in contrast to humanists as the deeper and more sensitive minds, but systems-engineers are declared as being more in tune with the cultural needs of their times than are inventive engineers, let alone theoretical scientists.

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This shallowness in sizing up global and age-old problems is a piece with the poverty of modern thinking about man. Clearly, if man is merely a servo-mechanism then there is no justification in talking about moral values. Clearly, if man is the product of blind chance, there is no justification in talking about the inalienable dignity of man. Clearly, if man is the outcome of an ironclad physical necessity, there is no justification in talking about moral responsibility. Yet, only the most extremist advocates of reductionism would say flatly that there is no moral responsibility, no alienable personal dignity, no difference between tools and goals. In other words, we may safely assume that there is such difference, such dignity, and such responsibility. If so then we have on hand a definition of man which leads us far beyond what science can say about him.

Herein lies the source of tension between modern science and moral values. As a historian of science I am tempted to say that the four-hundred-year-old story of that tension had already revealed practically all that can be learned about that tension. That history showed that language has to yield to stupefying silence if man is defined a machine, crude or sophisticated, and nothing else. That history showed that it is sheer naiveté to expect the Utopia in which all men would naturally do ^{the} good. That history showed that deadly inventions will

ot be destroyed in the blueprint stage. Should then we yield to the
ictatorship of classified research, or to the willfulness of Machiavellis?
he only alternative seems to lie in the willingness to keep in mind and to
ultivate the difference between the finest of tools, modern science, and
he finest of goals, man in his moral dimensions. A careful reading of
istory shows that 20th-century science put this age-old distinction in a
ew perspective only by giving it a never before experienced urgency.