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the individual and the cosmo have been shattered by a new awareness of unintended evil. The unaccounted-for consequences of economic and technical activity are becoming increasingly inescapable. Air, noise, and water pollution foul our natural resources, and our central cities are in many cases rapidly becoming unlivable.

The impact of these consequences has been to cause some moral questioning, and much name-calling and castigation. Who is to blame for our current situation? Whose fault is pollution? Whose responsibility is its alleviation? Who is to blame for unsafe automobiles? After all, remember *caveat emptor*. Is the government the sole protector of the public good, leaving individuals to maximize their self-interest? What responsibilities do you have as citizens, as engineers employed by a corporation, as members of a profession, and as political and economic leaders?

We are not so presumptuous as to pretend to be able to answer any of these questions, and we should all be sceptical of any attempt we should make. We can together, however, search for ways to think about such problems in order to find constructive ways of conceptualizing ethical problems so that they are more amenable to clear thinking, rather than merely losing sleep over them or ascribing blame to someone else so that we can go to sleep more easily.

The phenomenon of unintended detrimental consequences in the large, due to actions taken in the small, is of course not new. Cities have had to cope with the problem of garbage collection for centuries, and the questions of responsibility have been pondered since such problems were recognized; the Socratic dialogues are full of exactly the type of moral questions which have been raised here.

What, then, is different about our times? Why should we feel the need to come together here and now to talk about our mutual concern? First, a number of changes have taken place in our culture during the past fifty years or so which increase our awareness of these problems and give an urgency to the need for solutions to them. The frontier is gone and the consequences of economic activity (for example, depletion of natural resources) can no longer be alleviated by a deeper penetration into the hinterlands. Moreover, the system is vastly more complex and its subsystems more interdependent. As a consequence of these two factors, the impact of changes in the system, both beneficial and detrimental, is felt much more quickly and more severely than earlier in our history. Communication and transportation systems are far more sophisticated, allowing us to be aware of many parts of the system simultaneously and able to recognize their interconnections.

Another important change which is quite recent involves the perception of our position in the Industrial Revolution and our relative level of affluence. We can now afford to look around us and ponder what we have wrought, both in terms of time and money. We are no longer a young country in a hurry to make things and get places. We are older, more mature, and in a new way feeling responsibility for "ourselves and our posterity."

Let us then begin to look at the relation between technology and value or, more precisely, technology and ethics. We choose the term ethics because it refers to both aspects of moral consideration: value, good and bad; and obligation, right and wrong (i.e., roses which smell sweetly are to be valued, but we ought not to use them to make soup).

Notice that Adam Smith's formulation of the relation between individual self-interest and the collective good requires a distinction between two moral perspectives—two ways of looking at value and obligation. The first is individual—personal goals and motivations designed to maximize individual satisfaction. The second is collective—a perspective which considers benefits which accrue to the people in general, not to anyone in particular. Smith's theory proposed a correlation between these two calculations of good (value): the more individuals maximize their individual good, the more the public good is promoted. It is precisely this correlation which has now been called into question and which serves as the fundamental question for this conference: what is the relation between individual economic and technical action and the general welfare, and what can be done to adjust this relation to further the public good?

Delving further into this problem, utilizing this distinction between in-out (individual) and out-in (collective) ethical perspectives, let us distinguish between two types of reform proposals. The first accepts the Smithian (or, more accurately, Hobbesian) formulation of the self-seeking nature of man. The proposals according to this perspective are essentially manipulation of economic institutions in order to bring about the coordination for which the Hand is unseen (for example, Milton Friedman taxing pollution). The second type of proposal for reform is founded upon the hope that the nature of man can be changed by instituting new economic relationships, and by a system of propaganda which encourages business and technical people to consider their social responsibility. Note that the difference between these two approaches is not one of ultimate ends—that is, they often agree concerning the determination of the general welfare. Rather, they disagree as to the malleability of man's nature—the former asserting that it must be assumed to be constant over time and self-seeking in character, and the latter asserting that it can be changed for the better.

It follows from this distinction between two types of reform that there are, correspondingly, two formulations of the moral responsibility of the consequences of the economic and technical system. The first (fixed nature of man) argues that since man is by nature self-seeking, it cannot be his responsibility to change his calculations of cost and benefit to include public considerations. It is thus the responsibility of the government to compel or arrange such considerations of the public welfare. Rousseau articulated this position with his classic formulation of the stag hunt. In this formulation he supposes that ten men want to organize themselves for the purposes of hunting a stag. They agree that if one of them finds a stag, he will call to the others, and together they will have a greater chance of killing him. However, during the hunt, one man spots a hare. According to his calculation of individual gain, this

man would follow the hare and thereby gain more than what his share of the stag might be. Thus, some system of authority is necessary to ensure collective gain in the face of individual calculations of personal benefits. It is the responsibility of the men who compose this government to "provide for the common defense, promote the general welfare." The other type of reform position ascribes moral responsibility to the individual actors in the system, asserting that, in addition to individual calculators of personal gain, they are citizens of a collectivity. As such, they have a responsibility to consider the public welfare in their individual decisions. Con Edison, according to this view, should (i.e., has the moral responsibility to) consider the cost to the locale of their pollution of the Hudson River when they propose to build their new hydroelectric generator.

Just as there is divergence of opinion as to the malleability of the nature of man and the proper ascription of moral responsibility, there is also divergence as to the relationship between individual motivation and institutional imperatives. One point of view claims that the motivations of economic actors are determined by institutional incentives (he who is self-aggrandizing gets ahead). Marxists, for example, argue that the acquisitive, manipulative, materialistic nature of modern economic man is due to the nature of labor relations and, more broadly, the capitalist system. According to this view it is pointless to try to change the nature of man (e.g., encourage him to consider his broader social responsibilities) because it is the economic system per se which determines the motivations of his actions. Rather, the economic institutions and relations themselves must be changed. Another view asserts that it is man's "real" nature which is drawn upon by the system. In this case, it is pointless to attempt to change economic motivations and incentives by manipulating the institutional relationships or by using some form of propaganda, since those motivations are innate in man's character and will be operative in any system. Ralph Nader, for example, does not argue for a propaganda campaign to encourage corporation policy-makers to consider their social responsibility for the broader consequences of their individual actions. Rather, he acts as a watchdog for the general welfare, barking loudly when the corporation thief comes trespassing on the posted ground of consumer welfare.

Thus we can make two formulations of the problem of moral responsibility in our post-Smithian world, and two corresponding proposals for reform. The first asserts that it is man's fundamental nature to be self-seeking, that his decisions will always be made on the grounds of individual utility maximization. Accordingly, the only hope for alleviating the current problems which arise from the nonexistent Hand (i.e., the divergence between individual and system rationality) is to manipulate institutional relationships and incentives to ensure the protection of the general welfare. The second position asserts that man's nature is more malleable, and economic actors can be convinced of the wisdom of acting in accordance with the public interest rather than constantly seeking individual gain.

Consequently, these two views can be distinguished along three dimensions: 1) the malleability of man's nature (changeable or not, determined by economic institutions or not); 2) the corresponding view of moral responsibility (government or citizen); 3) the method of reform (institutional manipulation or moralistic propaganda).

Now that these two ideal-typical views have been conceptually distinguished from one another, we should like to proceed to consider some of the territory between these two polar extremes. We are sceptical of monocausal anthropological explanations of social phenomena. For example, both those who assert that certain innate characteristics of man's nature "determine" economic institutions, and those who assert that those institutions "determine" man's nature and motivations oversimplify the symbiotic correlative nature of the relationship between personality and cultural institutions. An ecological perspective of this interrelationship might perhaps be more elucidating. In the case of man, the organism responds to changes in its environment by adaptation but at the same time can manipulate certain changes in its environment. For example, when man first developed agricultural tools, they allowed him to manipulate his environment. However, the new environment created new pressures for adaptation in terms of social organization, which in turn created new possibilities for manipulation of the environment. Each element in the ecological system affects each other element symbiotically. Thus one cannot determine causal primacy since the changes are mutually causative.

Another view of the relationship between institutional structures and economic incentive is seen in what we might call the "after you, Alfonse" problem. In this view the incentive for change is seen as already existing within the personalities of the members of industry, but the economic structure and the legal framework within which they operate prevents them from changing their behavior accordingly. For example, the automobile manufacturers claimed that they were quite willing to design and build safer cars, but two factors prevented them: the public was not interested in safer cars, and antitrust laws prevented their combining their research development resources. According to this view there existed a situation in which each firm was willing to change its pattern of behavior if the other firms did so at the same time. Yet each firm was unwilling to go first, since by doing so it would be committing economic suicide, or so they felt. Hence—after you, Alfonse.

The response of government to this situation was to mandate safety standards which allowed the automobile manufacturers to offer safety features simultaneously. This is an intriguing view of the problem of values in the context of the economic structure since it asserts that the motivations for change are present, but the institutions thwart their realization as changed action. This is in juxtaposition to the views articulated earlier which asserted that it is the institutions which mold the motivations of the actors in the economic system, and that one must change their basic self-aggrandizing motivations either by propaganda or structural reform.

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More Basic Considerations

The unprecedented power given mankind by a science-based technology places him in a race between Utopia and oblivion.

Carl Madden, Chief Economist
U.S. Chamber of Commerce

[Systems simulations] give indications that suggest corrective action will often be ineffective or even adverse in its results . . . choosing an ineffective or detrimental policy for coping with a complex system is not a mere matter of random choice. The intuitive process will select the wrong solution more often than not.

Jay Forrester
Massachusetts Institute of Technology, Cambridge, Mass.

What is needed, but lacking, is a set of procedures to enable consideration of social utility and of scientific merit to be fused in both the design of institutions and the process of public policy.

Carl Madden

Underlying the concern with pollution, ghetto slums, unsafe automobiles, and robot assembly-line workmen is a much more general loss of faith. Somehow what was good and holy—the work ethic, the efficacy of technology to solve social problems—is no longer to be unquestionably revered. It is a rude awakening to many that the totem of technology has not worked its magic. This is in its deepest sense not a crisis of economic values at all—it is a religious crisis. Beliefs which have been deeply held and cherished are being smashed by our nation's iconoclastic youth. Our condition is not only one of confusion and malaise, it is one of anguish.

What is the nature of this religious questioning? What are the old values? What are the new ones being recommended to take their place? What changes in belief are called for, and why? Are there conditions which mandate change at this deeply personal level? We should perhaps approach this confusing and emotionally charged area of concern 1) with a language with which we can name intellectual concepts and communicate with one another with less chance of misinterpretation; and 2) from an historical perspective in order to view the present situation in its appropriate chronological context.

We think the current scepticism of our industrial system felt by much of the youth of the country and by many of the more thoughtful members of the "establishment" finds its focus in two basic tenets of the industrial-technological spirit. The first is scientism—the religious belief in the efficacy of science and technology to solve problems, advance mankind, and bring "progress." There is of course much evidence to support this view, but for most of us it has a very large affective or emotional component as well. Scientism is the belief that technological development is efficacious and beneficial.

The second fundamental tenet of the spirit of Western industrialism is individualism, the belief that cultural and technological advancement takes place most rapidly and beneficially when members of the culture work individually and independently. This type of activity maximizes the chances of innovation, clear thinking, and human creativity. As Max Weber argues with such insight, the rise of the spirit of capitalism came about in Calvinist Germany following the Protestant Reformation, which restored the direct link between individual men and their God. Through faith and work, individuals could obtain salvation through God's efficacious grace. This ethic was in opposition to the previous ethic of traditionalism—the acceptance of the institutionalized church as the link between man and God. Protestantism was ascetic (self-denying), nonvirtuosic (individuals could through their own efforts obtain salvation), and rationalistic (the meaning of the universe was understandable; purposive action could be taken, as opposed to the previous belief in the magical, the mysterious, and the traditional institution of the collectivity).

Weber asserts that it was precisely this Protestant ethic which served as the underlying spirit of capitalism and industrial development. In more simple language, it meant that individuals did the work that was before them; they did their job. Such was the highest form of human endeavor. If men worked at the tasks before them and lived a self-denying, conscientious life, they maximized their chances of going to heaven at the same time as they worked for the good of their culture. Thus the ethic was essentially this-worldly—involving a correlation between the religious and the secular—as opposed to almost every other major religion which involves a separation between this world and the next—between actions taken for personal material benefit and actions taken for spiritual benefit.

Combine this new Protestant ethic with the Smithian view of the ultimate collective benefits of individual economic action and one can begin to see both the power and the comfort of the new view of economic–technological behavior. Life was so simple. All we had to do was look out for our own interests and everything which we wanted in both this world and the next would result. All we had to do everyday was our jobs, and plod ahead doing our duties to God, self, and country, and we would advance science, culture, and ourself simultaneously. Such was the definition of progress—individualistic and self-aggrandizing, based on the efficacy of technological advances.

Now

Of course conditions have changed radically since the beginnings of the industrial revolution. But what changes affect this underlying faith in individualism and scientism, the Protestant-capitalist ethic? Why is it being questioned now? Essentially what has happened, and only within the last twenty years, is that the collective consequences of individual action are more easily perceived. The frontier is gone; land and other natural resources can no longer be conceived as inexhaustible, and the economic system of manufacturers, buyers, and sellers is now closed. Therefore, the feedback processes are apparent to all participants.

This new situation is much more significant than one might first think by merely listening to jeers of disgruntled students and the complaints of Ralph Nader. Individual action must be seen in an entirely different light. It is not