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SCIENCE, TECHNOLOGY AND VALUES

Science may be designated as the search for the understanding of phenomena apprehended by one or more of the senses in terms of theoretically postulated entities and the interrelationships between them in such a manner that the apprehended phenomena may be deducible from them along with others for which it was not postulated and with respect to which its truth and falsity, or rather fecundity or sterility, could be judged. This continuous interplay between the theoretically postulated and the sensuously apprehended, initially in terms of that which is first sought to be understood but more essentially in terms of that which has not yet been apprehended but which can be apprehended if the theoretical postulation is true, is the heart of the scientific enterprise as we have come to practice it today. The theoretical postulation thus links the past with the future, and thus makes the seeking for knowledge connected in an essential manner with what can only be called its relation to the future.

The future may, of course, not occur as entailed by the theoretic postulation. But that would only necessitate a change in the theoretic postulation, not an abandonment of its linkage with the future. Yet the future with which it is linked is a sort

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of pre-given future, something that is bound to be of a certain sort if our understanding of the phenomenon we sought to understand is correct.

The future to which we seek to relate ourselves through technology is, on the other hand, not a pre-given future. It is a future which we desire to bring about, or which we desire to avoid, abort, nullify. We are not, nor can we be, neutral about it. It is, so to say, a value laden future—a future about which we have hopes and fears, and which we see in terms of a possible action which makes a difference to it. The future, thus, to which the scientific enterprise of man is related is different in a fundamental sense from that to which technology is related. In a sense, the future to which the scientific enterprise is integrally related is retroactive in character in that it relates primarily to the theory propounded in the past and affects it in a substantial manner. The relation to future thus is in the context of an interest in the past or rather in a theory about the past which itself is seen only in the context of understanding.

All understanding, of course, is not necessarily in terms of the postulation of theoretic entities and the interrelationships between them, and if the "science" be confined to such an understanding, then obviously there will have to be such a thing as non-scientific understanding of phenomena. The overwhelming prestige of the scientific way of understanding things has made the philosophers give little attention to any other mode and has, in fact, resulted in the denigration of those who have cared to pay any such attention. Philosophers seem to be limited by the cultural horizons of their age as much as any other intellectuals. In any case, the understanding of symbolic creations of man would as much be a part of the cognitive enterprise as the understanding of that which he has not created, whether it be called "science" or not. The only relevant question, in the present context, would then relate to the relation of such an understanding to technology and values, and whether it shows some substantial differences from the ones we discuss in relation to what has come to be specially called "science" these days.

Leaving aside for the moment the deep difference between understanding in terms of theoretically postulated entities and the interrelationships between them, on the one hand, and the un-

derstanding of an object in terms of itself, on the other, it may be said that the type of understanding displayed in or through technology is of still another kind. It is the knowledge of a way of doing things, a skill in action, an understanding of the means through which some end or ends may be achieved. Knowledge is concerned with the way things are. Technology, on the other hand, is concerned with what might be and, in fact, tries to bring what might be into the realm of the empirically existent. Technology is thus related to action which tries to achieve a preimagined end which is deemed desirable and also thought capable of being achieved. It, thus, presupposes not only notions of the "desirable" as well as a knowledge of the causal linkages without which no action perhaps could be initiated at the human level, but also the notion of the "feasible" in that the believed causal levers must be of such a nature as to be capable of being pressed into action by human effort. The triad of causality, feasibility and value is thus intrinsic to the understanding of human action which contains technology as a necessary component of itself.

The changes, developments and innovations in technology thus come to depend, on the one hand, on changes in our notions of the desirable and, on the other, on changes in knowledge that affect our apprehension of causal linkages and their amenability to human manipulation and control. The three are analytically and factually distinct, even though there are intimate interrelationships between them. Many have tried to contend that the former are a function of the latter; or, in other words, that what we consider "desirable" depends on the knowledge that we have of man and the universe. On the other hand, it has equally been contended that the values that a society holds as preeminent determine the directions that the seeking for knowledge may take in that society. Both the contrary contentions can produce well known cases to substantiate their claim, but this only proves that the seeming contrariety is only apparent, and not real. There are many realms where such instances of mutual determination are found, even though they may not be palatable to those who like neat, one-sided determination only.

There, however, may be discerned phases when the notions of the "desirable" as embodied in a society's culture determine

the direction that technological innovations may take, as well as others when the causal knowledge that a society possesses tends to determine the notions of the "desirable" which it may come to entertain. The notions of the "desirable" themselves may function at many levels, ranging from those that are specific and concrete to those that happen to be general and abstract in character. The former, being specific and concrete, are realizable with a finality which the latter essentially lack. They may be realized, if at all, only approximately and asymptotically. The causal knowledge itself, on the other hand, ranges from the ordinary observed uniformities of experiential sequence to those that derive from the theoretically postulated interrelationship between entities posited to account for the observed phenomena. It may thus be hazarded that in the early stages of civilization it is the cultural consciousness of values that restricts the directions of the development of technology, while in the later stages when knowledge of causal interrelationships has itself become more complete, elaborate and sophisticated, the technology based on it begins to exert an increasing influence on what men begin to deem as "desirable."

Yet, however much we may talk of the three-way influence between science, technology and values, their relative autonomy has continuously to be kept in mind. The seeking for knowledge has an autonomous dimension of its own, both where the understanding is sought in terms of the theoretically postulated entities and their interrelationships and where it happens to be in terms of an existential, experiential encounter with the phenomenon or the object itself. Further, all such knowledge happens to be cumulative in character not only in the sense that present knowledge builds on the past, but that even when the paradigms of understanding and explanation change, the ones that are discarded, given up or just kept behind continue to be available for use the moment the human mind feels interest in them once more and reanimates them with its interest. Also, the paradigms themselves are not so discontinuous and unrelated to each other as has been sought to be made by some recent thinkers on the history of Science.

The same, in a sense, is true about technology and values also. Values, once apprehended and embodied in a decipherable

symbolic system, always serve as focal points beckoning man to their deeper exploration, understanding and realization in the lives of men as they are concretely lived in and through existential, experienced time on the one hand and human interactive interrelationships, on the other. However, new value apprehensions are not so easy to come by as new information or knowledge, and though it is not quite true to say that no new values have appeared on the horizon of human consciousness since the time of the Upanishads and the Buddha or of Christ and Confucius, yet the very fact that such is felt to be true by many people testifies to the radical difference between our apprehension of values on the one hand, and our knowledge of facts or reality, on the other. Further, even when a new apprehension of values dawns on the human consciousness, it does not exactly supersede the former. This fact is well known in the case of great works of art and philosophy, but that the same is true of the value apprehensions of man is perhaps not so well realized because of the messianic fervor of each new prophet who apprehends a new value.

As for technology, it is dependent both on the causal knowledge that man commands and the values that he apprehends, thus ensuring that it has unique features of its own. Changes in knowledge result in the obsolescence of technology as much as any new apprehension in the realm of values. However, the obsolescence caused by the former is primarily due to the replacement of a less efficient technology by a more efficient one, while that in the case of the latter is due to a shift of interest in what is sought to be realized or achieved. But as the change in the causal knowledge is relatively faster than the change in the apprehension of values, the obsolescence due to the former is bound to be far, far greater than that due to the latter. Further, as knowledge tends to be cumulative in the sense that the earlier knowledge is superseded by the latter, the technological obsolescence induced by this factor tends to be far more definitive in character than the one induced by a change in the value-apprehension of a people. The latter never tends to be of such a total nature as to obliterate completely the earlier or absorb it into itself and hence the technologies determined primarily by the pole of value-apprehension tend to persist even

after new value-apprehension may emerge into the field. Also, as the rate of change in the accumulation of knowledge tends to increase with time, the rate of technological change induced by this factor tends to increase also.

It may be objected that as the technological object is a function of both the relatively unchanging value pole and the fast changing pole of knowledge which can be translated into causal terms, it should remain in a state of relative *status quo* unless it is pushed on simultaneously by both the factors. To a certain extent, this happens to be true. Most changes in technology are merely different ways of doing the same thing and thus happen to be more apparent than substantive in character. However, as many of the technological objects happen to be of such a generalized instrumental nature as to be able to subserve the realization of diverse types of values, it may well happen that the realization of a value newly apprehended may utilize the old instrumentalities for its own sake. Thus even when the technology remains the same, it is no sure sign that the valuational pole has remained unchanged. On the other hand, a change in technology may not exactly mean that new values are being pursued by the people concerned, for it may well be that the old values are just being pursued more efficiently by the new technology that has come into being because of the changes in causal knowledge.

The introduction of the notion of "efficiency" with respect to changes in the field of technology brings the notion of "means-end" rationality on the one hand and that of "comparative costs" on the other into the picture. However, the widening of the notion of costs to include cultural and ecological costs makes the distinction between "means-end" rationality and what has been called "the rationality of ends" less crucial or important than it would have otherwise been. Considerations of "efficiency", then, are inevitably linked with what may be called the pattern or style of living especially when they cover a consideration of the extended costs which we mentioned just now. Technology thus is inextricably involved with life as it is lived and as in the process of living is sought to be made "meaningful" by man to themselves and to others. The choice of a particular technology, then, in a deep sense, is a choice of a way of life,

or rather of a setting and a structure in which life would have to be lived and made significant and meaningful.

But, is the question of a choice between technologies in the sense that the alternatives would make a substantially significant difference to the types of "meaningful livings" made possible by the alternative chosen, really feasible in practical terms? Is the choice not already foreclosed by the fact that certain types of choices had already been made in the past, and that these choices have been of such a nature as to make the societies, groups or countries which have made the choices stronger in military and economic terms than those who were not in a position to make the choice or who had not made them for some reason or other.

The type of industrial technology as developed in the West within the last two hundred years has not only made it difficult for any alternatives to be thought of because of the immense military and economic power that it gave to these nations, but also because of the prestige that came to be associated with it for these reasons. It may be noted in this connection that the so-called socialist countries did not reject or modify the type of industrial technology developed in the West, but rather went on an imitating spree without thinking of alternatives which would be relatively more humane and humanizing in terms of human living. The only difference they sought for and emphasized was in the field of socio-political organization which alone, in their view, could fulfil the potentialities opened up by the industrial revolution. The relations between the technologies of production and the technologies of socio-political organization on the one hand, and the relations of both to meaningful patterns of living, in the other, have hardly been the subject of sustained attention in the East or the West. The situation is further complicated by the fact that both the socialist and the non-socialist countries have a vested interest in exporting the type of industrial technology they have developed to the third world countries instead of helping them to evolve alternatives more suited to their condition.

The philosophical relevance of all this lies in the fact that though theoretically science is neutral to all values except those which belong intrinsically to its own field and thus should be

able to be used for the development of diverse types of technology suited to diverse ends within the large constraints imposed by the structure of knowledge, in actual fact it does not happen to be so. It tends to be determined too much not only by the exigencies of the circumstances in which it originally developed, but also by the fact that those forms of it which help to build structures of military and economic domination tend to drive out those that do not do so. There is, thus, a sort of Gresham's law in the field of technology where bad drives out the good, assuming of course that that which leads to the domination of one man or group or nation over another is something which is intrinsically undesirable in terms of the values we entertain. The search for genuine alternatives in the field of both industrial technology and forms of economic, social and political organizations on a global scale as embodied in the World Order Models Project and the journal *Alternatives* published under the editorship of Rajni Kothari, the well known Indian political scientist, is a welcome step in this direction. But unless the feeling of freedom with respect to the devising and elaboration of alternative technologies and forms of organization becomes as widely prevalent amongst the intelligentsia as the feeling of freedom with respect to the building of alternative models in the pursuit of knowledge, there is little likelihood of thinking in terms of alternatives becoming a part of the intellectual climate of our times. Even more than this, what is needed is a detailed analysis of the consequences for life of the various technologies and forms of organisation and a critical reflection on them in terms of a diversified and extended cost-benefit perspective.

The situation, however, would have been simpler if the role of technology had been confined only to the sphere of production or, even in an extended sense, to forms of social, political and economic organisation. Such, however, does not happen to be the case. Sophisticated and advanced technology is as much a requirement for the pursuit of knowledge these days as for purposes of production, defense or administrative organization. Cognitive interests themselves, thus, come to dictate the development of vested interest in the production of a type of sophisticated technology which can be delivered only by an advanced

industrial apparatus of a particular kind. Space technology is a dramatic instance of the fact that even many of the advanced industrial countries had to opt out of the race for lack of resources required to develop the type of technology in question. The deeper issue however relates to the question whether values involved in the pursuit of scientific knowledge should take precedence over all other values that a society has to seek, or that they should be in some sort of balance or even of subordination to one another. Further, as knowledge, or at least a large part of it, gets transformed into technology with which men and societies try to achieve their diverse ends, it becomes imperative to determine the directions which research may undertake, specially when most of it happens to be costly and requires large funding from public resources which could be put to alternative uses. There can be little doubt that the seeking for knowledge is a value in itself, but when it begins to require large resources for its pursuit and when it can take many directions, then the problem of choice becomes both imperative and difficult.

The means-end framework in which we have been thinking about the problems relating to science, technology and values, though adequate to large parts and most types of technology, can hardly be expected to do justice to all of them. In fact, means-end schema does not suffer merely from the well-known limitation that means may come in time to be desired and valued as ends, but also that in many domains the distinction may not be relevantly applicable at all. As all understanding may not be of the scientific variety, so all technique may not be technological, if the term is to be confined to that which may be understood essentially in terms of the means-end schema only. In the field of the arts, for example, it is well known that though there is always such a thing as technique, it does not function primarily in "means-end" terms and where it does, it is supposed to be a failure of the artist and even a desecration of the artist's function. However, the term "technology" may be widened to include technique and its relation to the means-end schema of thought may be loosened. If this is done, then the term would be taken out of the primary context in which it has usually been applied, and extended not only to cover the techniques

associated with the various arts and developed in their context, but also to those associated with religion such as Yoga or Zen or Transcendental Meditation.

The distinction between the techniques of art and those related to diverse kinds of religion and meditative practices lies not merely in the fact that the one is concerned with the creation of something that is externally apprehensible, while the other is concerned with the creation or transformation of a state of consciousness or being which is perhaps intrinsically inapprehensible by another, or at least not in the same public way as the former. The deeper difference rather lies in the fact that while in the case of the arts, technique remains integral to the final work of creation even though it may be completely invisible as it has been absorbed and integrated thoroughly into the work itself, in the case of religion it remains always and essentially unrelated to the state that is sought to be achieved. Art without technique is unthinkable; religion without ritual, on the other hand, is not only thinkable but rather it is essentially a denial of it. Religion negates ultimately not merely all technique, but also all objectivity whatsoever. The *advaitic* position in a sense is the heart of all religion; it does not merely negate the very possibility of any other, but also negates the reality of even this act of negation so that it may not lend even the faintest ghostly reality to this other through the act of being denied or negated.

The different relations to time in the form of future of both science and technology were pointed out in the very beginning of this paper. But the relation of techniques to time happens to be of a very different order in art and religion. In the arts, the created object is of such a nature that, if successful, it cuts off all relations to the past and the future and confines one's attention to the present alone which is filled with that object and no other, lending supreme fulfilment to the consciousness that contemplates it. The movement of time is stilled or rather frozen into the present moment which consists of the art object, cut off from everything else whether in the present, past or future. Even when the work of art consists essentially of something in motion, as in music or drama or dance or some of the recent works which defy any such classification, the aim is

always to produce this closed stillness which renders the object autonomous and absolute in character. The same is true even when the work of art, consciously or unconsciously, recalls in its structures *le temps perdu* or other creations of times past. Also, even though the attention wanders and the trivialities intrude, the work of art stays in its self-enclosed time and demands, softly or insistently, that it be treated as such.

In religion, on the other hand, time is not stilled or frozen but sought to be abolished altogether. The work of art is still in the present, the present cut off from everything else—isolated, self-sufficient and self-significant. What religion seeks, however, is a total loss of the sense of time, a present that is not cut off from past and future and other things in the present, but that engulfs them all in its immediacy and thus in which the distinctions of present, past and future do not obtain and time does not exist. Such is the basic difference between art and religion, and to a great extent the different role that technique plays in the two can be accounted for in its terms.

The relation to time is the heart of man's relation to values. Also, the diverse types of knowledge have an intimate relation to what man wants to do with that knowledge, the values that he wants to actualize in its terms and through its help. The diverse types of techniques and technologies embody in themselves the results of a dialogue between knowledge and values in a concrete visible form. Much of technology, therefore, is like a work of art. Only, its meaning lies totally outside itself. Also, as man is both a body and a mind, and perhaps something more than mind, and lives both in time and outside time, all types of technology and knowledge will always be necessary and meaningful to him. Cultures and personalities may perhaps be distinguished by the dominance of one type over the others, but the rest are always there ready to come to the forefront and make their presence felt in relation to the others.

The situation however is never static for long. It changes continuously with each increase in causal knowledge, each discovery of new technique and, even more dramatically, with each apprehension of a new value. The present is an age dominated by advances in scientific knowledge, and consequent thereupon, changes in technologies of production and forms of social, po-

litical and economic organization. But a little change in value perspectives, already being forced by global and ecological considerations, might change the whole situation in a radically different way. Yet, however radical the differences, causal knowledge with its attendant technology would always be as relevant to man as non-causal knowledge with attendant techniques for getting rid of the past and the future and living in the significant present cut off from both sides or for overcoming and abolishing time altogether.