ASPECTS OF INDIAN CULTURE IN RELATION TO SCIENCE

E. C. G. Sudarshan

Several centuries ago, using astronomical observations, Johannes Kepler formulated three laws of planetary motion: one, that planets move in elliptical orbits with the sun at a focus; two, the aerial velocity is a constant; and three, the square of the period of revolution is proportional to the cube of the major axis of the elliptical path of the planet.

From Kepler's laws, Isaac Newton was able to deduce the laws of universal gravitation. But Kepler's three laws are all quite different in character. We see the contrast between the "global" and the "local" laws. The first law is about the orbit, the orbit seen as a whole: but in the second law about the aerial velocity, one sees the motion in bits. And in the third one, about the square of the periodic time being proportional to the cube of the major axis, we see the cyclicity of time rather than the linear time in relation to which the aerial velocity is described.

Newton had formulated physics in the bit form in terms of differential equations: "this" being so according to law, "this" must develop. The pattern of developing physics in this particular fashion has been tremendously successful, and most of modern physics is in a certain sense the development and the completion of what Newton attempted.

Let me give a slightly different introduction to the notion of global versus local; let us take the surface of a sphere and let us draw a closed curve on it; then we can continuously deform the closed loop into smaller and smaller circles, until at last it can be made to vanish. But if we took a doughnut and instead of eating it if we started drawing loops on it, there are certain kinds of loops which can be made into smaller and smaller circles and made to disappear, but if we encircle the doughnut in any particular fashion, we will not be able to contract it.

In this case we see a difference between two different families of orbits, a difference which cannot be related to any piece of the orbit but is related to the whole of the orbit. It is related to the whole of the structure, and ultimately it really depends upon the total surface.

It is an analogy to this kind of phenomenon that I view this kind of question that I call the "global" aspects of culture, not in its geographical sense.

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In the development of modern science, the importance of experimentation is paramount. However, the final judgment is on the basis of a qualified

experiment as judged by a selected group of people who are called experts in their particular field. So is it with philosophy and spiritual life: that which fails to experience is developed. One may tentatively have faith that an experiment and/or experience will obtain, but if it does not obtain after a reasonable number of trials under reasonably controlled conditions, we ought to be like the sage-king Visvamitra: Visvamitra painfully came to the recognition that his temporal power was not a match to the spiritual power of an old man Vasista, who was sitting in a forest and meditating. Visvamitra told himself: "I was a king because I wanted to be the most powerful person, but now I found someone more powerful than me, and therefore I'm no longer the most powerful person. I'd abandon my kingship here and now, and instead pursue the other kind of power, the spiritual path to power". So he did.

Like Visvamitra, we too must recognize this: all theory building must obtain from experimentation: and if that experiment fails, all of the theoretical framework that we have should be abandoned.

This is said to be our guiding principle for modern science: but I'm a practising scientist, and I hope that at least some of you will take it from me on faith that in fact it is not so! To quote the latest situation, particle physicists were particularly excited about the possibility that all protons would decay. It will take a long time, and it will take up a lot of money to find out; and people did lots of experiments. You would think that at the end of it either they would say "Yes, the proton decays", or "No, the proton does not decay". But when people found that the proton does not seem to decay, they said, "We ought to do more experiments". If it did decay, one would not have said that we needed any more experiments.

Time, space and causality are themselves constructs and not primary entities.

Cause and effect appear in a broken-up system, a system which is seen as being made up of interacting subsystems. Experience when it is fragmented provides time, space and causality. A Malayalam poem states this very well: freely translated it says: "A single experience seen as many is the origin of time, and if many different times are identified as the same time, that is the origin of space; since these two processes seem to take place usually associated with each other, that is causality, and thus arises the universe". If this is the situation, then, of course, there exists a certain level of experience in which all data is registered, but in fact, there are no causes, and no effects, and no time and no space, because there is no breaking up of the experience. And it is within this particular context, according to the Indian tradition, *sri*, or grace, is allowed to operate. This is the case of causeless functioning of a system, not against cause, not violating causality but causality being irrelevant because in fact it is a complete system.

But even logically antecedent to metric time, (that is, how long an interval of time is there,) and even before ordering, (either early or later,) there is a topology of time. For example, there are such questions: is time linear or cyclic? Are there different times or only one time? Does the same time appear again, the same moment? Does it appear in sequence again afterwards? Can time come to an end, and can time arise?

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There are a couple of stories that I do remember in this connection. In the interest of brevity I would simply allude to these stories. One is the story of King Lavana. Lavana was a natural philosopher, even though he was a king, and he was very intrigued with the idea of time, and he wanted to know how was it we experienced the multiplicity of time and the fact that the time depends upon the state of the observation.

One day in his court appeared a magician who told the king that he would like to show some magic acts; the king was very pleased. The magician had a feather duster in his hand which he waved in front of the king, and the king suddenly saw a big white horse before him. And he asked, "For whom is this horse?" and the magician said, "For Your Majesty, of course". The king mounted the horse and urged his friends to join him and go hunting. But this horse was so fast and so fearless that it went further and further away from the other people, and eventually the king got isolated. It became late, and he did not know where he was, and he got himself lost. And at a certain point he lost the horse: and in those days the kings used to have very long hair, and so he found, like Absalom in the Old Testament, that he was caught by his hair on a tree and he had a difficult time. He managed to get down and sleep; in the morning he met a young girl who had with her food and drink; the king insisted that he should have some food otherwise he would die. She told him, "The only condition under which I will feed you is if you promise to marry me. I should tell you that I am not a princess. But if you want to marry me, you must come and talk to my father who is working in the field". And so he went, he partook of the brunch and then got married to the girl. In course of time they had children, and he lived with them for a long time. And then, there came about in the land a tremendous famine, and the king, now turned farmer, was unable to subsist on his minimal farm. So, he migrated. Along the way the children kept crying out for meat. The king decided that the only way to provide meat for them was to provide his own protein! So he gathered kindling, started a blazing fire and jumped into it. At this particular moment he woke up on his throne and concluded that the whole thing was only a nightmare.

But he was not really satisfied. The next day, in inspecting a part of his kingdom, he went off galloping around the place and eventually recognized the place which he saw in his nightmare and found an old woman sitting there. She was crying; when he asked her why she was crying, she said, "I had a daughter and she died, and I had two grandsons, and they are sitting here crying. They had a very nice father, my son-in-law. He was really a prince amongst men, and he committed suicide, unable to stand the agony of the starvation of his children, by jumping into the fire."

The king recognized the woman, the children and the place. He left with the same question at the end of the whole experience as to how is it that time could be multiple and at the same time be single.

Another story is that of Lord Buddha. The Buddha as young prince Gotama was overcome with compassion and decided to search for the root of all suffering. One day he sat under a tree, and then said to himself, "I shall not get up from here until I find the ultimate answer to the problem of suffering. Until

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I find enlightenment I shall not get up, even if the sun bleaches my bones". Time passes and he does have the enlightenment. As a by-product of enlightenment he gets knowledge of his past, and he recalls an event from his past: during the previous eon he was blessed by the then Buddha saying, "In the next eon you will be the Buddha. You will have enlightenment."

The question is, therefore, "Was it really true that prince Gotama took the oath? Was it true that he knew that he was to be the Buddha?"

These questions about time are of particular importance. As long as time is not to be thought of as linear, the question of progress, the question of advance, the question of differential equations which govern the advancement of the system could not be taken entirely as the only alternative but only as one of many possibilities.

Happiness is not to be pursued but to be recognized, and the recognition of happiness-here-and-now requires practice. To be oneself is to be a maker of the crossing from the state of ordinary awareness into the state of awareness in which happiness is recognized. Enlightenment and bliss are not things which are recognized in time, but in fact are beyond time. There is no time and there is no process which takes you step by step from one situation to the other one.

In the language of physics one would say enlightenment is a phase transition. It is not a change in the substance, but it is a change in the organization and function.

I already alluded to the story about the tradition of the "knowledge of the three times". As was mentioned, tradition is in the present and so is the future. In fact, that which is true is forever new, whether it has been old or whether it has yet to be discovered. As a teacher I have come to see very many times that the facts are old, and you are very familiar with them; but every time you have to teach it to a deserving audience, you have new insights into it, and the insights are as fresh as if they are new discoveries.

It is a traditional Indian notion to say Brahma, the creator, is an old man. He has a long white beard and grey hair. But his mother, Lakshmi, is forever young. She is always pictured as a youthful person. The precondition of creation is forever fresh, even though the artifacts of creation may have dates on them, and therefore, the moment of creation perhaps is in history.

And in the notion of *sankalpa*, the cognition of the goal, the future comes before the present. When perception is in harmony with intention, transcendence is obtained without losing the vividness of the multiplicity.

In the *Bhagavadgita* there is a passage in which Arjuna, after a long discussion with Krishna allows him to have a moment of transcendence: in this transcendent moment he sees the whole world as one entity, the *vishvarupa*. And in this phase transition what is deified is not an external god, a god which is different from nature, but in fact all of nature is deified.

Consider the morning ritual that we perform at the beginning of the day. The idea is that a little chosen place does provide a setting for something sacred. Sacredness is, therefore, not something that is from outside: that which is can be recognized as being sacred.

This experience of transcendence, of deification, is described in many songs.

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There is a Tamil poem in adoration for Sarasvati, the goddess of learning. It says: "She who sits on the white lotus, the One who is in the voice of the people when they sing; the inspiration of the poet, the artist and the artisan..." Sacredness is not to be associated with something set apart, something that is different from you, but in fact, that which is around you: that it is an altered perception of the same data!

Insight can be induced by events, but often by means of an inducing agent. If the inducing agent is identified, that particular identity is deified as the guru, the holder of oneness, and therefore, it is said: "The guru is one who collects all of your knowledge and makes it an undivided whole, a mandala. And this undivided mandala must contain all things static and dynamic, all entities and processes. Thus you recognize the true nature of existence."

And it also goes on to say that process is primary, and substance is an artefact. And in this sense one may say that the moment from Aristotle to Newton, so celebrated by historians of science and modern practitioners of science, was in fact a reverse transition from process to substance. And Newton's great discoveries and the triggering of modern science was possible because in some sense he said that unaccelerated uniform notion was simply not "news". There is nothing to talk about. It simply is in the nature of things, and it is inertia. Therefore, a process is as constant as the substance, the object itself is preserved, and the uniform state of motion also is preserved. Science in the traditional Indian setting must, therefore, talk about process as both primary and secondary, and substance as a derivation from it.

The space-time fabric with all possible topologies—closed, open, cyclic, connected, disconnected—and causality as a derivation, and with scope for causelessness as a component of the universe as potential—these are logically prior to both form and substance.

Some of these topics should sound very modern. In fact, they are at the research forefront of modern physics at the present time. The notion of quantum gravity in which all possible structures come together—we call it, superspace. The idea that in fact substance is a crystallization; that initially there was in fact not even form; there was only the potentiality of form. But physics is still very uneasy with causelessness; we physicists can deal with chance, we can deal with partial order, we can deal with complete order, but we cannot yet in modern contemporary physics deal with causelessness as distinct from chance!

The realized model is full of substance in contemporary physics, but then substance has laws of its own. But behind these laws are more basic laws, and those laws themselves are derived from principles.

The best example is the history of modern physics in this century. To start with, the atoms were very substantial objects, and one simply wanted to explain the laws of chemistry and certain of the laws of spectroscopy. But it brought about the invention of modern field theory in which objects are in fact complexions of an underlying entity which itself is never directly perceived. Even where substance predominates, as in the Vaisesika system, tradition has it that they have to be given potentials and potentialities. Therefore, these

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atoms that the Vaisesika theorists expounded are more akin to chemical atoms than the sterile Greek atoms.

The methodology of the system, therefore, involves laws which are startling: That knowledge is not the same in all states of awareness: that as the state of awareness changes, the laws change, not because different, better, more improved laws come in, but because the perception of what is being explained, what is being dealt with, itself changes. Therefore, one is warned against measuring entities at one level by the norms and categories of another level. The breaking up of the world is fragmentation, and this fragmentation leads to alienation from direct, immediate experience.

Let us also remark that there is another obstacle to creative minds, leading to fragmentation. It comes from accepting other people's knowledge: in this context the creative person is gone: he becomes a sharecropper rather than a farmer. One is not dealing with one's own impressions, but one is dealing with somebody else's. If one does it for a living, well then, probably that may be justifiable but it is certainly not very pleasant. And one may refer to this as involuntary bondage. The intuitive edge is lost. Substance crowds out processes. Artefacts are confused for art.

But there is another big problem that has come up in more recent times, and by pointing this out probably I will lose the few friends that I still have: The confusion of technology, which is the vehicle and the artifact, for science is more inimical to science than the outright hostility of the superstitious; bureaucrats are at their worst when they confuse technology with science.

Technology makes marvellous systems while science is magic in operation. Science conquers forever new territory. Technology, on the other hand, excels in faithful and reliable repetition.

The truly scientific endeavour is to invoke insight with disciplined search, but no immutable constraints. The purpose of science is not to generate technology but it is an art form. Technology is a by-product of science pursued well. The wonder is not in the extraordinary but in the ordinary, and to see that in fact it being ordinary is the most extraordinary thing.

For technology, on the other hand, by all means let us imitate, import, implement, inculcate, innovate and indigenize. But science is not to be imported but generated. Excellence, rather than the average, becomes the norm. It is not acceptability but pristine intellectual satisfaction which is the norm of science.

We have had many people talk passionately, scientifically, clinically about the destruction of the environment: but the greater tragedy is the destruction of the environment for total experience, the isolation of science from tradition by limiting the purview of science. Going about it this way, only competent but not excellent science emerges, too selfish and sterile to generate its own technology, too limited in scope to produce joy in the heart and a song on the lips. The scientist gets isolated from his culture and his people and becomes less of a person for being a scientist. It is the worst case of desecration and denuding of the environment that I know of, it is comparable to the predations of tract house builders in the 1940s in the United States whose idea of preparing

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For technology, on the other hand, by all means let us imitate, import, implement, inculcate, innovate and indigenize. But science is not to be imported but generated. Excellence, rather than the average, becomes the norm. It is not acceptability but pristine intellectual satisfaction which is the norm of science.

We have had many people talk passionately, scientifically, clinically about the destruction of the environment: but the greater tragedy is the destruction of the environment for total experience, the isolation of science from tradition by limiting the purview of science. Going about it this way, only competent but not excellent science emerges, too selfish and sterile to generate its own technology, too limited in scope to produce joy in the heart and a song on the lips. The scientist gets isolated from his culture and his people and becomes less of a person for being a scientist. It is the worst case of desecration and denuding of the environment that I know of, it is comparable to the predations of tract house builders in the 1940s in the United States whose idea of preparing

the ground was to bulldoze the entire territory and denude it of all trees and all natural formations. In the attempt to root out superstition, there are many who have advocated and who are working towards eradicating all traces of culture and make it clean and have the bulldozer come and level it; and then, of course, you know how to erect prefabricated structures. But true science seems compatible with many different cultural matrices which on their own level may be incompatible.

Finally, the search for a sense, the search for personal involvement in science without having to abandon one's cultural heritage is not always a happy story. Even though people have tried to assure us that in a society like Indian society tragedy is not possible, in fact, this could be a tragedy.

I am reminded of the story of Karna. Karna, as you know, was the first-born son of Queen Kunti, who was born of the Sun god as the father, but he was born at the time when Kunti was not yet married. And in those days social norms were such that Kunti abandoned the baby boy; he was picked up by a charioteer. So Karna grew up without quite knowing his parents. But eventually, because of his skill, because of his innate ability, because of his experience and his high qualities as a person, he became a general in the Kaurava army. His one ambition was to fight with the Pandavas and to teach those fellows a lesson because they had been insulting him and making his life miserable.

But at this point he has become a general, and the next morning the great war with the Pandavas was to commence. Karna has the entire night to himself. And he asks himself the question: "Who am I? I am a general. This is my function, my purpose at the present time. But who am I?"

And the question is particularly troublesome for him, because after all, one has to keep one's affairs in order before going into such a battle, because this is a battle to the finish. And when his agony mounts up to the point where he could no longer sustain it, Queen Kunti appears before him with a strange request, saying: "My dear, Karna, General Karna, you are really my first-born son. Your father is the great Sun god himself. I have one request to make of you. Why don't you switch sides, because after all, you should ally yourself with your brothers." And Karna says: "Where were you all these years when I had to grow up as a bastard? While what you say may be true I have my honour, by duty, my allegiance. I will not change sides."

And then Kunti says: "In the case, don't kill any of my five sons." And Karna says, "Look, you had five sons before, and I can promise you that at the end of this war you will have five sons. Either I will kill Arjuna or he will kill me." In the battle Karna gets killed by Arjuna. It is said that as Karna's head falls down on the ground, the glory that was his essence floated upwards to rejoin the Sun god.

There is a definite danger that one's head and one's heart may be separated in the process of trying to retain one's tradition and to be able to investigate things because if you do that, then you really must investigate everything.

Anytime you investigate anybody else's science, you stand the danger of being cut off from your own culture; your head may tell you one thing, and your heart may tell you something else. The head may tell you that while you

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may have all of these thoughts, don't say it out loud because you may be cut off from society. On the other hand, your heart will tell you that in fact you must go where your heart leads.

I do not think that in the long run there is any possibility except to return to the tradition. Tradition is not superstition. Tradition is not what somebody else wrote at some particular time. But tradition is the spirit that moved King Visvamitra to abandon his temporal power when he found there was a superior power: in his case the poor man had to make such decisions many, many times in his evolution towards becoming a sage. Each time he felt that things were not working out, he said "Look, I must abandon everything that I have attained up to this point but seek greater attainments." Tradition does not allow a possibility of simply negating all that one has grown up with, all that one is growing up with, without due examination, without "due process". One must put the same searchlight on tradition as well as contemporary science and technology, and one should also have the courage to say, "Science is what I seek: technology may follow": equally well, "Insight and happiness are what I want to recognize; let utility follow".

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Indian Realities

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