My dear Joshi,

Thanks for your
e-mail. I met
Prof. Gadgil at Delhi -
I'm sending you a copy
of my letter to him with
~~an~~ a reprint of my old
article. regards

Kaly

Gadgil
to
Dr. N. V. Joshi.

Centre for Indian Knowledge Systems
Real-world solutions from traditional science.
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16th June 2001

Prof. Madhav Gadgil,
Centre for Ecological Sciences,
Indian Institute of Sciences,
Malleshwaram, Bangalore 560 001

Dear Prof. Gadgil,

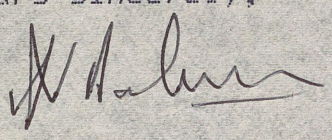
Greetings from Chennai. It was indeed a pleasure to meet you at Delhi and pick up the threads of our previous dialogue (now over two years old). I feel sorry that I had lost much time - when I had responded to you earlier and I did not hear anything from you I had concluded that you had lost interest in this topic or that you were so put off by my response (or may be combination of the two) that the matter was, so to speak "closed". Had I known that it was still alive and occupying your mind we could have moved it along a few steps. Personally, I feel quite dissatisfied with the brief snatches of conversation that we have been having on this subject (sometimes under the glare of Chairpersons who ~~be~~ rightly felt that we are prolonging the tea and delaying the next session) - it is totally insufficient to do any justice to this subject. I feel that we need a critical mass of people interested in the subject as well as some minimum time to see arguments through to some level of completion so that there can be some mutual understanding. Personally, I feel that it would be a good idea if a group of eight to ten of us can meet for something like two or three days to arrive as some kind of a mutual understanding about how we comprehend the nature of traditional Sciences and Technologies. I have made a similar suggestion to Joshi and I have promised that I will send him a note spelling out what I have in mind a little bit. I plan to do this sometime in July.

In the meanwhile, I am sending you a copy of an article I had written several years back (in PPST Bulletin, 1987) entitled - "Is indigenous Technology 'simple'?" I thought it may be of interest to you. I am also sharing with you ~~the~~ a brief story / anecdote which I found quite amusing. Any relation that it bears to the question you have continuously posed to the practitioners of Traditional Indian Sciences and Technologies (Where is your Science ....., where is your method .....) may of course be purely accidental.

Could you please also send me the address of Dr. Bhat (from Pune?) - you had mentioned at Delhi that he had carried out some studies / analysis that has bearing on the relationship between biodiversity and health. It would be helpful, if you can send a copy of his paper in case it is readily available with you.

With warm regards,

Yours sincerely,



A.V.Balasubramanian

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June 1987

IS INDIGENOUS TECHNOLOGY 'SIMPLE'?

I. INTRODUCTION:

If we are to scan the pages of our newspapers or even the more scholarly presentations in journals or policy documents, it seems that it is really quite a straight-forward task to see which way the arrow of `progress´ is pointing. This is particularly so in the case of Sciences and Technologies where the moment we see words like Modern, Latest, Sophisticated, Electronic or Computerised, we know that progress is around the corner. Conversely the adjectives which are used to describe indigenous technologies are often words like Simple, Crude, Primitive, Unrefined or Coarse. It seems quite obvious, that replacing simplicity with sophistication, or the primitive with the latest, is what the business of progress is all about. So much so that the words modernisation, computerisation etc., are often used and understood as being synonymous with progress. These words are considered to have some kind of an absolute meaning, which is above and beyond the specificities of the situation, or the cultural and civilizational context. It would seem that there is some absolute way to measure the simplicity or sophistication of some technology and to make a choice based on this criterion. It appears to us however, that much of this line of thought is confused and does not take into account what these terms have meant in various societies and in various points of time. Hence a lot of decisions that are made based on such criteria need to be critically re-examined. As an illustration we would like to take up the question of `simplicity´, for a closer look.

II. SIMPLICITY IN WESTERN TRADITION:

> "The purpose of all theory is to discover the viewpoint from which the subject matter appears to be in its greatest simplicity". - J.W.Gibbs.

In general it appears as if in the context of Science and Technology, simplicity is considered as a virtue in Western Tradition.* Of course, this in itself does not mean very much since simplicity, seems to depend on numerous factors such as the period of time, one's point of view and the level of approach. A few examples will make this point clear.

To begin with, it should be seen that simplicity is never an objective quality in the sense that one cannot just `examine' an object or a theory and pronounce on its simplicity. What we see really depends on our own state of knowledge and advancement. To take a common instance, bicycles are highly successful machines, and most people would consider that they are a simple mode of travel. But bicycle technology is mature. Bicycles evolved during the last half of the 19th century, to reach their present state of development by around the turn of the century. To be successful, they needed the invention, development and production of ball bearings, sprockets, roller chains, the freewheel and gear-changing mechanisms. The pneumatic tyre required advances in the processing of rubber. Lightweight frames needed thin walled drawn steel tubing. The most expensive bicycles today use tubing with carefully graded wall thickness to give extra strength near the ends. The fact is that bicycles were complicated solutions to the problems of providing cheap personal transport to people who would otherwise have walked or ridden horses. They would have appeared totally unbelievable and impossibly complicated to the leading engineers of the preceding age (1).

Similarly, simplicity also depends on the viewpoint. The `Simplicity' assigned to an instrument for example may look different from the two ends - user and designer. Take for example the case of photography. The first cameras were wooden boxes with elementary lenses. Exposures were made by removing the lens cap. Modern single-lens reflex cameras

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* It is interesting to note however, that the common meaning in the dictionary sense, appears to be quite mixed - largely negative but sometimes also carrying a positive connotation. If we consider the usage in an early English version of the Bible (the 17th century translation - the `King James' Bible) all references are derogatory. Here, generally simplicity seems to be considered as the antonym of subtlety and wisdom. In the Oxford Dictionary too, most of the meanings assigned are negative - wherein simplicity is equated with artlessness, foolishness, ignorance, low rank etc. Such a meaning is also reflected in popular use - as in the nursery rhyme about `Simple Simon'. But occassionally it is also equated with greatness and lofty ideals - as when Wordsworth laments that - "Plain living and high thinking are no more....."

have over one hundred accurate moving parts. They have multi-element lenses with low f-numbers that can approach the diffraction limit of resolution. Molecular layer coatings provide superb light transmission. Many lenses have zooming and close focussing. Shutter-speeds are controlled by measurements of light from the film during the actual exposure, and they can span as many as five orders of magnitude. All this complexity at the designer's end makes it a different proposition for the user.

It appears as if as a general trend such a simplification for the user is achieved by increasing the complexity at other levels. We hear that electronic circuit design has been `simplified', by the availability of cheap reliable microcircuits. But if we look at the whole scene - inside the factory that makes the micro-circuits that go into the `simplified' design - it demands extremely complex machines with great optical and mechanical accuracy; materials are purified to an astonishing degree and extraordinary levels of cleanliness are necessary. In general, the substitution of electronic parts for electrical or electro-mechanical parts requires large increases in <u>overall</u> complexity.

Many scientists and philosophers of Science have claimed to be guided by `simplicity', in their choice of hypotheses and formulation of theories. Einstein for example says - "Our experience, justifies us in believing that nature is the realization of the simplest conceivable mathematical ideas". When he chose the tensor equations for his theory of gravitation, he picked the simplest set that would satisfy the requirements. It is said that he told the Mathematician John Kemeny, "God would not have passed up an opportunity to make nature that simple" (2). At one level simplicity appears to be a `value' incorporated into science. In a larger sense, since there is no universal or time independent or supra-historic yardstick to measure `simplicity', it has also been merely a carrier, reflecting various other values. What is simple, or how simple something is, has always depended on several `extra-scientific' factors.

Thus we see that at the level of theories or abstractions, simplicity is claimed to be a guideline - since it is considered `God's way' or aesthetically more pleasing etc.* At an operational level a variety of terms with positive connotations such as sophisticated, complex etc. are used to describe processes and devices of modern technology which

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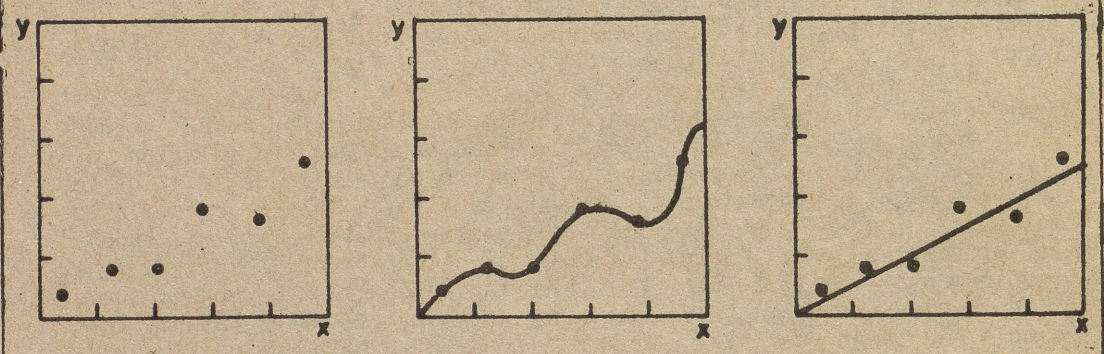
* Occasionally there are other qualities which are candidates for this guiding principle. For example the physicist Paul Dirac has been credited with the statement that - "It is more important to have beauty in your equations, than to have them fit experimental data".

SIMPLICITY IN SCIENCE AND SCIENTIFIC METHOD

We see that though `simplicity´ itself cannot be clearly defined or can vary depending on the level of analysis, it is constantly claimed to serve as a value that guides the scientist. The classic instance which is very common, is the graphing of a relation betwen two variables. The scientist records his observations as dots on a graph, then draws the `simplest´ curve that comes close to those dots. Simplicity can even overrule the data. If the spots fall near a straight line, he will not draw a wavy curve that passes through every spot. He will assume that his observations are probably a bit off, and pick a straight line even though it may miss every spot, and guess that the function is a `simple´ linear equation such as x=2y (see illustration).



If this fails to predict new observations, he will try a curve of next-higher degree, say a hyperbola or a parabola. Other things being equal, the `simpler´ curve is believed to have the higher probability of being right.

However, there is no way to measure this kind of simplicity or even define it. One cannot just count the terms in a theory´s mathematical formulation, because the number depends on the notation. The same formula may have ten terms in one notation and three in another. Einstein´s famous $E=mc^2$ looks `simple´, only because each term is a shorthand symbol for concepts that can be written with formulas involving other concepts. This happens also in pure mathematics. The only way to express pi with integers, is as the limit of an infinite series, but by writing pi (symbol) the entire series is squeezed into one symbol. Minimizing the powers of terms is also misleading. For one thing, a linear equation such as x=2y graphs as a straight line only when the coordinates are Cartesian. With polar coordinates it graphs as a spiral. For another thing, minimizing powers is no help when equations are not polynomials.

achieve `simplicity´ for the final user. In essence Modern Technology seems to increase complexity overall, and the claim is that this is done to simplify matters for the end user.

Both these aspects need a closer look - what happens at the user´s end as well as what is the consequence `everywhere else´. In terms of the larger consequences, a closer look at any modern marvel invariably proves its cost to be quite devastating, if it is looked at in a total sense - cost as energy, or its impact in ecological, social or human terms. However, if at all modern technologies are judged as successes, they seem to be so only because, those who use it successfully, do not have to `bear the cost´, so to speak, of the overall increase in complexity. One way of doing this is political - wherein the users who benifit from the success of modern technology, merely pass on the cost to a hinterland or colony. Thus in the `success´ of the early phase of industrialisation of Europe, European development was made possible by the underdevelopment of her colonies. There are other ways too - the cost may be the onslaught on nature herself. Thus, a process that is fuelled by a renewable energy resource can be substituted by one which uses up fossil fuels - thus increasing its `productivity´ etc. But the cost in the form of degradation of nature or eating into her capital is borne by nature. Modern processes typically increase `productivity or efficiency´ only by such means and thus by definition, its successes can only be partial - for its user at the expense of others.

The user´s end also merits a detailed examination and one has to see to what extent and in what way matters are rendered `simple´ for the user. This is discussed in detail in a later section.

III. SIMPLICITY IN INDIAN TRADITION:

Simplicity appears to take on a very different kind of a meaning in the Indian context. One reason for this seems to be that in the Indian Tradition of Science and Technology there is no fragmentation of approach which is characteristic of modernity. All problems in reality are situated in a context, where they are linked in diverse ways to the rest of the world. The modern approach is to `isolate´ the problem and manipulate parameters in this isolated situation to `optimise´ something or the other. This is the essence of the laboratory method - a central pillar of modern Science and Technology. This enables one as we have seen earlier to achieve `a sort of simplicity´ for the end user at the expense of increasing overall complexity.

The traditional Indian approach does not attempt such an isolation, but believes in evolving solutions in an actual situation granted its diverse links to the rest of reality. The traditional approach seems

to be characterised by two qualities - development of very high skill on the part of the user and a great sophistication at the level of design of theory or `device´. Needless to say that neither of these are achieved by increasing the `cost´ (in the larger sense of the term) to the overall situation. The `price´ cannot be passed by the user to `others´ or `any one else´ - because the problem is perceived and understood and solutions are sought at a holistic level, where the user and others are not even fragmented into seperate entities. With this viewpoint, the solutions that are considered `simplest´ seem to be of a very different nature.

A few examples would serve to elucidate some aspects of the nature of traditional approach to problems. As we said earlier, one prominent feature seems to be that it calls for a considerble degree of skill on the part of the users of these theories or devices. Some of these are such a common part and parcel of our daily lives that we take it for granted and it may normally go unnoticed. Consider for example the following observation of some commonplace things of our daily life by an outside observer.

"There is another variation of the basket work, the marram (muram) a triangular tray peculiarly shaped, deeper at the broad end and with an opening at the narrow end. It is made of split bamboo and is used for winnowing grain or cleaning it. With a movement that combines tossing, and shaking, a woman can separate broken rice from whole grains, or separate two kinds of grain which have become accidently mixed, or extract unwanted grains and weed seeds. Let anyone not accustomed to such work try this, and they will admit it requires a very high degree of skill. Yet any village woman seems to do it automatically.

When I needed the vegetable garden to be dug and the seed sown, it was done by two lads, with the short spades called `mumtis´. They had no measuring line, no hoe or rake, or dibbler, and scarcely seemed to look around them. But with this one tool they made perfect rectangles for carrots, turnips, beans and beetroots, with irrigation channels between. Before the rice seedlings are planted, the field has to be flooded and then made perfectly level. If this is not exact, the crop will be a failure, as one part of the field will be dry when the rest is under water. Levelling is done by boys and men riding round standing on wooden planks drawn by bullocks. They, and the bullocks, are splashed with mud all over. They take no measurements, do not stop to use a plumb line but the result leaves a sheet of shimmering water in which the seedlings can be planted at even depth and be flooded evenly as long as necessary - that is, until the grain is formed and ripe.

The people who exercise these skills are not well paid, and their

products are not highly valued. To Indians these things are just part of life, as it has been for hundreds of years. To tourists they are mostly unobserved and unknown. Tourists buy things specially made for them, such as ivory carvings, Kashmir carpets, Sandalwood jewel boxes and hookahs of chased bronze. Few of them pause to look at the potters, basket makers or harvesters. Their coaches do not stop long enough, but rush from one famous temple or palace to another. You have to live quietly with people to understand and value their common skills which are among India's greatest assets" (3).

The solutions that are evolved by the Indigenous approach have certain striking contrasts to the modern approach. It seems that in the modern world, the greater the sophistication or advancement of technology, the more meaningless it renders the human being and his role is progressively reduced to a zero, and his skill or judgement or other qualities are rendered devoid of any meaning. In contrast traditional solutions call for a more dynamic and live interaction of the `user' and the theory or `device'. Often the device itself may be simple but the user may have to sythesize a lot of inputs, and exercise his varied skills and use his judgement to achieve a brilliant end result. This is guided and made possible by an extremely sophisticated theory. Numerous and diverse examples can be cited. Consider the Vaidya who is trained in Nadi Pariksha (Pulse examination). The `device', itself is trivial but it calls for a high degree of skill and requires the evaluation of the influence of varied factors such as the age, sex, physical condition of the patient, season of the year, time of the day, mental state etc. Analysis, is of course made possible by a highly sophisticated theory which can if correctly used give one an insight into all factors that influence the Nadi. Or consider for example the Indigenous process of Iron and steel making. Iron was smelted in furnaces that were considered extremely `simple'. The high quality of the product was only made possible by the great skill of the artisan and the high degree sophistication at the level of design. To quote an 18th century observer:

"Their smelting furnaces, though rude in appearance, are nevertheless very exact in their interior proportions, and it has often surprised me to see men who are unquestionably ignorant of their principle, construct them with precision, in so simple a manner; their unit of measure is the breadth of a middle sized man's finger; 24 of which constitute their large and 20 their small cubit; thus there is a constant ratio of 6 to 5 prevailing thoughout these furnaces, nor is it of the least consequence, that their dimensions are larger or smaller, so long as all the parts are in the same proportion. .... The above description is not founded on theoretical conclusions; the measurements given are derived from taking the mean of several and the results were proved in furnaces under my own superintendence; the

coincidences of the several parts are very striking; the angle of the blast is also worthy of notice as well as the simplicity by which both it and the obliquity of the furnaces is obtained; all these serve to show that the original plan of this singular furnace must have been the work of advanced intelligence, and that its geometrical proportions have been preserved by simple measures; hence though its original form may be changed by caprice or ignorance, its principle can never be lost so long as hands and fingers remain. .... Having now exhausted all my information which was obtained from actual experiment and impartial trial and proof, I shall conclude with the following remarks - viz: that the Indian forge is able to make crude metal, for two pounds six shilling, and good malleable iron for five pounds ten shilling per English ton; it is moreover susceptible of improvement; it requires but little outlay; it is portable; and may be transported from place to place, the implements being the only things necessary to carry; it may be erected in places which combine the advantages of proximity of ore and fuel and where other furnaces requiring a large supply of water cannot be set up - and it may be erected for temporary purposes and abandoned when the object is fulfilled without material loss, the furnaces being the only part which would be lost and their cost is about 6 shillings each.

The employment of so simple a forge in England would be absurd - but considering it an instrument adapted to the existing condition of the country where it is used - it assumes a different character for such is the cheapness of labour and fuel that I question whether any other furnace would complete with it ....." (4). Similarly, the Indian sailors used a device to keep track of their latitude which could be made merely by piece of cardboard and a length of string. But here again, typically, the latitude cannot be obtained as a metre reading by a push button device but calls for an active application of the user's knowledge and skill (see box).

The sophistication involved in indigenous technology should not be confused with the complexity that accompanies modern technology. Let us consider for example the case of Nadi Pariksha, to see the difference. When a Vaidya examines the Nadi, he makes (among other things) an estimate of various factors like, the rhythm, flow and the force (of the beat) of the pulse. In a sense he is assessing the same factors that an allopathic physician would call as pulse rate, blood pressure and flow rate. The training in Nadi Pariksha builds on one's natural ability and the theory helps to systematize observations and refines the process of drawing conclusions. In contrast the modern approach would be, to build instruments to measure these parameters separately, perhaps with great accuracy. Thus while the Nadi Sastra builds on one's natural skill, the modern approach replaces the finger by a set of instruments. One consequence would be that measurement is

INSTRUMENT USED BY INDIAN MARINERS

"In a note on an instrument used by Native mariners for finding their latitudinal position off the coast, Captain Congreve describes the following simple and ingenious instrument. A piece of thin board, oblong in shape, three inches long by one and a half inches wide, is furnished with a string suspended from its centre, eighteen inches long. A number of knots are made in this string, indicative of certain previously observed latitudes; in other words, coinciding with the position of certain well-known places on the coast. The position of these knots is obtained in the following manner. The observer elevates the board in his left hand, its longest side being upwards, and draws it backwards and forwards in front of his eye until its upright length exactly corresponds with, or covers the space included between the pole-star and the horizon. With his right hand he next catches hold of the string, and brings it to his nose. He makes a knot at the point where it touches that feature; and, if he at the time be abreast of point Palmiras, an undeviating index is afforded, which will in future show him when he is off that point, the north star's elevation being always fixed, and therefore, all the parts of the triangle formed by his line of sight, the string, and the distance between the polar star and the horizon, or the length of the board equally as constant. To make the thing as clear as possible, suppose the observer finds, when out at sea, that the knot which measured the former coincidence of his position with Point Palmiras, again impinges on his nose, he is satisfied, on this occasion, he is in the same latitudinal line as he was on that, or that he is off point Palimras. He makes similar observations at, and the knot is fixed opposite each conspicuous place, on the length of the string, as far as Domdra head in Ceylon generally. Thus by a simple observation at any future time the mariner is enabled to ascertain his position with sufficient accuracy for his purpose" (5).

now rendered very complex. This could mean for example that what one can do is to strap on a pressure sensor and read the Blood Pressure (BP) from a dial or a digital read out. If this is one's training, then in the absence of this instrument one cannot form any estimate of the blood pressure. In other words, the capacity to estimate BP has been replaced by the ability to push buttons and read dials.

At the other level the theories and categories are also in terms far removed from our level of experience and observation. Experiments can be designed or theories constructed to explain how any one parameter like BP can vary with exercise or stress under controlled laboratory

conditions. A similar theory can be made for the pulse rate. But then dealing with a real life situation becomes a task that is stupendously complex. It requires instruments of great complexity to measure each parameter and an even more complex theory to attempt (if at all) to synthesise various data to tell us what it means in terms of our own experience or observations. The ordinary user is rendered devoid of his natural skills and he has become dependent to carry out even the smallest task. No innovation is possible at the user level since design and understanding is a special process confined to a small number of specialists and experts. In fact, even these specialists, seem to be alienated from the implications of their own theories at user level. It is a commonplace observation that there a are large number of Doctors or even `Heart specialists´, who are heavy smokers and this does not cause us much surprise. But such an abuse of the body would be considered surprising and unacceptable to us if observed in any Vaidya.

Surely one is not of course opposed to having things rendered simple for the users. But it should be seen that what modernity offers as a solution, is not just a simple way to perform the task. Rather, one´s skills are being replaced by the `Capacity´ to push buttons or swallow pills - exercises that are in themselves devoid of any meaning. One is rendered alien to the skills and prowess naturally involved in the task, rendered unable to innovate at the user level or take any pleasure in it. Above all it takes away the control from individual users and delivers it at the hands of a select few. Such an arrangement may no doubt have its uses under special conditions such as a war, where expediency takes priority and action may be regimented by retaining control centrally. But making this design a part of normal life, indeed reduces the normal user to a near zero.

In contrast, we can see that the traditional approach looks at the phenomenon in its integrity. It seeks to build on one´s natural abilities and skills by systematising them and making them more rigorous without destroying them. This help us to come up with solutions that do not destroy the essential unity or multifacetedness of nature and our interaction with it.

Since all development of Science and Technology is in a sense an interaction between human beings and nature, it may be said that the difference is really only a question of `where the line is drawn´. While this is no doubt true, it should also be pointed out that the two approaches in fact constitute fundamentally different understanding of the relation of human beings with nature. In the modern view, man is seen as being distinct and apart from nature and often the scientific or technological progress is related to the extent to which one can control nature; this may also sometimes be expressed as

`understanding´ nature, since the purpose of such `understanding´ is supposed to be to acquire power over it (`Knowledge is power´). In the traditional view, human beings and nature are understood as existing in a state of natural harmony. Hence any `development´ in science and technology is guided by the thought that the harmony should be disturbed minimally (if at all) and the harmony if disturbed should be reestablished in another plane.

In fact, problems are generally identified and analysed in terms of loss of harmony and solutions are seen as moves to reestablish harmony. For example, disease is the loss of harmony between the doshas and a cure reestablishes their mutual balance. It should be emphasized that this view is incorporated in the basic outlook itself and not merely applied as a "corrective" - as seems to be the case with some of the `alternative´ perceptions currently emerging from the West today.

IV. CONCLUSION:

> It took me quite a lot of patient study and observation to discover that his simplicity was a very complex art. "Simplicity is not so simple a thing as most people imagine", he once remarked on a subsequent occasion. - Pyarelal Nayyar on Gandhiji (6).

It becomes important to understand the use of words like simple or primitive or sophisticated, since these words are not just neutral adjectives or mere descriptors - but are in fact value judgements today. It is often considered `obvious´ that Indigenous Technology which is - `simple, primitive, crude, underdeveloped´ etc., needs to be replaced by modern Western technology which is `sophisticated, modern, refined´ and so on. Our problem seems to be at two levels.

At one level there is an inability to understand Indigenous Technology - either in itself or in relation to its own context, history or its link with our society. It invariably gets juxtaposed against contemporary Modern Western Technology. A whole lot of adjectives employed in this connection are `relational´. That is, primitive means not yet `modern´, crude means not yet refined to Western Technology, underdeveloped means not yet developed into what the West has. The colonial mind has always perceived Indigenous Technology as a kind of "unfinished European Technology". In this view, technologies other than European are believed to be inferior since they had not `evolved´ into European technology, which was considered the natural and desirable course. Such a tendency still afflicts a large number of us also. Hence even our own studies on Indigenous Technologies, tend to pose questions like - `why did this not develop into what Europe has´, rather than to understand its principles and potential in our

context.

In fact at present the very fact that a Science or Technology has origins in India seems to be sufficient to give it the label backward or primitive. Last year, a paper was published in a reputed journal on History of Science, analysing the medieval Kerala School of mathematics on infinite series (7). In the journal's annual index, the editor classified this paper under `primitive' mathematics! Most of our own thinking is also haunted by the same syndrome. The result is that by and large we are unable to understand indigeous Technology and its potential.

At another level we are unable to utilise our traditional technologies since we often approach them and tend to use them in the same manner as modern technologies. Traditional technologies, as we have seen earlier, cannot be used mechanically as `devices' (in a - `push button' sense) or as merely a `formula', which just needs to be routinely applied. It is with such a spirit (or lack of it), that many traditional solutions are taken up for trial today and it is no great wonder that it appears not very successful in such cases. Take for example the case of Yoga. Prescriptions in Yoga texts are not to be applied mechanically, but every individual is expected to choose his own set of Yogic Asanas, keeping in mind varied factors such as his age, fitness, physical condition etc. Moreover one should pay close attention to seasonal and even day to day variation in one's own health and condition to suitably modify one's practice. But quite often we find Yogic Asanas being done mechanically by rote and it is no great surprise that its potential is so little realised.

Not only in the area of Science and Technology, but also in the social or political sphere, solutions tend to become caricatures if they are applied mechanically. The way the modern Indian views issues very mechanically, is brought out by the following instance, recounted to the author by a well know Gandhian Scholar. For quite some time now, the traditional hand - plied charkas are being replaced by a much smaller number of mechanical charkhas operated by fewer people. It is even stated sometimes, that the reason for this change, is that in this way it becomes `simpler' to keep track of the production and do the accounting. The charkha programme was initially conceived to provide productive employment for the largest number of beneficiaries. But in the absence of an active and alert mind to keep this in focus, the charkha can become a mere `device' and the programme can degenerate into a meaningless exercise.

It seems to be a general requirement (running though the entire fabric of Indian thought in varied areas) that at no stage and in no arena, is the human agency to be reduced to mere button pushing. Employing

traditional Scientific approach is dependent in the use of Yukti - i.e. the use of one's own skill, intelligence and judgement to perceive a phenomenon in its totality and to act suitably taking due note of the total situation in the context of the time and place.* For example even laws regulating the function of the Society are not canonized as `Rule of Law'. Traditional Law was more in the nature of guidelines and precepts. Its actual manifestation in any given situation was governed by varied factors such as Desha, Kala etc. and could be only spelt out in the given context by a human mind endowed with judgement, sensitivity, imagination etc.**

It is time that our scientists and technologists as well as the planners and policy makers rid themselves of several pre-conceived notions and prejudices regarding Indigenous Sciences and Technologies, which need to be studied and understood in our own terms and in relation to our society, our history and our needs. This calls for a radical change in the outlook of those schooled in the present day scheme of education and training. A rediscovery of some of the finer functions of the mind and an alertness and aliveness to our own context and needs should form an essential part of this change.

It is indeed fortunate that even today, a large majority of our people are still drawing their material, intellectual and spiritual sustenance from our Indigenous tradition of Science, technologies etc. If our vision is only to `catch up with the west', by some deadline or the other, then whatever our people have and in fact the people themselves appear to be great obstacles. However, these very qualities can be turned into our greatest assets, if only we rid ourselves of our prejudices and plan for a future that builds on our own resources and strengths.

A.V. Balasubramanian,
PPST Foundation.

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* See also the discussion section of the paper on `Impact of Modernisation on Milk and Oilseeds', appearing in the same issue of the journal.

** It is perhaps for this reason that our tradition has often stressed the importance of Mahans/Mahatmas who are needed from time to time to revitalize our tradition and interpret it, in every age. Thus, the Santi Parva of Mahabharathia says - "Vedas are numerous, Smritis may be conflicting and there is no one Rishi whose opinion can be called final. The path of Dharma is subtle and hidden very deeply from sight; hence, the path (interpretation) shown by the Mahans is indeed the true path".

REFERENCES:

1. Some examples in this section are from the article - The perils of being simple by Stephen Salter, New Scientist, 25th Feb. 1982 pp.495-7.

2. Several examples in this section are from - Simplicity as a Scientific concept: Does nature keep her accounts on a thumbnail? by Martin Gardner, Scientific American, Sept. 1959 pp.118-121.

3. Unvalued assets by Dora Scarlett, Resurgence, March - April, 1986 pp.44.

4. Mode of manufacturing iron in Central India by Major James Franklin (Circa 1829) cited in Indian Science and Technology in the Eighteenth Century by Dharampal (1983 Reprint, Academy of Gandhian Studies, Hyderabad).

5. Ethnographic notes by Edgar Thurston (undated) pp.571-2.

6. Gandhiji as I know him by Pyarelal Nayyar in - Incidents in Gandhiji's life (Ed.) C.Shukla (1948).

7. Paper by Prof.Rangachary, published in Archieves for History of Exact Sciences (1986).