

The Science And Technology Policy 2003

A Critical Evaluation

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The previous NDA Government led by the BJP at the centre adopted a new science and technology policy on 10 January 2003 and circulated it through the website of the DST (Department of Science and Technology) as “The Science and Technology Policy 2003”.¹ The present UPA Government has also committed itself to the same policy. The only change in the DST web page is this: In the BJP period the three quotations in the title page before the policy were cited from Vajpayee, MM Joshi and Bachi Sing Rawat. Now the DST quoted from the President, Man Mohan Singh and Kapil Sibal. However, that has nothing to do with the policy statement. The policy statement may therefore be considered to be an official line of the Union Government in general.

The science policy of the Government largely bears upon its other policies pertaining to the different areas of education, culture, history, economy, development, social ethic, and so on. The new S & T policy, therefore, deserves critical attention of the scientific community.

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[1] The Objectives

The Indian Parliament had adopted a Science Policy Resolution at the initiative of Jawaharlal Nehru in 1958. A critical analysis reveals that it had failed to properly identify the main obstacles before the scientific research in our country². For example, on the one hand, the overwhelming presence of feudal culture, psychology and values among the people – both literate and illiterate, pushed them towards a false and romantic glorification of India’s past; and, on the other, in absence of a democratic culture, an environment of authoritarianism prevailed in the entire science and technology regime – from top downward, from the central bodies to the institutions, from project approval to fund allocation. In order to tackle these problems, the science policy was required to undertake two primary tasks, namely, (1) secularization of the entire society and polity liberating it from the impacts of religious, caste and other particularistic traditions; and (2) democratization of the total structural functional and psychological scenario of the Indian science and technology regime – including education, research, administration and

funding. Failure to identify the problems also led to a total neglect of these tasks and further aggravation of the problems. So, in spite of a boost to scientific research and creation of some research institutes, during the operation of the 1958-policy the cultural-psychological scenario in the institutions and among the individuals remained more or less unchanged.

Since the 1990s there were, however, several abortive attempts to revise the old document or adopt a new strategy for S & T. So when the new policy was ultimately formulated, we had rightfully expected it to analyze the 45-year-long experiences of the last policy, soberly evaluate its limitations and failures, and take appropriate measures to overcome them.

On reading its text we were totally frustrated. Instead of taking into account the above-mentioned basic weaknesses of the previous policy, it turned the first weakness into a virtue and eulogized the ancient Indian tradition in the highest possible glorifying terms: "Science and technology have been an integral part of Indian civilization and culture over the past several millennia. Few are aware that India was the fountainhead of important foundational scientific developments and approaches. These cover many great scientific discoveries and technological achievements in mathematics, astronomy, architecture, chemistry, metallurgy, medicine, natural philosophy and other areas. India also assimilated scientific ideas and techniques from elsewhere, with open-mindedness and a rational attitude characteristic of a scientific ethos. India's traditions have been founded on the principles of universal harmony, respect for all creation and integrated holistic approach." The policy makers felt that these achievements were yet to be absorbed in the existing knowledge bank of the world, and therefore, sought to "utilize the extensive

knowledge acquired over the long civilizational experience of India." Thus, far from striving to undermine, we are afraid, it sought to tacitly encourage the revivalist elements of our society.

Secondly, still worse was the Government's attitude towards democratic norms as reflected in the designing of the policy. They undertook no programme of a thorough review of the science policy resolution of 1958, of its achievements and failures, among the concerned segments of the population. Nor did they let a new science and technology policy be proposed, discussed and debated among the S & T community before its final formulation – as is naturally expected in such a case in a truly democratic setup. The policy statement was not even made an agenda of discussion in the Parliament. It was not properly circulated among the members of the scientific community at large, nor was their opinions sought. There was a two-fold object behind its circulation through the net: first of all, it could be said to have been formally made public for all to see; secondly, it would be seen only by those who had access to computers and net-connection, and that also if, by chance, they happened to stumble at the DST website. Moreover, nothing was stated there about its status – whether it was only a draft paper for discussion or the final policy statement of the Union Government, and in that case, how, by whom and where it had been formulated, discussed, approved and adopted.

The attitude betrayed by the policy designers, therefore, was: no matter what the larger public think, feel or like, we are to going to carry out our already decided plans and programmes under the façade of a national policy. An executive decision of the then Union Government actuated by the narrow political-ideological concerns of the main party of the ruling alliance was flaunted as a national policy

on science and technology, keeping the people of the country, the scientific community, the opposition in the parliament and even the partners of the coalition government – thus the entire nation as such – in complete darkness about its existence and contents.

This is perhaps the kind of appreciative spirit they had imbibed from the long tradition of the country they so boldly exhorted upon.

Now let us proceed to examine the policy in its perspective approach.

[2] A Different Perception

But at the outset, we had better hear the opinion of a great Indian scholar of the Sanskrit literature in the nineteenth century – Ishwar Chandra Vidyasagar, a towering personality of the Indian Renaissance – on the relevant points. The policy statement refers to many subjects, but we shall confine ourselves into two of them, namely, mathematics and philosophy, and cite Vidyasagar's observations on them. "In mathematics", Vidyasagar wrote, "Lilavati and Vijaganita are the text books. Lilavati treats of arithmetic and mensuration and Vijaganita of algebra. These two works are very meagre and from a curious perversion of ingenuity and obsessed of a right sense of real value and object of such studies, the author has made them so difficult by putting the rules and questions all in verse that the students cannot go through them in less than three or four years. The examples are very few. *The fact is, the study of Sanscrit-mathematics is not only nearly useless in itself, but it interferes largely with other studies and engrosses a great deal of time and labour which might be employed in far more useful pursuits.* Hence the study of mathematics in Sanscrit should be discontinued. I wish to substitute the pursuit of it in English, whence in less

than half the time now given to it an intelligent student will acquire more than double the amount of sound information that he could obtain by the most perfect acquaintance of all that exists in the Sanscrit language in the subject."³

On philosophy, he observed: "True it is that the most part of the Hindu systems of Philosophy do not tally with the advanced ideas of modern times, One of the principal reasons why I have ventured to suggest the study of all the prevalent systems of philosophy in India is that the student will clearly see that the propounders of different systems have attacked each other and have pointed out each other's errors and fallacies."⁴ Thus his interest in the teaching of the Hindu systems of philosophy did not involve any expectation to absorb some fruitful knowledge or approach from them but veered round the hope to expose their "errors and fallacies", and thereby, to underscore their irrelevance today in full. Vidyasagar strongly believed that the resurgence of the country necessitated a break with the past, with the adoption of a new outlook and a new mode of life. He had no illusion about the superiority of the Vedic or Vedantic thoughts to the modern western ideas about nature, life and society. In his own words: "For certain reasons, we are obliged to continue the teaching of the Vedanta and Sankhya in the Sanscrit College. *That the Vedanta (sic!) the Vedanta and Sankhya are false systems of Philosophy is no more a matter of dispute.* These systems false as they are, command unbounded reverence from the Hindus. Whilst teaching these in the Sanscrit course, we should oppose them by sound philosophy in the English course to counteract their influence."⁵

Rather than locating any useful information and any valuable foundational approach in the ancient texts, Vidyasagar clearly spelt out: "It must be confessed however that there are many passages in Hindu Philosophy

which cannot be rendered into English with ease and sufficient intelligibility only because *there is nothing substantial in them.*⁶

As against the policy statement, Vidyasagar found the traditional Hindu society of his time conspicuous by the absence of a “rational attitude” and an “open-mindedness” to “assimilate scientific ideas” from elsewhere: “It is not possible in all cases I fear that we shall be able to shew real agreement between European Science and Hindu Shastra. Even if we take it for granted that we shall be able to point out agreement between the two, *it appears to me to be a hopeless task to conciliate the learned of India to the acceptance of the advancing science of Europe. They are a body of men whose longstanding prejudices are unshakeable.* Any idea when brought to their notice either in the form of a new truth or in the form of the expansion of truths the germs of which their Shastras contain they will not accept. They believe that their Shastras have all emanated from omniscient Rishis and therefore, they cannot but be infallible. When in the way of discussion or in the course of conversation any new truth advanced by European Science is presented before them, they laugh and ridicule. Lately a feeling is manifesting among the learned of this part of India, specially in Calcutta and its neighbourhood, that when they hear of a scientific truth, the germs of which may be traced out in their Shastras, instead of shewing any regard for that truth, they triumph and their superstitious regard for their own Shastras is redoubled. From these considerations, *I regret to say that I cannot persuade myself to believe that there is any hope of reconciling the learned of India to the reception of new scientific truths.*⁷

It is clearly visible from these observations that according to Vidyasagar the ancient Sanskrit scriptures of the Vedic and post-Vedic times neither

contained any useful and veritable knowledge worthy of today’s consideration, nor fostered a critical and comprehending mind – conducive to the growth of science – among the scholars who cultivated them. If it were true in the nineteenth century it is all the more so today when the new policy has been floated. It there-fore starts with an already tested and rejected perception of the past tradition of India.

[4] Ancient Indian Wisdom Already Explored

But there are many people who are carried away by another consideration. They think: Although it was wrong to flout the democratic norms, the Union Government was sincerely trying to rescue, preserve, cultivate and highlight whatever valuable knowledge had been produced in this country of a long past history. So, its procedural mistakes might be pardoned for the time being. The secularists and rationalists always raise the democratic arguments to forestall the restoration of the ancient Indian wisdom.

Let us now discuss that point.

The following two things deserve their further consideration.

1. We have to decide first whether the rescued pieces of the ancient knowledge were at all valid and true as a system of information in the past context where they belonged.
2. Even if they were true in that relevant context, we have to check whether they are still equally valid and relevant in the present context in which we are living and thinking to assimilate and apply the modern body of knowledge.

As regards the first task I would like to point out that the resources of ancient Indian wisdom had far from remained

unattended to so far. Ever since the early nineteenth century a large number of both Indian and foreign scholars conducted many fruitful detailed and thoroughly investigative studies of what were gained as positive knowledge in ancient India. They collected old manuscripts, studied and analyzed the ancient texts, translated and edited them with care, and in the process, published for the common readers. For example, see the excellent works of some of the eminent authors on different subjects: (a) *mathematics*: Colebrooke⁸, Brennand⁹, Thibaut¹⁰, Smith and Karpinsky¹¹, Kaye¹², Cajari¹³, Clark¹⁴, Datta¹⁵, Datta and Singha¹⁶, Laubebacher and Pengelley¹⁷; (b) *medicine*: Wise¹⁸, Sinhjee¹⁹, Jolly²⁰, Hörnlé²¹, Mukhopadhyay²² & ²³, Zimmer²⁴, Filliozat²⁵, Keswani²⁶, Sharma²⁷; (c) *chemistry*: Ray²⁸, Neogi²⁹, Iyer³⁰, Krishnan³¹; (d) *history of science*: Seal³², Sarkar³³, Sarton³⁴, Clark³⁵, Majumdar³⁶, Sen³⁷, Bose *et al*³⁸, Jaggi³⁹, Chattopadhyay⁴⁰ & ⁴¹, Dasgupta⁴²; (e) *geography*: Sircar⁴³, (f) *education*: Hunter⁴⁴, Altekari⁴⁵, Mookerji⁴⁶, (g) *general achievement*: Barnett⁴⁷, Keith⁴⁸, Dasgupta⁴⁹, Piggott⁵⁰, Basham⁵¹, Kosambi⁵², Renou⁵³, etc. The literature extends (see references), into other foreign languages too, like French and German. Remember that the list is far from complete and exhaustive. Besides, I could also cite many authoritative papers, written by informed specialists in the last two centuries and published in specialized journals, dealing with different aspects of the development of science, technology and culture in India.

It is, however, true that the findings of these authors differ from one another on many aspects of the subject – namely, value, authenticity, reliability and chronology of the facts and their sources, their importance and interpretation, and so on. On the one hand, some Indian authors tend to overestimate and

exaggerate the significance of a fact, push the dates of achievements as earlier as they fancy, extrapolate modern discoveries into the past on the strength of scanty or ambiguous data, and even speculate credit for many deeds based on dubitable sources. On the other, some western scholars on their part are inclined to see nothing significant in the past history of India. One may, therefore, rightly consider the research to be far from conclusive and plead for still continuing the study – in depth and/or breadth. One may even want to bring the debates and differences among those scholars on many details to a workable consensus through some fresh and more elaborate efforts. However, that demands a grand and long-term comprehensive research project with the involvement of a large number of persons competent for the job, free from any kind of national, cultural or religious prejudices and presentiments, that is, people who remain committed to rigorous methods of data collection and their logical, scientific analysis, irrespective of their personal faiths, creeds and commitments.

[5] Structural Evolution of Knowledge

But, then, what should be the purpose and object of these studies? The interest behind any such study, we should remember, is *historical* and its purpose is mainly *historiographical*. It is done with a view to situating the ancient knowledge in the proper context in which it was relevant, where it played a positive role in the on-going cognitive process of man. It is not considered as such a *subject of learning* today, for it is neither relevant nor sufficient for solving the problems confronting us today. It forms a part, a study material, of the *history* of that subject. It is not itself a study material today.

Let me elaborate the point.

When we study the history of how man advanced in his cognitive activities and organized his knowledge in diverse fields, we see three concurrent processes at work: namely, *accumulation*, *integration* and *contiguity*.

[1] **Accumulation:** By the cumulative process we mean that what we know today about anything in any sphere of cognition is not something known just today, isolatedly, sporadically, as it is only; it is an accumulated product of a long process – which may be spread over many hundreds, even thousands of years. Man can know only bit by bit, gradually, and successively. But the knowledge at every step begins from, and is added to, what has been acquired up to that point of time. No positive knowledge once gained by man is ever lost in the human civilization (unless of course all the members of a human group are annihilated, like the people of the Maya, Aztec or Inca Cultures of South America; or the Melanesians or Polynesians of Southeast Asia). It is therefore obvious that *the present knowledge about something contains all that has been known by man thereabout till now*. This also explains why Vidyasagar rejected Lilavati and Vijaganita in the Sanskrit College course of mathematics in favour of English textbook on mathematics. The latter contained all the materials of the former and much more as well, including a better logical framework.

Let us take a simple example. When a big building is constructed, all the separate bricks used for the purpose are permanently set there in the total structure. They may not be separately visible to the naked eye, but everybody knows that they are quite extant there in the true sense of the term. Knowledge of anything is a totality like that. We may not know the ancient bit of information in it as a separate item; but we do know that it is contained therein. If we want to know

what man had known about it at a particular point of history, we may explore it as a subject of study.

Everybody who undertakes research in any field complies – consciously or unconsciously – with this process of accumulation. He thoroughly surveys the available literature on the problem in question, to see what is already known and how far advances have been achieved. It is only then that he starts his search for additional knowledge.

[2] **Integration:** But knowledge in any field is not gathered like a serial addition; the way we store telephone numbers in a pocketbook. It also undergoes a two-fold integrative process. In the process of accumulation of all the bits of information man garners over time, knowledge is continually transformed into a new qualitative product. This is a sort of *vertical integration*. Again, at every stage, knowledge of one sphere is combined with knowledge gained in many other related spheres to produce a more appropriate and comprehensive knowledge of the concerned area at a time. This may be termed as the *horizontal integration*.

In the above-mentioned example, a wall is not a mere heap of bricks; the bricks must be properly combined with one another as well as with the other materials and components used.

As a result of this integrative character of human knowledge leading to ever higher levels of understanding of the things known, the particular elements of knowledge acquired at a particular time of history may not be properly identifiable later. It does not mean that it is not there, or that it is not recognized as such. Even if it is not separately mentioned, or made intelligible, it is still there embedded in the present body of knowledge. It means that the particular knowledge remains embodied, inherent in the overall body of knowledge, as an inseparable component of the whole.

More examples. When a modern student of science learns mechanics or relativity theory, nobody advises him to consult Newton's works or Einstein's original papers for the purpose. He reads the latest, the modern versions of these theories developed by the current authors. Similarly, the student who wants to study the history of the Roman Empire, does not start from Gibbon but a more up-to-date textbook. In fact, in all the different fields of knowledge the more up-to-date is the literature the more usually is its value as a resource material.

[3] **Contiguity:** Thirdly, in order to make horizontal integration possible, knowledge in different fields must be contiguous, that is to say, the truths acquired in one field must not contradict but agree with those in the others, in terms of mutual properties, time characteristics, logical requirements, etc. It may be stated in another way, namely, the different approaches to understand a fact or verify a conclusion should not contradict each other but should lead to the same truthful result.

As regards the cited analogy, we may say that the height, angles, width, elevation, etc., of the adjacent walls and corners of the structure must match one another.

Let us take some examples from the practical fields of knowledge. The estimated biological time at which land animals and plants were first evolved in the earth must succeed the projected geological time when land surface appeared for the first time on the earth crust. The electronic theory of matter, which explains the physical properties of elements better, should also be able to similarly explain their chemical properties. Any geometrical theorem should also be verifiable in terms of some appropriate algebraic computation. When the deduction about constancy of the velocity of light from Maxwell's famous equations clashed with the already firmly

established knowledge of Newtonian mechanics about the dynamics of mass particles, this contiguity was lost. It is now well known how Einstein restored the contiguity between them by introducing a new set of relativity relations.

Or consider the following cases. The literary reference about a fact in history must coincide with the archaeological evidence about it. The history of the Aryan migration deduced from the linguistic evidence must match the chrono-geographical distribution of the horse fossils and other relevant archaeological data. Since the early urbanization required clearing of dense forests, which in its turn required heavy iron instruments, no urban culture can be dated in history prior to the discovery and use of metals. The various methods of chronometry used in history or geology, if valid, must yield the same time range for the same fact.

Thus the contiguity of truths is an essential condition to be satisfied in the relevant places of all subjects of sciences as well as social sciences. In fact, this condition is one of the primary desiderata that make various multidisciplinary studies possible.

It is evident that no part of the ancient wisdom, even if true in its own context of the time, can be made contiguous today with any part of the present level of knowledge in the relevant field. It will appear too narrow, too simplified and too shallow to be integrated with the much broader, more all-sided and profounder understanding of the modern man in the pertinent area.

I shall now illustrate the working of these three simultaneous processes with the simple case of development of the wheel.

The wheel is an invention of the Neolithic man about 10,000 years back. We are using wheels even today as a basic locomotive component of the modern vehicle system. It can surely be seen that

man gradually improved upon the design of the wheel to suit the increasingly advanced and divergent types of vehicles made by him through the ages – starting from the bullock cart and horse cart through the bicycles and tricycles to the steam, electricity and petrol driven automotives. The present wheel is the product of the accumulated knowledge about it gathered by man through the last ten millennia. Again, the present wheel also represents both – a vertical integration of the cumulative knowledge about it over the years, as well as a horizontal integration of the present knowledge gained in other fields like statics, dynamics, thermodynamics, friction, ball bearings, lubrication, brakes, tyres, spokes, roads and soil conditions, air pressure, metallurgy, material science, and so on. Lastly, the modern wheel has been possible, because the laws of physics, chemistry, etc. are in agreement with each other.

In order to understand the modern vehicle system we have no need today to learn from the Neolithic wheel. But we do study the Neolithic wheel. We have to study the development of the wheel from the Neolithic era *only* in the historical sense, when we are required to make a historiography of wheel, that is, when we want to know how its knowledge developed in time.

This way of understanding the process of development of human knowledge is crucial to a study and appreciation of the ancient Indian wisdom. We must remember that whatever positive knowledge is contained in the ancient Indian literary classics are of historical interest only. These have already been incorporated in our present body of knowledge and duly recognized by the world in the history of science. We may here refer to the invention by the ancient Indian scholars of the concept of “zero” and their introduction of the consequent decimal place-value system in

mathematics. Take any standard work on the history of science and you will find these Indian contributions acknowledged with a high degree of appreciation and gratitude.⁵⁴ But we must remember that we do not need to cultivate their initial forms to learn mathematics today. We start at the present level of accumulated and integrated knowledge about it. And this is true for all subjects of knowledge today.

[To be concluded in the next issue]

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