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# Science Education and the Privilege Divide: A Case of West Bengal

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In fond memory of the
late Prof. S.S. Barman

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Views expressed here are of my own, and for the errors and omissions, whatsoever, I am solely responsible.

# PREFACE

The present paper by Asokendu Sengupta, a trained physicist engaged in education research, is an expansion of the area of work of the Pratichi Trust and the Pratichi Institute that the Trust has set up in 2011. So far, our main endeavour has been focused on investigating problems of elementary education, health and children's issues and organising public debate and discussions on these areas. The engagements have resulted in preparation and dissemination of a number of study reports and organisation of a series of public dialogue.

In the area of elementary education, our initial focus was on the institutional and functional aspects of schooling – enrolment, attendance, teaching and learning, and so on. This was deemed to be important because conditions of elementary education in the state were in the need of urgent reform. This, in turn, warranted serious public engagement; and we believe that Pratichi's 'research for action' played a significant role in this regard. These promising developments encouraged us to take up the more complex issues, such as curriculum and syllabus and their relationships with learning achievement, teaching at school, home-task, private tuition and the interweaving of class and social identities with the extent of educational participation. Following the advice of Professor Amartya Sen, who illuminatingly brought out these complexities in his Introduction to the *Pratichi Education Report II: Primary Education in West Bengal – Changes and Challenges* (2009), we organised, in 2010, a public committee that made an inquiry into the load and relevance of the curriculum and syllabus operative at the primary level. The Committee on Syllabus and Curriculum constituted by the Government of West Bengal in 2011 took note of some of the recommendations of the committee that we had organised.

The course of inquiry of the aforementioned public committee raised a debate on contents and methods of teaching-learning of science subjects at primary level. While the debate remained alive, it took some of us to an informal but regular engagement on a related topic: extent and scope of science education in the state and the actual practice of science as a subject at high school level. The interactions carried out, often bilaterally, amongst Achin Chakraborty, Gautam Ghosh, Dilip Ghosh, and Asokendu Sengupta (all advisors of the Institute), and Manabi Majumdar and Kumar Rana, Director and Project Director respectively, of the Institute, warranted the initiation of an inquiry on the subject. Data on scope and extent of science education, however limited, presented a disheartening picture and this added urgency to foreground this issue for public discussion.

Asokendu Sengupta, who has keen interest in science and its practice, has been involved in addressing a number of issues in this area, and despite several limitations – constraints of data, time, and other resources, he has taken up the challenge of preparing a paper on the subject with much enthusiasm and seriousness. We very much hope that this work would provide a base for further inquiry and generate a much required public discussion on this often quoted but relatively under-researched subject.

On the one hand, the spin-off disasters associated with the much publicized technological triumphs like big dams, the green revolution, nuclear explosions etc. have often urged many to doubt and dismiss the claimed values of scientific developments. On the other hand, some die-hard advocates of (pseudo)-science have been led to project science as the panacea for all problems. Amid such claims and counter-claims, Pratichi seeks to foster a public debate on the teaching and learning of science in this state, and more broadly on science as a method of enquiry that affords one the 'freedom to doubt'. The publication of the work is in this spirit: while the views expressed here do not necessarily reflect Pratichi's understanding, we would like to generate a wider discussion and debate on this major, but neglected, issue.

Kolkata, July 2 2012 Manabi Majumdar

# Science Education and the Privilege Divide: A Case of West Bengal

Education, by virtue of being a near-universally accessed space, possesses the rare ability to reflect society almost in its entirety. Social diversity, inequities, norm, mores, parameters of value, structures of exclusions are all discernible within classrooms. Science education is especially useful in this respect, because Science in India bore, and still bears, the privileged markings of a European, Enlightened upper-class (and caste) civilised modernity, with occasional undercurrents of a postcolonial nationalistic patriotism. Therefore, the reach and health of science education in our society in general – and our public schools in particular – are excellent indicators of the state of our 'growth'.

This paper looks at the state of West Bengal through the lens described above, and attempts to map the historical development of science education in it, on the political and socioeconomic condition of its people. In so doing, it also hopes to chart a more effective route for universal school science education, and through it, for an inclusive and just society.

## INTRODUCTION

*'... Science strengthens the commitment of a man to free enquiry and to the quest for truth as his highest duty and obligation. It loosens the bonds of dogmatism and acts as a powerful dispeller of fear and superstition, fatalism and passive resignation. By its emphasis on reason and free enquiry, it even helps to lessen ideological tensions which often arise because of adherence to dogma and fanaticism. Although it is largely occupied with the understanding of nature at present, its development is tending more and more to help man to understand himself and his place in the universe.' Kothari Commission Report, Vol. 1, pp 12- 13,*

The fact that the science had widely been discussed in Indian literature and philosophy directly and indirectly, from the age of the Vedas to the early Mughal era is widely accepted. The art of reasoning and celestial observations were practised intensively in ancient India. The interactive openness of some of the early day exponents of scientific knowledge made profound impacts on other civilizations of the world. As Amartya Sen points out '… so-called 'Western Science' is not the special possession of Europe and America Certainly, since the Renaissance, the Industrial Revolution and the Enlightenment of the eighteenth century, most of the scientific progress has actually occurred in the West. But

these scientific developments drew substantially on earlier work in mathematics and science done by the Arabs, the Chinese, the Indian and others.'[1] That's history – ancient Indian history now, a past that is delinked from our present, glory notwithstanding. By the time India was conquered by the wily foreign traders, this country had plunged itself into a darkness created by its superstitions. By the late eighteenth century, superstitions, irrationality, prejudice, caste and gender inequality, sati, polygamy, child marriage, the purdah system, and so on had engulfed the entire Indian society.

During the early phase of the Nationalist movements a section of Hindu-nationalists had started to claim that many new scientific discoveries and technological innovations were already present in ancient India, and such knowledge could be found in the scriptures. The scientist and teacher Meghnad Saha ridiculed such claims with the famous sarcastic quip, '*Shob byade achhe*' ('Everything is in the Vedas'). But, people like Saha could not deter the *Ramrajya* propagandists for whom, even now, dated beliefs and religious scriptures are far more important than progressive science and modern education. They practise superstitions setting aside scientific knowledge, they believe in *gurus*' mesmerizing tricks more than the ablest scientists' astounding feats, not realising that these religious leaders do take advantage of modern science and technology for their 'miracles'. Not only the illiterate masses, even many amongst the enlightened academics and scientists tend to religiously adhere to dictates of superstitious customs unquestioningly; wearing *tabij* unhesitatingly to ward off evils is a common custom.

Nehru, the much acclaimed architect of modern India, dreamt of a prosperous nation propelled by science and technology. Naturally, school science education received special attention in the brave new world of Nehru's India. But, to what end! Looking at the Indian society, even after 65 years of independence, can we claim that the vehicle of education designed by the state has succeeded in installing a scientific temper in the minds of its citizens?

Before talking about science education in post-independence India, let us take a quick look at the state of school education, including science education, in India since the era of the East India Company.

## The Company Raj and Indian Education

The Calcutta Madrasa was established in December 1780 by Warren Hastings, the first Governor General of India, for the study of the Arabic and Persian languages and Muslim law so that the *sons* of the Muslim gentry could help the company in running the revenue administration and judiciary. However, within a decade Arithmetic, Geometry, Astronomy, Theology, Natural Philosophy, Law, Logic, Grammar, and other disciplines were added to the list of prescribed subjects for study and such addition clearly vindicated interests of native people at least in some branches of science.

The Asiatic Society was founded by Sir William Jones (1746–1794) on January 15, 1784

to enhance and further the cause of Oriental research. In the first meeting, the Governor-General, Warren Hastings was elected its first President and Sir William Jones the Vice-President. Warren Hastings greatly sympathized with the aims and objectivess of the Society. But he declined to continue in this post. On his request and advice Sir William Jones was elected President of the Society on February 5, 1784 and held this post till his death in 1794. A new chapter of the Society opened when in 1829 its membership was made open to native Indians.

Fort William College was established in 1800 by Lord Wellesley. This college 'emerged as both a centre of research and a publication unit, a cradle of creativity as well as scholarship planned originally to train probationer British civilians in the languages and cultures of the subjugated country, the college rendered services tantamount to those of a university in promoting modern Indian literatures, Bengali in particular... Under the leadership of William Carey, the College could also claim credit for drawing together Sanskrit pundits and Perso-Arabic *munshis* to reshape Bengali prose.'[2]

Establishment of the Calcutta Madrasa, the Asiatic Society and the Fort William College completed the first phase of Kolkata's emergence as an intellectual centre of the subjugated country.

Notwithstanding laudable efforts of some Englishmen like David Hare, the watch-maker of Kolkata, William Jones, the great orientalist, Elphinstone, the Governor of Bombay Presidency, and others, the Company did not consider it their business or responsibility to look into the educational needs of the people. They were driven by the motivation of trade and profit and were not interested in educating the natives at all, and followed a hands-off policy.[3]

## State Education: A sulky beginning

It may be noted that in the late 1700s and early 1800s 'education' was not a state responsibility even in England. Elphinstone encouraged setting up of 'The Bombay Native Education Society' (BNES), which started District Primary Schools for teaching History and Geography, Astronomy, Philosophy, Algebra, Geometry and Trigonometry, in addition to the three Rs: reading, (w)riting, and (a)rithmetic.

The Charter Act, 1813(Clause43), made a sea-change in the history of education in India. It was stated in no uncertain terms that the company would have to set apart a sum of not less than one lac of rupees in each year for the revival and improvement of literature and encouragement of the learned natives of India and for the introduction and promotion of a knowledge of the sciences among the inhabitants of the British territories in India.[4]

Hindu College was established in 1817. The sponsors of Hindu College wanted to give secular education to their children. The primary object was 'The tuition of the *sons* of respectable Hindus in the English and Indian languages and in the literature and science of

Europe and Asia'.[5] William Carey in June 1814 submitted [to Lord Hastings] 'a plan for instructing the natives of India the European Science'.[6] In 1823, the Governor General-in-Council resolved that 'There should be constituted a General Committee of Public Instruction … to submit to Government the suggestions of such measures as it may appear expedient to adopt with a view to the better instruction of the people, the introduction of useful knowledge, including the sciences and arts of Europe.'[7]

Now, we may have a quick look at the state of indigenous education at that time. Generally speaking, indigenous schools languished for many reasons – there were no big donors amongst the Zamindars or the Peshwas as Peshwa rule came to an end in 1818; *pathsalas* or Hindu primary schools lost social relevance, teaching was a non-remunerative amateur profession, whereas English schools became very popular from 1817 onwards in Calcutta, Madras and Bombay. In his 'Minute' of 10 March 1826 Sir Thomas Munroe observed that there were 12,498 schools with 1,88,650 pupils in Madras Province; In Bombay Presidency the Governor Elphinstone ordered a survey in 1829, which showed that there were 1705 schools with 35,153 students.[8] Adam was appointed in January 1835 to survey the state of vernacular education in Bengal. He submitted no less than three reports (1st Report: 1 July 1835; 2nd Report: 23 December 1835; 3rd Report: 28 April 1838). It was stated in the reports that 7.8 percent of children of the school -going age were in school.

Talk about elementary schools under government auspices began in 1835. But as the funds at the disposal of the government were considered to be insufficient, the elementary schools were neglected and, then, almost forgotten.[9] After Charter of 1813 there was a rush of missionaries into India. The setting up of the Serampore College for the teaching of, and conferring degrees in the arts and sciences of the West propelled a plenty of missionary activities and it helped development of vernacular literature. Some critics thought that the purpose of all these Missionary societies (which came after the 1813 sanction) was to 'convert' and to meet the educational needs of the 'converted'.[10] But, studying the activities of Serampore College one may conclude that end results certainly exceeded the primary objectives.

After 1813 the second big landmark decision was the acceptance of English as medium of instruction, by what was known as Macaulay's Minutes, in 1835. Macaulay, in later evaluation an inflexible and arrogant young bureaucrat, once remarked, 'A single shelf of good European Library is worth the whole native literature of India and Arabia.'[11] The Government resolution based on that minute reads:

> His Lordship in Council [Lord Bentinck, the Governor General of India] is of opinion that the great object of British Government ought to be the promotion of European literature and science amongst the natives of India and that all the funds appropriated for the purpose of education would be best employed on English education alone.[12]

The authorities tried to introduce English in Calcutta Madrasa as a subject for study in 1826. However, not many students were found willing to learn English as Persian was still

the medium of administration in India. But in 1837 the colonial government replaced Persian with English as the official language.

The next milestone is Charles Wood's dispatch of 1854 in which it was stated that the nature of education was to be the 'improved arts, science and literature of Europe.' Very important was the recommendation to start three universities at Madras, Bombay and Calcutta on the model of London University. Government of England took over administration of India from the Company In 1857. The number of elementary schools in all of India leapt from 16473 to 82916, number of pupils went up more than three times from 607320 to 2061541, during 1871-81.[13] Hunter Commission (1882) felt that missionary efforts need not be encouraged. During 1901-02 and 1911-12, due to Lord Curzon's favourable policies the number of primary schools rose from 93604 to 118262 and students from 3076671 to 4806736.[14]

## SCIENCE: A VOICE UNHEARD

The British rule during the nineteenth century did not take adequate measures to help studies in European science and technology in India, despite many declarations, and instead focused more on arts and humanities. Till 1899 only the University of Bombay offered a separate degree in sciences. In 1899 Bachelor of Science and Master of Science courses were also supported by the University of Calcutta. By the late nineteenth century India had lagged behind in science and technology and related education. However, the nobility and aristocracy in India largely continued to encourage the development of sciences and technical education, both traditional and western.

While some science related subjects were not allowed in the government curriculum in the 1850s the private institutions could also not follow science courses due to lack of funds required to establish laboratories etc. The fees for scientific education under the British rule were also high. The natives who did manage to attain higher education faced issues of discrimination in terms of wages and privileges.

One argument for the British detachment towards the study of science in India is that England itself was gradually outpaced in science and technology by European rival Germany and a fast-growing United States so the prospects of the British Raj adopting a world class science policy towards its colonies increasingly decreased.

Further, it may be noted that the interests of British rulers were very clear; philanthropists might have seriously advocated in the British Parliament and elsewhere in favour of spreading the light of European science and literature in India, but it was not actually accepted by the rulers as prime motive. For them education was a veiled political programme. They wanted an English educated brigade that would help expansion of British trade and commerce, and would protect their business interest, and also reduce overhead costs of establishment. Macaulay declared in no uncertain terms that 'English means Money'. The British thought

was that this English education would help natives to earn money and rulers to make money. British capital was not eager to establish any industry worth the name in their colony (philosophy of market economy was altogether different at that time) and so rulers had no urgency to invest in meaningful science education.

The Calcutta Convention of the Indian National Congress (1906) resolved that 'Time has arrived for the people all over the country earnestly to take up the question of national education for both boys and girls, and organize a system of education, literary, scientific and technical, suited to the requirement of the country on national lines and under national control and directed towards the realisation of the national destiny.'[15] Bengal National College headed by Aurobindo Ghosh as Principal was launched in August 1906 by the Society for Promotion of National Education. The society, National Council of Education, was formed in that year by Sir Gurudas Bandopadhyay, Subodhchandra Mullick, B.N.Seal, C.R. Das, Satishchandra Mukhopadhyay, Rashbehari Ghosh, S.N. Banerjee, Rabidranath Tagore and others.

In 1911 Gokhale moved a private bill seeking compulsory elementary education for natives in the Imperial Legislative Council. His venture was appreciated but bill was not passed. Maharaja of Baroda, Sayaji Rao Gaekwad, meanwhile made primary education compulsory in his stateBy 1943, the Reconstruction Committee of the Government of India asked the education advisor of the government, John Sargent, to prepare a memorandum on post-war educational development. The Sargent Plan or the 'Post-war Educational Development Report 1944' was the last of the efforts undertaken by the British rulers to 'improve' education in India. It may be noted that, in 1946-47, number of secondary schools was 17258 and number of students enrolled was 3.6 million; whereas, primary schools were 1,72,000 with 13 million students.[16]

## Science: Education, movement and temper

Cultivation of scientific temper and fostering science culture are two important aspects of any science education movement. Let us enter into this section with Jawaharlal Nehru's idea of scientific temper**.** As he once said**, '**The future belongs to science and those who make friends with science.' Nehru considered science education to be rational, universally applicable and inspired by the eighteenth-century European Enlightenment. For Nehru, who was an agnostic, science education was not only an effective instrument for solving the economic problems of a developing society like ours, it also had to make India a strong and self-reliant country, a country free from false sense of pride and Brahmanical prejudices, with competent scientists and technicians. He insisted, 'It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people. . . Who indeed could afford to ignore science today? At every turn we have to seek its aid.' Part of this dreamt policy was the building of first-rate

scientific educational and research institutions that Nehru promoted himself – like the IIT's, CSIR, ICMR, ICAR – , and, those he promoted aided by business houses, like the IISC and the TIFR.

But what did he mean by scientific temper? It is noted that Nehru's emphasis on the need for scientific temper predated independence. The features of scientific temper were mainly two-fold as elaborated by an observer:[17]

1. Scientific temper referred to a mentality or an outlook rather than a specialized body of knowledge. It addressed itself to Universalist concerns of "values of life" rather than to narrow and specialized questions of scientific research and application.
2. Unlike scientific expertise alone, the project of scientific temper was a call for the diffusion of "science mindedness" throughout the population. The growth of scientific temper was measured by the extent to which ordinary people were using the methods of science to life's problems.

Clearly one may expect that science would not just play a role in building scientific expertise but also help reject superstition, prejudice and injustice. As Yashpal has noted, 'Science will also have to come forward in changing our thoughts and eradicating various social evils, including casteism, extremism…'[18]

India, in Nehru's vision, could become a great country if the people adopted such a 'scientific temper.' Nehru made no mistake in underlining the contradictions in the lives of scientists themselves who uphold science in the laboratories but discard science in everything else they do in their life.

Beyond Nehru's lifetime, our leaders of social and political bodies failed to understand the importance of propagating the concept of 'scientific temper' and it was reduced to a debate among intellectuals of various hues. As part of the 42nd Amendment to the Indian Constitution in 1976, 'scientific temper' joined the list of Fundamental Duties of every Indian citizen vide Part IV-A, Article 51-A (h): 'to develop the scientific temper, humanism and the spirit of inquiry and reform.'

A group of intellectuals led by P. N. Haksar released a 'Statement on Scientific Temper' in October 1980. It has been noticed that at the highest levels of governance phrases like 'Scientific Temper' are as a concept discussed with much fanfare and finally quarantined. (In his first Independence Day address to the nation from the Red Fort in 2004, Prime Minister Manmohan Singh also called for the promotion of scientific temper, which he added must become a 'national movement' and not a prisoner of bureaucracy or ideology – one example is perhaps not enough to convince uninitiated readers of the claim above). And the matter ends there!

A full and proper assessment of the impact of 'scientific temper' in our sixty-two years of independence is yet to be made.[19] It is beyond doubt that the Nehruvian idea of 'scientific temper' has not sufficiently penetrated Indian society.[20]

## Science in Society: The cultural context

Since the beginning of the 20th century the wave of Nationalism had influenced heavily the social, educational and cultural activities of the Indian sub-continent; consequently even the practice of science had come to acquire a nationalistic hue. The achievements of Jagadish Chandra Bose, P. C. Roy, C.V. Raman, Meghnad Saha, Satyendranath Bose etc were regarded as points scored against the colonial rulers.

Many of those scientists were gifted with their skill at communicating scientific ideas to the masses. They wrote both fiction and non-fiction in widely circulated publications, gave extensive public talks, and started popular science magazines. People like Bhudeb Mukhopadhyay, Akshoy Kumar Datta, Rajendralal Mitra tirelessly campaigned in favour of science education. Ramendra Sundar Trivedi practically dedicated himself to invent appropriate style to popularize science.

It would not be out of place to say a few more words on science fiction in Bengali. In 1879, Jagadananda Roy penned *Shukra Bhraman* (Travels to Venus), with imaginary descriptions of aliens that, notably, predated H.G.Well's *The War of the Worlds* by a decade. In 1882, Hemlal Dutta published the famous science-fiction piece *Rohoshyo* (The Mystery) in 'Bigyan Dorpon' (The Mirror of Science), a picture-heavy science magazine of the time. Jagadish Chandra Bose's writings on science topics had subtle literary flavour; he penned some scientific essays including the marvelous science fiction *Palatak Tufan*. Most of these essays were featured in his book *Abyakto (1903)*. This trend continued with literary works of Rajshekhar Basu ('Parashuram'), Hemendra Kumar Ray, Premendra Mitra, Satyajit Ray, Shirshendu Mukherjee and other literary giants. Fictional scientists like Professor Shanku and Dr Bhootnath Nondy have initiated a whole generation of Bengali-reading teenagers into the romance of scientific discovery.[21]

Contribution of Rabindranath Tagore in popularizing science is unsurpassable, and so he deserves special mention. In his book *Biswaparichoy* Tagore ventured to explain scientific discoveries of his time; he discussed in this book many a basic scientific principle. Both its content and approach, its lucidity enthralled general readers for decades. Following the ideals of Rabindranath, Viswa Bharati started publishing a series of monographs in Bengali related to science under the scheme Viswa Vidya Sangraha. Viswa Bharati also published also books on 'popular science' (e.g. *Padarthavidyar Nabayug* by Charuchandra Bhattacharya, 1951).

Rabindranath felt that the serious matters related to Bhattacharyya scientific and technical principles and applications general readers would like to learn if explained in a simple language. But, he cautioned, food for their thought must be nutritious as well as it being delicious; in the name of simplification, the essence of any subject must not be diluted. Another important contribution of this great thinker was his consistent advocacy in favour of mother tongue as the vehicle of education[22] even at the university level. He addressed the students at the convocation of Calcutta University in Bengali and that inspired the

university authority and the Bengal intelligentsia of that time to ponder over seriously the importance and usefulness of mother tongue as vehicle of education. University authority and a large section of the intelligentsia supported the scheme; they took initiatives to popularize science through books and journals in vernacular. They were, as was Rabindranath, aware of the fact that *paribhasha* (scientific and technical terminology and definition) was needed to realize that dream. A *paribhasa* committee started functioning to facilitate textbook and other writings. The scheme was later accepted at the national level with the patronage of the central government. In 1961 Commission for Scientific and Technical Terminology was constituted and Dr. D. S. Kothari was made its permanent Chairman. Admittedly, these men went beyond the narrow formulations of a nationalistic 'Indian' science.

After Independence, popular Science movement continued through many journals in India's regional languages following the footsteps of Bengal luminaries and who contributed immensely to the vitality of science education in India. Contribution of several science societies of India in propagating science culture, creativity and scientific temper is definitely noteworthy.

Kerala Sastra Sahitya Parishad (KSSP), established in 1962, is a movement for mass education woven around the theme of 'Science for Society.' In 1973-74 several teachers took to a campaign for setting up 'Science Clubs' in 1500 high schools. Rural Science Forums also emerged as a result of activities undertaken in 1974. With strength of several thousand teachers among its members KSSP organizes children's science festivals, publishes science journals and books for children, and organizes mass movement for quality improvement and mass literacy campaigns.

Hosangabad Science Teaching Programme (HSTP), started in 1972 by an organization called Eklavya in Hosangabad District of Madhya Pradesh with the help of the State Government. Unfortunately, this laudable Programme met with political opposition and on trivial allegations Madhya Pradesh government had withdrawn its support to it in 2002.

Centre for Science in Society under the Cochin University of Science and Technology in Kochin, Kerala is one such institute. The facilities available are described in its leaflet as 'A Combination of Rare Facilities for Children to Develop Interest in Science and Technology.' It began with a Science Talent Development Programme in the summer vacation of 1998.

People's science movement has been launched in several other Indian states (Karnataka, Andhra, Delhi etc.) after KSSP and hence such initiatives gained momentum. Agastya International Foundation, 1999 has devised a unique outreach programme; through its mobile laboratory Agastya has fuelled excitement of young learners in rural India.

Mediocrity, lack of autonomy, bureaucratic shackles and a general lack of inspiration have snapped these once-budding links between science and society in India. Support to

science education and research by private trusts and wealthy individuals was very common in 19-20th century India. Establishment of Hindu College set the ball rolling. Industrialist Rajen Mookerjee's patronage of the Indian Statistical Institute deserves mention. These grants were markedly different from the private model of scientific and technical education that has evolved in the Indian Union ever since, where people of wealth create low-grade institutions of science and technology largely as money-making machines. The contribution of private players towards research and development in free India is abysmal and dubious. In the name of Corporate Social responsibility big houses in this era of neo-liberalism offer support to government in social sectors, including education, but normally all such proposals bear a price tag.

There are many necessary pre-conditions to create a culture of science. These include freedom of speech and expression, a society that indulges intellectuals to be loyal only to truth, and an environment that supports arguments and counter arguments. If these things existed in India, a researcher has rightly claimed, many would have protested the arrogant and narrow-minded parade of *swadeshi* aerial bombers, tanks, missiles and devices of mass murder that continues to be used to hoodwink the people in the name of 'scientific achievement'.[23] The issue of National development propelled by science and technology is discussed presently.

## THE CENTRAL GOVERNMENT AND EDUCATIONAL PLANNING

### The Weak Base of Basic Education

The spirit of nationalism, at the time of independence, indeed influenced the teachers and learners, but, that did not help move the nation fast; the level of literacy was abysmally low - hardly 15 percent. Education curriculum, particularly school education curriculum, even after independence followed mostly the model set up by the British. The alternative models as proposed and practised by Gandhi or Tagore were found to be impractical, the resolution adopted in Wardah on Education, *Nai Talim*,[24] accepted in 1938 in Haripura Congress, was forgotten.

It may be noted that Gandhi wanted to reject the British form of education. Gandhi in a speech in London in 1931, had criticized severely the British education system that was being imposed on the people of India. He argued that education had been turned into a commodity in today's "consume all" society and we should not assess value of education in the same manner as we assessed the value of land or stock market shares.

However, importance of eradicating mass illiteracy was well understood. Free India was committed to provide free and compulsory education to all children until they attain the age of 14 within a period of ten years from the commencement of the Constitution.[25]

India's commitment towards universal basic education was no exception, children's rights to education all over the world has been a major concern of civilization. Universal Declaration on Human Rights (UDHR) - 1948 has stated that, 'Everyone has the right to Education. Elementary Education shall be free and Compulsory (sec 1). Parents have

prior right to choose the kind of education that shall be given to their children (sec 3).' (Of course India's commitment inspired other countries and world bodies.)

Looking at Table 1 one can clearly see a respectable growth in literacy in the past half century. However, despite improvement in literary rate, it is indeed a shame that even after six decades of independence, the nation is yet to achieve full literacy. We may note that, in his inaugural speech in the first meeting of Governing Council of National Mission for SSA, held in New Delhi 21 February, 2005, the Prime Minister said, 'Our country must become fully literate. I do not want to specify time-frame for this, as we have already done so many times. Slogans like 'Health for All', 'Education for All' and suchlike have been given before and deadlines set – by 1980, by 1990, by 2000 and so on. We give dates that have lost meaning. We need education for all today.'

Table 1. Literacy rate in India – 1951-2011

| Year | M | F | Total |
|---|---|---|---|
| 1951 (5+) | 27.16 | 8.86 | 18.33 |
| 1961 (5+) | 40.40 | 15.35 | 28.30 |
| 1971 (5+) | 45.96 | 21.97 | 34.45 |
| 1981 (7+) | 56.38 | 29.76 | 43.57 |
| 1991 (7+) | 64.13 | 39.29 | 52.21 |
| 2 001 (7+) | 75.26 | 53.67 | 64.84 |
| 2011 (7+) | 82.14 | 65.64 | 74.04 |

Census of India, various years.

We also must not fail to note that the education we offer is neither 'good' nor 'effective'. This education failed to instil the scientific temper or culture in the young minds.

## Education policy in independent India

For proper educational planning the University Education Commission, under the chairmanship of Dr Radhakrishnan, was formed in 1948. The Commission rightly recommended the need to reorganize secondary education, since that was the feeder to higher education. Following that recommendation Secondary Education Commission was formed in 1952 under A.L. Mudaliar.

In addition to the two Commissions mentioned above there have been many Commissions and Committees constituted since independence. Among them the Education Commission, 1964-66, to be referred as Kothari Commission hereinafter, deserves special mention because the report of this commission touched upon almost every aspects of education at all levels.

Kothari Commission categorically advocated for 'good and effective education', and emphasized, among other aspects, **'**cultivation of science and scientific temper'. It recommended that science and mathematics should be an integral part of general education till the end of school stage (10 years of schooling). The importance of science teaching is

explained in this report. Report states[26]: Science strengthens the commitment of man to free enquiry and to the quest for truth as his highest degree and obligation; it loosens the bonds of dogmatism and acts as a powerful dispeller of fear and superstition, fatalism and passive resignation.

The report states, 'With a view to accelerating the growth of national economy, science education and research should receive high priority. Science and mathematics should be an integral part of general education till the end of the school stage.'[27]

Elsewhere in the report the commission says, '… The greatest contribution of Europe doubtlessly is the scientific revolution. If science and *ahimsa* join together in a creative synthesis of belief and action, mankind will attain a new level of purposefulness, prosperity and spiritual insight. Can India do something in adding a new dimension to the scientific achievement of the West?'[28]

This question raised by the commission still remained unanswered. We do not know if anybody ever ventured to add the coveted new dimension.

Some important observations and recommendations of the commission may be noted here.[29]

- The aims of teaching science in the primary school should be to develop proper understanding of the main facts, concepts, principles and processes in the physical and biological environment. More emphasis should be laid on the deductive approach or the use of scientific method.
- In the lower primary classes, the focus should be on the child's environment – social, physical and biological.
- At the upper primary stage, the emphasis may shift to the acquisition of knowledge together with the ability to think logically.
- A science corner in lower primary schools and a laboratory-cum- lecture room in higher classes at schools are minimum essential requirement.
- At the secondary level, science as a discipline of the mind and preparation for higher education deserves special emphasis.
- From class 5 onwards the Indian almanac should be studied by observation of night sky; earth science should be introduced in the secondary school.
- It would be worthwhile to have a few secondary schools attached to some of the universities for the purpose of experimenting with dynamic school programme under the supervision and guidance of the university faculty.
- The close connection between science and agriculture and industry should be stressed even at the early stage.

- A weak feature in the present system of teaching is laboratory work, where the approach is confirmatory and not investigatory.
- Demonstration experiments performed by the teacher, or by selected students under the supervision of the teacher, should form an integral part of science teaching.
- The quality of science teaching has also to be raised considerably.
- The central government engaged a review committee to look into the recommendations of Kothari Commission and consequently National Policy on Education 1968 was framed. Despite all these policies and promises, coupled with help rendered by International organizations, the government failed to light the lamp of basic education in every nook and corner of the country.

## Education in Five-year Plans: Low priority?

The theoretical recognition of the centrality of education is apparent. In their mid-term appraisal report of the 10th Five-year Plan, the Planning Commission said that 'The government recognized education as a critical input in human resource development and in the country's economic growth'. Nevertheless, the primacy of economic growth perhaps blurs their view of the wider connection of education as a moral obligation of a nation to its people. This resulted in creating a gap between what was promised and what was delivered.

Let us now take note of the underlying principles of the past several 5-year plans, as they apply to science education

In the 2nd Plan (1956-61) there was stress on basic education and improvement in the curriculum of secondary education, in science education and in the quality of higher education. By 1960-61, students entering science courses had increased from 33 percent to 36 percent.[30]

Greater emphasis was laid on science education in the 3rd Plan (1961-66) and the objectives were to take the percentage of students entering science courses in secondary education to at least 42. Large provisions were earmarked for equipments and laboratories.

Undoubtedly, serious governmental endeavour in accelerating the literacy drive was observed during 7th plan period (85-90) based on NPE 1986. Interestingly, it was observed, more stress on achieving higher literacy rate at a quicker pace had inspired the state governments to remain forgetful about the quality of education.

Programme of Action 1992 called for 'a planned expansion of secondary education facilities all over the country'.[31] During Ninth Plan the central government promised that special measures would be taken for better teaching of mathematics and science with new popular source books, and by linking the subjects to the immediate environment of the child.

Neither the philosophy and guidelines of the planning bodies nor the recommendations

of committees and commissions, could help realize the dream of the nation regarding basic education including science education.

### Science Education in India: The role of international agencies

The University Grants Commission (UGC) and the National Council of Education Research and Training (NCERT) launched many science projects in collaboration with USAID and National Science Foundation (NSF) of USA. They organized summer science Institutes from 1963 to 1972 in order to introduce latest developments in science and new methodologies for teaching science to the Secondary school teachers. In 1969, assisted by UNESCO and UNICEF, a Science Education Project was started that covered 500000 schools, 2500000 teachers and 87,000,000 students.[32]

'Strengthening of Science Education' was a programme in the late fifties and early sixties in which Ford Foundation assisted in establishing extension centres in existing teaching centres for giving in-service training to teachers in science education. The department of Science and Maths Education was set up in 1962-63. In the interest of promoting science education in schools, UNESCO and UNICEF provided experts, fellowships and funds for the development of science and mathematical education. State institutes of Science Education were set up in all the states for planning and improvements in science programmes in schools. In 1969, a pilot project called Science Education Project, with assistance from UNESCO and UNICEF, was started at all levels of education in the states and UTs. Again, UNESCO and UNICEF assisted in setting up the Centre for Educational Technology in Delhi which was responsible for preparation of educational materials for the Satellite Instructional Television Experiment (SITE) in 1975. This had to be given up for lack of finances.

## UNIVERSALISATION: A PRE-REQUISITE FOR SCIENCE EDUCATION

### The global connection and the Indian context

The world conference in March 1990 in Jomtien, Thailand considered the issue of Education for All (EFA). The conference declared that its goal is to be achieved by 2015. In April 2000 the World Education Forum met in Dakar (Senegal) where representatives of 164 countries were present. Forum reaffirmed the EFA goal. The 'Dakar Framework' as it was termed, gave a call to all countries to adopt policies to provide 'quality basic education'.

Kofi Annan, the former Secretary General of United Nations in its forwarding note in the document *The State of the World Children 2004*, wrote, 'Two of the Millennium Development Goals – agreed by all the world's countries as a blueprint for building a better world in the 21st century – focused on education for girls and boys alike.'

Since the introduction of New Economic policy, rather to usher the policy, the government had to recognize some important social ills. Malnutrition and illiteracy naturally

occupied two top slots in the priority list. In order to accelerate literacy drive of the state in one hand and to eradicate malnutrition at early ages on the other the government commissioned a few major projects, namely Mid-Day Meal (MDM) and Sarva Siksha Abhiyan (SSA). It may not be wrong to say that both judiciary and the world market compelled the government to take some expeditious steps in this direction.

The *National Programme of Nutritional Support to Primary Education*, commonly known as *MDM* project, was launched as a centrally sponsored scheme on 15th August 1995 with a view to enhance enrollment, retention and simultaneously improving nutritional levels among children.

*The Sarva Shiksha Abhiyan (SSA),* launched in March 2002, was a proclaimed commitment to universalisalising elementary education, with ensured quality and the opportunity for social justice. The goal of SSA was to provide meaningful elementary education for all children (in the age group 6-14) by 2010; this required bridging, gaps created by various divisions – social, economic, regional, ethno-linguistic and gender gaps therein. This could only be achieved with the active participation of the community in school management inter alia public interventions.

Broad Strategies of the SSA are as follows:

- The central and state governments will undertake reforms in order to improve efficiency of the delivery system.
- SSA envisages cooperation between teachers, parents and PRIs, as well as accountability and transparency to the community.
- Education of girls, especially those belonging to the SC and ST and minorities, will be one of the principal concerns of the SSA.
- There will be a focus on the inclusion and participation of the children from SC/ ST, Minority groups, urban deprived children, children with special needs, in the educational process.
- SSA recognizes the critical and central role of teachers.
- SSA is based on the premise that financing of elementary education interventions has to be sustainable.

*The 11th Five-year Plan* promised to take this inherited – though yet unfulfilled – commitment farther with *SUCCESS* (the *Scheme for Universalisation of access to and improvement of quality of Education at the Secondary Stage*), thus emphasising secondary education as the thrust area in this Plan period. The goal and objectives of the scheme includes, among many components, Science and Mathematical education, construction of laboratories and the strengthening of laboratory facilities. In fact, the National Policy of Education (NPE) 1986 (modified in 1992) stated that, 'Access to Secondary Education will be widened with emphasis on enrolment of girls, SCs and STs, particularly in science, commerce and vocational streams.'

### Right to Education: Legal safeguard of a moral commitment

The Right to Education Act 2009 is a landmark in the history of education and rights movements in India. The General Council of United Nations in 1989 accepted the resolution of Convention of the rights of the Children (CRC) in which it was declared that, 'The child is entitled to receive education, which shall be free and compulsory at least in the elementary stages. He shall be given an education which promotes his general culture and enables him, on a basis of equal opportunity, to develop his abilities, his individual judgment and his sense of moral and social responsibility and become a useful member of the society.' The Government of India endorsed it in 1992, despite its constitution commitment to gender equity, and the unfortunate embodiment of male privilege in the phrasing of the resolution.

The 86th Amendment of Indian Constitution, 2002, sought to make free and compulsory education a Fundamental right to all children by inserting a new article 21-A in part III (Fundamental Right). The new Article 21A reads as follows: 'The State shall provide free and compulsory education to all children of the age six to fourteen years in such manner as the State may, by law, determine.' It will not be inaccurate to say that it was the logical conclusion of the verdict given by the apex court in the case between Unnikrishnan vs the State of Andhra Pradesh in 1993. Pre-primary education before the age of six years has been taken away from the ambit of fundamental rights (through the exclusion of this age-group from the purview of the Act). It has, instead, been placed in Art 45, which after amendment reads: 'The State shall endeavour to provide early childhood care and education for all children until they complete the age of six years.'

## SCIENCE EDUCATION IN SCHOOL: A THEORY-PRACTICE MISMATCH

Undoubtedly, the makers of new India understood the importance of school science education in piloting the country to a better world in terms of wealth, wisdom and free thinking. The broader policy towards school science education however remains confused at best, though, there were recommendations based on analysis of the expert committees in the hands of the government.

Many individuals also placed their valuable suggestions. The noted scientist J.V.Narlikar underlined the importance of science education. He claimed that propagation of science education needed 'To combat hoax of astrology, ill-conceived tradition etc, miracles, and superstitions.' To make science education at school more effective and productive, Narlikar suggested, we need to encourage science exhibitions and science parks and exploratory as these are good options to propagate scientific knowledge.[34]

The main weaknesses of science education in India have been categorised as (a) the style of introducing science/mathematics at the primary level; (b) the glaring divide in quality of science education in urban vs. rural schools; (c) the acute shortage of competent teachers and the vicious loop of bad education spawning bad teachers.[35]

## Provisioning for elementary education

Persistent under-provisioning for education, elementary education in particular, has resulted in a large cumulative gap. The Kothari Commission stated that the state must invest adequately in Education. Annual outlay, the Commission recommended, should be equivalent to 6 percent of GDP. It never happened.

Table 2. Public Expenditure on Education in India (as % of GDP)

| 1970 | 1985 | 1995 | 2000 |
|---|---|---|---|
| 2.5 | 3 | 3 | 4 |

Source: Jha, Praveen et al, *Public Provisioning for Elementary Education in India*, SAGE, New Delhi, 2008, p-39, pp 195 -7.

The Tapas Majumder Committee (1999) stated that additional funds for Universal Elementary Education of Rs 1,36,922 crores, at constant prices over 10 years (1998-99 to 2007-08) would be required.[36] The National Knowledge Commission reiterated that the state must spend no less than 6 percent of GDP in education sector. Government in principle accepted that the expenditure level has to be enhanced; and in budget papers we find that allocations in this field have remarkably been increased in recent past. However, it never achieved the level of 6 percent of GDP and actual expenses in education are found to be much less than Budget Estimates regularly. In this context it is amply clear that claims for more funds for school science education would not find favour with the government. Now the question is: can we plan better school science education with such financial constraints as prevailed in India? If we seriously consider the suggestions put forward by Bhabatosh Datta Commission (discussed subsequently) we can emphatically say – yes, money is no big problem, problem is our attitude. On the other hand, science and Technology has attained such a height that to meet the natural quests of the present-day learner we need to build good laboratories, planetarium, science cities, museums etc, we need to organize science fairs, 'explanatory' etc as envisaged by Prof. Narlikar and many others. Those who have been trying hard to propagate science education may carefully redraw the roadmap, by accepting Indian reality as regards availability of funds, to achieve the target without diluting the mission.

## The National Knowledge Commission: A paradigm shift

The recognition of a paradigm shift in education is manifested in the establishment of the National Knowledge Commission, and endorsed by Dr. Manmohan Singh, the Prime Minister of India: 'The time has come to create a second wave of institution building, and of excellence in the fields of education, research and capability building'.

The National Knowledge Commission (NKC) was constituted on 13th June 2005. In its report to the nation NKC categorically stated, 'Unfortunately, as the economy grows, fewer students are opting for the pure science. We are aware that this is a worldwide phenomenon.' NKC felt that to rejuvenate science education and research in the country effective steps should be taken immediately to attract more students in mathematics and science. To achieve this, 'NKC has recommended launching a massive science outreach program, upgrading available infrastructure, revitalizing the teaching profession and revamping teacher training at all levels.'

NKC underlined a few more steps to rejuvenate science education programme some of which are stated below:

- A science popularization program should be launched to effectively cover children across India.
- Each school should be funded to open a science club.
- A National Science and Mathematics Mission should be constituted. – What do they propose to do?
- The country needs many more child friendly science magazines.
- TV programme like 'Turning Point' and 'Quest' should be promoted.
- Programme like Vigyan Manthan Yatra of the Madhya Pradesh Government etc., should be replicated across India.
- Mobile laboratory and mobile library programme need to be designed properly so as to popularize science across the country.

We find in this report the following statement along with its recommendation: NKC feels that in view of the disappearing boundaries between various disciplines of knowledge and knowledge emerging as a continuum, India should set up a National Science and Social Science Foundation(NSSSF) which will look at all knowledge as one seamless entity. We will be the first country to set up such an *avant garde* organisation – and rightfully so, given our 5000-year-old tradition of broad-based knowledge. The objectives of the proposed NSSSF will be to: a) Suggest policy initiatives to make India a leader in the creation and use of new knowledge in all areas of natural, physical, agricultural, health and social sciences, with emphasis on those areas which cut across traditional disciplines; b) Ensure that science and technology are maximally used for betterment of the lives of our people; c) Develop a scientific temper.

NKC has certainly paid due attention to the importance of science education. But there are reasons which lead one to believe that the commission has practically recommended overhauling of the Indian education system in order to create a knowledge society that would support the development strategy of the market. There are many takers of such education policy as envisaged by NKC, but there are people who contradict the philosophy

of development concept and hence oppose such development-oriented education policy (discussed presently). We shall discuss this point in the next section.

## The India Science Report (ISR) 2004: Glaring evidence of neglect

This report was prepared by National Council of Applied Economic Research (NCAER) at the behest of Indian National Science Academy in order to focus on science education and related matters. It was a pioneering work. 'The ISR is an ambitious project that is intended not as an event but as a process, of which this first report is the beginning', claimed the authors. But, unfortunately, as far as our knowledge goes, such an outstanding work no one, individually or institutionally, cared to continue further.

Some important observations and recommendations recorded in the ISR we need to take note of.

a) Mathematics remains the most preferred subject, with a third of students in classes six to eight rate it as number one, and over 21 percent still feeling the same way in classes 11 and 12.

b) At the class six to eight level, 22 percent of students said they would like to study pure science at higher level of education. Yet, when it came to students in class 11 and 12, just 13.4 percent wanted to study pure science at the graduate/postgraduate level.

c) While close to two-thirds of students in classes six to eight are satisfied with the quality of science teaching, this falls to just 40 percent in classes 11 and 12.

Table 3 presents clearly the preferential difference of subjects by students, as they progress through the school system.

TABLE 3: Preferred subjects of students (in per cent)

| Subjects | Level of education | | | | All |
|---|---|---|---|---|---|
| | 6-8th | 9th | 10th | 11-12th | |
| Physics | 2.0 | 1.8 | 3.1 | 10.1 | 6.3 |
| Chemistry | 1.0 | 2.1 | 1.3 | 7.1 | 4.3 |
| Mathematics | 32.6 | 31.8 | 34.8 | 21.1 | 27.2 |
| Biology | 7.2 | 6.3 | 8.4 | 12.3 | 10.0 |
| Humanities and Social Sc | 17.8 | 16.8 | 13.9 | 17.1 | 16.4 |
| Com Sc | 0.5 | 0.4 | 0.6 | 1.0 | 0.8 |
| Other subjects | 29.3 | 28.4 | 26.0 | 28.1 | 27.8 |
| None | 9.5 | 12.4 | 12.1 | 3.2 | 7.3 |
| Totals | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: NCAER's Science Survey 2004, ISR 2004, Table 2.13

d) ISR shows that the proportion of those enrolled in science courses has gone up from 28.8 percent of the total enrolled students in 1995-96 to 34.6 percent in 2003-4. With an increased number as well as proportion of students enrolling for science education – 28 percent of all enrolments at the post graduate level were in the scientific field in 1995-96 and this went up to 31 percent in 2004 – it is difficult to believe there is any sense of crisis in the science education scene in the country. Indeed, over three-fourths of teachers polled in the National Science Survey-2004 were of the view that science education is growing.Children of cultivator background tend to study arts courses a lot more than those whose parents are salary earners or businessmen. Those in rural areas also tend to go in more for arts than those living in urban areas. The level of education of parents influences the choices their children make.

The reasons for disinterest in science drew differently from different constituencies: While one-third of the students reportedly did not find any motivation to study the sciences, another 40 percent raised the issue of overcrowded classrooms, that makes teaching and learning difficult; on the other hand, half the teachers interviewed were more concerned about the physical infrastructure and material 'lacks' of science education - computers, laboratory equipment and so on. Only 15 percent of them felt that the centrality of effective teacher-training; a mere one-tenth (11 percent to be exact) felt the need for simplification of the course content. It might be interesting to note here that television remains the primary source (57 percent) of information in the country. Nearly 65 percent of science news in India is got from visual media.

We have already noted that NKC categorically stated that fewer students are opting for pure science and that is a worldwide phenomenon. So, observations recorded in ISR regarding non-existence of any crisis in science education in India are not acceptable.

Findings are unique in that no comparable data exist for the country prior to the 1st ISR and after it. But, there is no state-wise report and hence its essence may not be acceptable to all parts of the country, experiences may be very different in many states. West Bengal was once, as we all know, the torch-bearer of science education and culture. And, therefore it will not be bad if we examine some all India findings as stated above in the light of West Bengal experience.

## West Bengal in the India Science Report

In West Bengal one of the major problems in education is private tuition. Private tutors in Mathematics and English are much sought after persons. Yet, enrolment statistics from the West Bengal Council for Higher Secondary Education show that the most preferred subject amongst students is History. It is true that no survey is ever made in this state to assess the independent choice of students, and equally true that their parents consider employability as education's ultimate goal, thus trying to induce, if not force, them into 'suitable' streams or subjects. However, social hegemony also plays a role in the low

enrolment in high-school science. Several members of the lower castes and classes have internalised – through felt experience – the idea that science is an exalted upper class preserve, well beyond their own 'natural' capabilities.

Obviously a large section of students who are in science stream at plus two levels sit for the JEE, or the joint entrance examination for medical and engineering degrees. About two decades ago a group of researchers of IIMC reported that more than 80 percent of parents in this state, irrespective of their profession and educational background, wish their children secure a white-collar job. Now, it is true that it is very difficult to get serious and dedicated students in the pure science at degree level. But, it may not be true in this state that students of rural areas are less motivated than their friends in the urban areas in pursing pure science courses. We do not have any documentary evidence at hand in this regard; however one may, looking at school enrolment statistics of science subjects of the districts like Purba Medinipur or Hoogly, claim something different. Other factors such as cut-off marks, availability of science-education facilities and teachers, and the quality of education must also be taken into account.

If the government fails to provide appropriate infrastructure it is useless to talk of good and effective education. The physical and human resource in the state's education field has been deteriorating fast, the presence of para/part-time teachers in huge number at every stage, lack of teachers' training, political interference etc. have definitely put a big question mark on the quality of education in West Bengal. There is no reason to be satisfied with the quality of education.

Scrutinizing data of university enrolment it is observed that the students enrolled in West Bengal for undergraduate science stream remain at about 14 percent of the total enrolment during last 5 years and the trend is negative (see Table 4). Crisis in the science education in the state is obvious.

Table 4. Student enrolment at UG and PG level in West Bengal

| Year | No of students enrolled at UG and PG level | No of students pursuing Science & Engg | % of students pursuing Science | % of students pursuing Engg |
|---|---|---|---|---|
| 2000-01 | 590254 | 124669 | 18 | 2.7 |
| 2001-02 | 622467 | 133221 | 18 | 3.4 |
| 2006-07 | 802440 | 172587 | 15 | 6.7 |
| 2007-8 | 833113 | 171399 | 14 | 6.5 |
| 2008-09 | NA | NA | NA | NA |
| 2009-10 | 944693(UG) +94980(PG)= 1039673 | 126436(UG)+ 20710(PG) = 147146 | 14 | 7.5 |

Source: Annual Report, Dept. of Higher Education, Govt. of West Bengal

It may also be noted that percentage of science teaching colleges in the districts to total number of science teaching colleges in the state, during the period 2007-08 to 2009-10 varies from 1.16 (South Dinajpur) to 17.83 (Kolkata). North-south divide is also very clear in this regard – North Bengal is deprived.

**The Cultivation of Science in Society**

The NCAER's India Science Report mentioned earlier underlines a social perplex: despite poor interest in science and technology programmes, most Indians have great faith in science (p. 37). This professed 'faith' is not exactly good news. If most Indians have poor interest in science would it be prudent to depend much on their 'great faith in science'? Or, should we 'ignore the ignorant'? Unscrupulous state power may exploit the ignorants' great faith in science. Pierre Curie once gave such a caution which failed to attract much attention and subsequently mankind had to witness the devastation caused by progress in nuclear physics.

Second, Public Understanding of Science & Technology (PUST) enables people to understand the scientific basis of modern society so they can play an active role in social debates. The high level of illiteracy and low levels of income in the country have not prevented Indians from having very high levels of interest in a whole range of social issues as well as a reasonably good knowledge of scientific and other events. The fact even the illiterate are reasonably aware of various natural phenomenon is a testimony to the fact that the traditional knowledge is still alive.[38]

It is very difficult to believe that a science report may convey such a fanciful story and for a modern society it is not easy to accept that without questioning. It is true that the conclusions arrived at were based on the survey conducted by the NCAER and hence, we cannot but question the methodology of the survey.

We have noted earlier that cultivation of scientific temper and science culture and science education received tremendous support from Nehru in free India. At the same time, we need to say, at least, that he had overemphasized the importance of science and technology in economic development of the country. We may note that the scheme of Five-year plan was aimed at improving the living standards of the people by making judicious use of natural resources.

On 12 April 1948 Nehru laid the foundation stone of the dam, Hirakud (for the second time), and named it the temple of modern India. He was in fact affirming a commitment to modernization and socialism in post-independence India. And the nation conveniently remained silent over the plights of thousands of displaced persons, destruction of biodiversity etc. But why blame Nehru alone? New world economic strategists are pursuing practically same development models with more vigour. Environmentalists and rights-groups all over world have been contesting the very basics of such development models. They do have enough evidence in their favour. In 1960s the Indian state supported with

much fanfare the scheme of green revolution. Dramatic increase in growth rates of some crops made Dr Swaminathan, main architect of green revolution, a national hero. But, within two decades looking at the depleted ground water table and other environmental crisis, pollution, health hazards people started realizing the adverse effects of green revolution. Even Dr Swaminathan practically admitted that the scheme green revolution was a mistake. No simple mistake it was, losses are irreversible and more importantly exponents of such development ideas, including Dr Swaminathan, continue to stick to their guns.[39]

To democratically discuss questions of growth or development in context of their long-term effects on people and society, we need to prioritise the cultivation of scientific temper and scientific culture with due emphasis. Of course, science education is important in itself, but its role in nurturing informed debate in our technological age cannot be over-emphasised. And for that matter we should encourage propagation of science education. Moreover, designing science education in the modern perspective is a big challenge for our society. It cannot be left at the mercy of the state alone.

## STATUS OF SCIENCE EDUCATION IN WEST BENGAL: MILES UNCOVERED

At the time of independence West Bengal was far ahead of other states in India in the field of education. As regards literacy rate it was placed next to Kerala and as regards the learning achievements it was certainly quite high. It is universally acceptable a fact that once Bengal was the bedrock of science education and naturally it was far ahead of other parts of the country in this context. It was not simply a by-product of National Education movement; it was a separate movement in itself – of course, it has its root in the so-called Bengal Renaissance. Stalwarts of various branches of our society untiringly helped building up consciousness in this regard. We have discussed in the preceding sections the contribution of Bengal in propagating science education before independence.

After Independence, in West Bengal Satyendranath Bose, ably assisted by another unsung hero of people's science movement, Gopal Chandra Bhattachayya, created the *Bongiyo Bigyan Parishad* (Bengal Science Council) in 1948 and they also started a science magazine called *Kishor Gyan Bigyan* (Knowledge & Science for Youth). Despite best efforts and the social clout of Satyendranath and his associates (last of the Mohicans!) popular science movement could not be sustained in West Bengal.

It is very saddening to note that the West Bengal intellectuals and social activists practically kept themselves away from any sort of science education movement after 1960s – at least no sustainable collective effort was visible.

Exceptions were there indeed. In the 1970s and 1980s in West Bengal, rationalist publications such as *Utsa Manush* (Human Origin) sparked 'science and rationalism' groups. But, that was in no way a popular science movement. The *Paschim Banga Vigyan Mancha*

started its journey in 1980s in order to launch another wave of popular science movement. Unfortunately, this did not succeed in gaining a momentum required for transforming it to a real movement. What made this endeavour unfruitful is certainly a question of inquiry. Was it simply political, as some from the non-left-front quarters allege? Or was it rooted in the very social structure of the state? These are difficult questions to answer and need serious examination.

What is, however, certain that after independence science education movement lost its momentum slowly and systematically. Neither the civil society nor any dedicated organization / person took any noteworthy initiative in West Bengal to keep the movement alive. It was practically left to the benevolence of the government and its bureaucracy to carry the baton. For the government science education was only a tiny part of its total education programme. One may argue that if the government fails in its duty to spread the light of education, elementary education in particular, science education would certainly meet gross neglect and the destiny is quite visible. Now the question is: did the government fail in its duty for reason whatsoever?

There is a popular claim that the performance of the state of West Bengal in the field of education, particularly since 1970s, has been found languishing. Some even take this date back to the partition in 1947. Whatever be the 'cut off' date, there is hardly any lack of consensus on one issue: West Bengal failed to retain its place of glory in the national educational map. In other words wb failed to capitalise and build up on the advantage that it had historically acquired – the advantage of being the epitome of intellectual churning. And this resulted in the poor state of science education. We shall in particular consider the status of education and science education simultaneously.

In the year 1992 the government of West Bengal constituted a commission, led by Dr. Ashok Mitra, to study the status of education in the state and to recommend measures to be taken for the improvement. The findings of this commission, based on state government data, were taken by some quarters with scepticism. Some critiques alleged about certain pro-government bias in the report, which tended not obscure the failures and weaknesses of government policies. On the other hand some blamed the government for not caring much to implement the recommendations of the report. Despite the debate on the substance of the report there is no much doubt on one issue: the commission did not consider the status of school science education at all.

However, the previous education commission, commonly known as Bhabatosh Datta Commission, 1984 did discuss the issue though it was not within the purview of that commission. Commission observed that science teachers encourage cramming and do not emphasize the basic techniques of science. Datta Commission opined that the problem is not finance or lack of a grand laboratory. School geometry box, a few weights, a pendulum, a few lenses, lamps and prisms, some wires, batteries and bulbs, … scalpels and blades, pebbles and crystals, models and charts – these are enough … ponds, … trees, flowers and

fruits, … animal, fishes, birds… insects… rain... sky – the laboratory of nature is everywhere…[40]. The commission lamented that the practice of classroom demonstration had practically disappeared in West Bengal.[41]Unfortunately, the state government took no action on the Datta Commission report, and swept it under the carpet.

The *15th Joint Review Mission (JRM)* of the *Sarva Shiksha Abhiyan* (SSA) reviewed the progress made by the State in implementing SSA and the results with respect to the overarching goals of SSA. The West Bengal School Education system is a multi-layered structure with great complexities. All schools in this state, apart from schools affiliated to Delhi Board or Central Board, fall under the jurisdiction of the following bodies: Primary Board, Secondary Board, Higher Secondary Board, Department of Panchyati Raj (SSK-MSK).[42] The schools are mostly government aided; there are very few entirely government or entirely private schools.

We gathered a handful of information from that report and this information will give some indications of the strength and weaknesses of the elementary education system and infrastructure prevailing in the State of West Bengal. These have been outlined below:

- The formulation of the rules for the RTE Act was still under consideration by the government during the JRM visit (however, the Rules were finally framed in April 2012).
- Estimates of Out of School Children (OoSC) were still not settled and were assumed, from other data, to be quite large. As per the household survey (HHS), carried out by the State SSA, OoSC in the State had reduced from 13 lakhs in 2006 to 2.4 lakhs in 2010. However, the 2009 repeat survey of OoSC by SRI-IMRB had estimated this figure to be 7 lakh (5.25 percent). The discrepancy is wide enough to require re-examination of the data, but the numbers are still worrying.
- The State has no information on migrant children.
- As per the 2010 HHS the estimated OoSC among various social categories was 7.6 percent for SC, 5.2 percent for ST and 6.9 percent for Muslim. Murshidabad, Uttar Dinajpur and Purulia together carry large share of OoSC.[43] Two districts have low ST enrolments and larger dropouts among Muslim and General category boys.[44]
- The extent of high Student-Classroom Ratio (SCR) and Pupil-Teacher Ratio (PTR) is large in the state, and are unable to comply with the RTE norms. And the regional variations make the average shortfall more acute. There are 76,861 primary schools including 16,100 SSK and private schools. At the upper primary level there are 14,952 schools including 1920 MSK. 1341 MSK are building-less as compared to 39 government and government-aided primary building-less schools. Around 30 percent of primary schools have two or less rooms. The ratio of primary to upper primary schools primary schools in the State is highest in the country at 5.13.

- While enrolments in class I remain around 25,00,000 unchanged over the last ten years, upper primary enrolments (all classes) has increased from about 35,00,000 in 2001-02 to over 65,50,000 in 2010-11, over 30.5 lakh increase over the last ten years. If upper primary system is not strengthened immediately, it is apprehended that high transition rates will lead to push outs.

## Progress towards achievement of goals

The State had got approval for establishing 5676 new upper primary schools (mostly by upgrading primary schools) during the period 2007-08 to 2009-10 but only 1884 schools were built. MHRD had not sanctioned the spill over money for the schools even after hurdles have mostly been overcome by the state.

Table 5: Teachers' availability

| | Enrolment 2010-11 | Regular teachers | Para/contract/ SSK teachers* | PTR | Teacher requirement as per RTE | Net Teacher requirement |
|---|---|---|---|---|---|---|
| Pry. Schools | 6050421 | 174346 | 21439 | 34.7 | 207061 | 32715 |
| Upper pry. Schools | 6140996 | 92350 | 27546 | 66.49 | 157325 | 64975 |
| SSK | 1425236 | 0 | 46758 | 30.48 | 53861 | 53861 |
| Total | | 266696 | 95743 | | 418247 | 151551 |

Source: Report of 15th JRM.* This estimate does not include the MSKs. Para teachers not counted in last two columns.

State's estimations of transition from primary (grade IV) to upper primary (grade V) show an increase in transition for girls as compared to boys. However transition rate as per DISE data for grade V to grade VI has decreased both for boys and girls and for girls by 3.7 percentage points.

Teacher availability: for primary and upper primary schools in West Bengal there is a total requirement of 4,18,247 regular teachers according to RTE norms. Now there are 2,66,696 regular teachers in place. This leaves a shortage of 1,51,551 regular teachers; for Upper primary section only there are nearly 65000 vacancy. In this State 95,743 para or contract teachers are working in regular vacancies.

Despite SSA norms of recruiting 50 percent science graduates for upper primary sections, the visiting JRM team found a very few teachers having degree in science/ mathematics. The team observed that the schools they visited were not offering Science at the HS level. If this problem is not taken care of, the Mission apprehended, science graduates would decrease in number. The report reads, 'It is a matter of great urgency that higher secondary as well as secondary and primary schools be equipped with science teachers and promote the offering of science at the higher secondary level from now on.'

We need to study this point a little further with the help of the data available from WBCHSE.

In West Bengal total number of HS schools with science stream is 4653 in 2011; out of these 4653 schools 1457(31.3 percent) offer physics as a subject to study; students can study pure science in 1766 (38.0 percent ) schools and Bio- science in 1973 (42.4 percent) schools (see table 5A).

Table 5A. Scope of pursuing pure science at Higher Secondary level in West Bengal

| North Bengal Districts | Pure Sc % | Bio-Sc % | South Bengal Districts | Pure Sc % | Bio-Sc % |
|---|---|---|---|---|---|
| Uttar Dinajpur | 13.9 | 18.3 | Paschim Medinipur | 55.4 | 60.0 |
| Kochbihar | 15.2 | 16.6 | Purba Medinipur | 49.2 | 55.3 |
| Darjeeling | 15.7 | 26.9 | Hugli | 48.2 | 53.2 |
| Dakshin .Dinajpur | 20.7 | 22.0 | Bardhaman | 47.7 | 50.4 |
| Malda | 23.3 | 25.3 | Kolkata | 45.5 | 58.4 |
| Jalpaiguri | 27.8 | 27.8 | South 24 Parganas | 28.8 | 33.1 |

Source: Calculated from West Bengal Council of Higher Secondary Education, 2011

This table clearly demonstrates that the scope of science education is comparatively much better in south Bengal.

Table 5.B: Category-wise Registration: Higher Secondary Examination- 2012

| | M | F | All |
|---|---|---|---|
| General | 237928 | 227850 | 465778 |
| SC | 103049 | 76759 | 179808 |
| ST | 19532 | 13212 | 32744 |
| OBC | 33818 | 26319 | 60137 |
| All | 394327 | 344140 | 738467 |

Source: Website of the West Bengal Council Higher Secondary Education

The 2011 registration data indicate that percentage of total students pursuing Physics at this level was 10.8, whereas for Chemistry and Biological Science the figures were 11.2 and 14.3 respectively. Enrolment of girls in these subjects varied from 27.8 percent to 36.7 percent. Scanning district-wise enrolment data we find that percentage of total students pursuing Physics in Kolkata and in Kochbihar were 20.9 and 4.2 respectively. Disparities of the same order between north and south districts persist in Chemistry and Biological Science also

Kerala statistics reveal that in the year 2003 percentage of students pursuing Science at +2 levels was nearly 43. Interestingly, out of the total Kerala students enrolled in science

58.1 percent were girls. We will certainly try to get current statistics, but, educational tradition of Kerala will reaffirm the trend, we presume.

Table 5.C: Identity and gender-wise division of students pursuing science in Kerala in 2003

| | Boys | % | Girls | % | All | % of total students pursuing science |
|---|---|---|---|---|---|---|
| Gen | 18044 | 40.9 | 26076 | 59.1 | 44120 | 51.3 |
| SC | 2841 | 39.3 | 4388 | 60.7 | 7229 | 43.2 |
| ST | 220 | 43.1 | 291 | 56.9 | 511 | 37.5 |
| OBC OEC | 19120 | 43.6 | 24727 | 56.4 | 43847 | 36.6 |
| OEC | 1013 | 38.0 | 1650 | 62.0 | 2663 | 40.0 |
| All | 41238 | 41.9 | 57132 | 58.1 | 98370 | 42.7 |

Source: Website of the Department of School Education, Kerala

## A CONCLUDING REMARK

Our inquiry into West Bengal's science education may have wider relevance, as has been indicated in our all-India contextualisation of the present work. The pursuit of this study was aimed at connecting the various local coordinates of science education, but given the shared national history and common socioeconomic plane of existence, there is reason to believe that it might be capable of providing insightful lessons for the rest of the country. Both physical and human resources of the infrastructure of elementary education in West Bengal are far from satisfactory. Here, the education system pays little or no attention to school science education; the attitude of the educational planners and administrators of the state seem to be indifferent in this regard. Two flagship programmes, MDM and SSA, have helped improve enrolment and retention but the state government has not been paying adequate attention to increase number of students substantially (by per cent) for undergraduate or postgraduate science courses.

To deliver quality education and to attract more learners to educational institutions two major problems, namely malnutrition of the children and lack of cultivation of scientific temper and culture – two distinct but closely interlinked features – need immediate attention. As regards malnutrition, it may be noted that according to West Bengal Human Development Report 2004, malnutrition among children was lower than the national average. The proportion of anaemia (78 percent) was higher (in rural area it is 82 percent) compared to Indian average of 74 percent. Researchers of Pratichi Trust have recently confirmed that the actual situation is much more alarming.[45] It is practically useless to talk of education, let alone science education, in this prevailing condition of malnutrition.

Overarching regional imbalance in the availability of school facilities for education[46], health and child development has a direct bearing on science education. Weaker sections

of the society have also reason to be aggrieved about their deprivation. There is a strong case for placing science education in the larger contextual plane involving the construction of a deprivation index, and mapping the structure of ideological dominance that works behind this deprivation. It may be noted that no research or survey has yet been undertaken, as far as our knowledge goes, in the matter of comprehensive school science education in West Bengal. It is important to contemplate empirical investigations to develop understanding on the role of public provisioning of education, as well as the need for – and capability of – informed interlocution by the society as a whole. This involves strengthening of the role of civil society in the cultivation of scientific temper and 'science culture'. This is the terrible, and manifestly neglected situation our school science education is in needs to be changed radically and immediately. This requires an informed public discussion which this paper hopes to initiate. We have gathered information, as evinced in this paper, but certainly, we have to proceed to build a fuller informational base, including the state of pedagogy, the content of syllabi, health of infrastructure, and so on. Our failure is not only ours; it indicates a possible national loss. When some other states can move ahead, why, being a part of a federal structure, can Bengal not?

It will be a matter of considerable regret if we forget the basic ideas behind spreading science education; it is to inculcate scientific temper, it is for creating a culture that will fight social ills. Unfortunately, our national leaders and planners are possibly more interested in spreading science education to achieve economic developments at a faster rate; they are busy in elevating the status of this country by turning it the biggest supplier of scientific and technical 'human resources' to the world market. Importance of employability is something we cannot not lose sight of; quality science education will certainly enhance the employability of a student. But if it fails to transform this superstitious Indian society, if it cannot free our society from the shackles of dogmatism and fatalism, if it does not encourage reasons and free enquiry then the education has failed its most basic function

We strongly believe science should emerge as something alive, fallible, and therefore exciting. Such a model is required that will meet the wider aims of science education, and at the same time awaken the spirit of enquiry in our future citizens. .

Half a century after Kothari's landmark report, his words on the centrality of science education to the human experience are still so very relevant; It helps, he said, 'a man to understand himself, and his place in the universe'. It is his legacy, indeed, that we have become more scientific and inclusive in our use of language, and now, with his inspiration, would like to modify his words to explicitly include women as rightfully equal owners of all social goods, such that we can now say: 'science education helps *people* to understand themselves, and their place in the universe'. And by this, we can address the challenge of privilege divide in our society, on all counts.

**End Note :**


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4. Sinha, N.K., *100 years of the University of Calcutta University, Commemoration Volume*, 1957, pp-5-6.
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6. Ibid, p-7
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8. Ramchandran, Padma & Vasantha Ramkumar, *Education In India*, NBT, New Delhi 2005, p-52
9. *Adams Report*, 1835-8
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11. Sinha, N.K., *100 years of the University of Calcutta University, Commemoration Volume*, 1957 p- 17
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15. Ibid, p-80
16. Ibid pP-135
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18. 'Science must reach the common man: Yash Pal', *The Times of India*, Patna, May 16, 2005.
19. For an important contribution to the discussion of scientific temper, see Sen, Amartya, *The Argumentative Indian: Writings on Indian History, Culture and Identity*, Penguin, London 2006
20. Guha, Ramchandra, 'Verdicts on Nehru', *Economic and Political Weekly*, May 7, 2005.
21. Chattrjee, Garga , 'The Wrong Formula' , *www.himalmag.com/component/.../5039-the-wrong-formula.html*, 26 March 2012, -
22. 'It is Sir Rabindranath's strong conviction that, while English should be skilfully and thoroughly taught as a second language, the chief medium of instruction in

schools(and even in Colleges up to the stage of university degree) should be the mother tongue. He has four reasons for this belief; first, it is through mother tongue that every man learns the deepest lessons of life; second, because some of those pupils who have a just claim to higher education cannot master the English language; third, because many of those who do acquire English fail to achieve true proficiency in it and yet, in the attempt to learn a language so difficult to a Bengali, spend too large a part of energy which is indispensible to the growth of the power of independent thought and observation; fourth, because, a training conducted chiefly through the mother tongue would lighten the load of education for girls whose deeper culture is of high importance in India'.: *The Saddler Commission Report*, 1919, 1 pp- 226-7

23. Chattrjee, Garga , 'The Wrong Formula' , *www.himalmag.com/component/.../5039-the-wrong-formula.html* , 26 March 2012
24. Resolutions adopted in the *National Convention* held at Wardah (22nd & 23rd October 1937) under the chairmanship of Mahatma Gandhi:
    1 That in the opinion of the Conference free and compulsory education be provided for seven years on a nation-wide scale.
    2. That the medium of instruction be mother-tongue.
    3. That the Conference endorses the proposal made by Mahatma Gandhi that the process of education throughout this period should centre in some form of manual and productive work, and that and all the other abilities to be developed or training to be given should, as far as possible, be integrally related to the central handicraft chosen with due regard to the environment of the child.
    4. That the Conference expects that this system of education will be gradually able to cover the remuneration of the teachers.
25. Art 45 under the Directive Principles of Indian Constitution. 'Education' was then a State subject. But after 42nd Constitutional amendment act of 1976 'Education' was placed in the concurrent list.
26. *The Report of the Education Commission 1964-66*, henceforth referred to as the *Kothari Commission Report*, Vol. 1, Chapter 1.
27. Ibid, Vol. 1, p - xviii.
28. Ibid, Vol. 1, p – 39.
29. Ibid, Vol 2, , pp-343-8
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32. Ibid, P-337
33. Ibid, p-388

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37. *ISR-2004*, p-15
38. *ISR 2004*, p 45.
39. '…unlike Europe and North America at a comparable stage of industrialization, India did not have access to colonies… Tragically, since economic liberalization we have instead adopted a more profligate pattern of resource use. …There is an enchantment with American lifestyles, that is to say, with lifestyles that rests on a continuously increasing demand for resources. Values of simplicity and frugality, espoused by great Indians such as the Buddha and Gandhi, and once respected, though perhaps never willingly followed except by a minority, have now completely vanished. ..To meet the needs of corporate sector and the consuming classes, the government has encouraged a new scramble for resources in the tribal areas of central India and in the Northeast. These regions are on their way to becoming our 'internal colonies…' Guha, Ramachandra, 'Growth at what cost – Dams and the damned', *The Telegraph*, Kolkata, 16 June 2012.
40. *Datta Commission Report*, 1984, p-147
41. Ibid, p-151
42. See for details, Rana, Kumar, Santabhanu Sen and Manabesh Sarkar, "Small Schools for the Underprivileged: The SSK experiment in West Bengal"; paper presented at a seminar on *Small Schools* at the National University of Educational Planning and Administration, New Delhi, on 4-5 February, 2009; www.pratichi.org
43. Section 2.1, 15th JRM Report
44. Section 1.4.2, 15th JRM Report
45. *The Pratichi Child Report*, with a foreword by Amartya Sen, Pratichi Trust, Kolkata 2009, and The Pratichi Education Report II: Primary Education in West Bengal – Changes and Challenges. Pratichi Trust, Kolkata 2010.
46. Rana K, *Social Exclusion in and through Elementary Education: the Case of West Bengal*, Pratichi Trust in association with UNICEF, Kolkata, 2010.