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# SCIENCE, TECHNOLOGY AND SOCIETY

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SHRI RAM INSTITUTE FOR INDUSTRIAL RESEARCH

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May I begin with thanking Shri Dharma Vira, Chairman of the Board of Governors of the Shri Ram Institute for Industrial Research and the members, for their invitation to deliver the Founder Memorial Lecture this year. When Shri Dharma Vira extended the invitation, I readily accepted it for more than one reason. I had a fairly long association with Lalaji extending over a period of two decades. Secondly, it provides me with an occasion to express a few things which have been revolving in my mind.

### **Lala Shri Ram's interest in science and technology**

As Chairman of the Executive Council of the Central Glass & Ceramic Research Institute, Calcutta, he gave us great support in building up the Institute into a good scientific research institution of its kind. Deeply involved in whatever responsibility he undertook, critical yet constructive, no detail was too small for his attention. Lalaji was an ideal Committee man. He used to read meeting papers from A to Z and was impatient with people who did not read papers, but started speaking flamboyantly at the meetings. I recall an occasion at the meeting of the CGCRI Executive Council, when a certain member started making observations unrelated to the item under consideration. Lalaji interrupted saying, Dr. so & so, have you read the papers? Since the reply did not come spontaneously, Lalaji said smilingly, something like this "Let us adjourn for a while, so that members could read their papers." There was great laughter. Such was his sense of humour and the subtle way of dealing with situations. Not only the CGCRI but the entire Council of Scientific and Industrial Research owes him a deep debt of gratitude for the unstinted support and backing it received from him as one of the founder-members of the organisation and a continuing member of its Governing Body till his death.

Lalaji mixed with the scientists and cultivated their company. This had a great influence on his thinking. He was a believer in the role of science and technology in nation building activities. Apart

from the many industrial enterprises which he set up during his lifetime, he was among the very few captains of industry who established a research organisation with a munificent endowment to help in the industrial progress of the country. His aim was, that this Institute for Industrial Research which happily bears his name, should grow on the lines of the famous Battelle Institute. I strongly believe and I have been saying this frequently that for best results, industrial research should be organised in industry, by industry. The Shri Ram Institute for Industrial Research represents such an approach and hence I am attracted towards it. A little after Lalaji's demise, there was a move to make the Institute a part of the Council of Scientific and Industrial Research. The negotiations fell through. The Institute retains its original character. It would have saddened Lalaji if such a thing had come to past.

In a country like India, where during the early days of independence, the industry was not well organised, it was but natural that government had a major share of the effort in organising industrial research. Personally, I am against governmentalising all such efforts beyond certain limits. We should keep as much of scientific and industrial research as possible outside direct government control. Government should be in the role of a patron, a supporter and a well-wisher of research and development. Research activities under independent auspices whether these are under the auspices of industry, private or public, or under the auspices of Universities and independent research institutions, should be enabled to grow and flourish.

It was Lalaji's idea that the research activities of the Shri Ram Institute be so organised that it earns its own living and is not dependent upon grants-in-aid. This is an important distinction. Grants-in-aid compromise independence of an institution, for the one who pays the piper can insist on calling the tune. But if an institute earns its living on the basis of contract projects, the relationship between the financier and the institution is on a very different footing, namely, one of equality. The complexion of the Shri Ram Institute continues to be what Lalaji had desired.

Even in socialist countries like the USSR where all activities are governmental, government-controlled, financed and managed, there is now increasing awareness of this principle and a policy which makes industrial research institutes earn a part of their living through contract research is encouraged. A number of institutes in the USSR

are only partly funded through grants. The part which the institutes earn through contracts is gradually increasing.

Why cannot a similar approach be tried in regard to the financing and management of industrial research institutes in India? This can be an effective way of making their activities relevant to the needs of industry or of fields they seek to serve and also of improving the alertness of the scientists and technologists engaged in applied/ industrial research. In the earlier days, such a proposition might not have worked as Indian industry did not have the strength and diversity needed to sustain industrial research of viable magnitude. But today when we claim that we are among the top ten industrial nations of the world, that we have the third largest number of scientists and technologists in the world and that the quality of our scientific activities is among the best, I do not see why the relationship between the scientists, engineers and technologists engaged in industrial research and the industry should not be put on a contractual basis with absolute equality on both sides, and not that of an employer-employee type. This is particularly important for the following reasons.

Indian industry is becoming research minded. With the incentives now available, fiscal and administrative, a number of industrial firms are setting up in-house R&D facilities. We have now a better idea of the dimension of these efforts, because to be entitled to these incentives, the firms have to register themselves with the Department of Science and Technology. I understand that so far about 500 industrial units have registered themselves with the Department. This growth, which is very desirable, will have its own impact on the government established laboratories devoted to industrial research. I should not be surprised if over a period of time there is gradual diminution of worthwhile industrial research problems which may be referred by industry to the government industrial research laboratories. I understand that reference to the National Research Development Corporation from the government industrial research laboratories for industrial exploitation of products and processes, has been showing a gradual decline. It is time that these laboratories seriously took note of these trends and organised their research programmes on an entirely different basis. In terms of commercial language, they should develop the ability to "sell" their research capability and competence and attract more and more of contractual work which will bring them both credit and funds. With government's policy of only selective import of technology, there



will be immense possibilities for industrial research laboratories to undertake such activities in collaboration with industry and consultancy firms. Also even if industrial establishments set up their own in-house R & D facilities, it would not be possible for them to employ all the necessary expertise in various disciplines of science and technology which is required to solve all their problems and undertake new developments. They will have to go to the big research laboratories where interdisciplinary teams, expensive equipment and organisation are available. Modern industrial research is very expensive and it will not be possible for every company to organise such research on a massive scale by itself. Herein lies the opportunity for government industrial research laboratories.

### Growth of science and technology in India

Taking advantage of the privilege I have been given today. I also wish to devote some attention to the role of science and technology in the context of India's social problems. Government's interest in and support for science and technology as spelt out in the Science Policy Resolution of 1958 is not merely one of helping the industrialisation process but also the social development of the country. For over 30 years since independence, the political leadership of the country has repeatedly declared its unstinted support to the growth of science and technology. I am giving a few tables which would show how much growth of science and technology has taken place since independence. Since growth of science and technology cannot happen without the basic substratum of educational growth, I have also indicated the efforts for educational development and also the scale of development that has taken place.

**TABLE I**  
**NATIONAL EXPENDITURE ON RESEARCH & DEVELOPMENT**

(In crores)							
Year	1948-49	58-59	65-66	70-71	75-76	76-77	77-78
Central Government	—	21.78	62.45	112.47	261.19	311.23 (80)	—
State Government	—	1.00	3.51	12.58	27.49	30.96 (8)	—
Private Companies	—	0.15	2.43	14.59	41.15	46.53 (12)	—
Total Expenditure	1.10	22.93	68.39	139.64	329.83	388.72 (100)	412.27*

NOTE : Figures in brackets are the percentages.

\*Estimates for 1978-79 ... .. 476.74 crores.

**TABLE II**  
**EXPENDITURE ON EDUCATION**

Years	(Rs. crores)
Years	Expenditure
1947-48	55.18
1950-51	114.38
1955-56	189.66
1960-61	344.48
1965-66	622.02
1970-71	1118.29
1975-76	2106.81

The figure of 25,00 is an estimate of 1978-79.

SOURCE : Education in India, by Ministry of Education.

**TABLE III**  
**GROWTH OF EDUCATIONAL INSTITUTIONS IN INDIA**

Year	No. of Universities, I.I.Ts & other			No. of Institutions offering post graduate courses in Engineering	No. of Medical Colleges
	Universities	I.I.Ts	Other Institutions deemed as Universities		
1947	20	—	—	5	22
1952	30	1	—	10	30
1962	55	5	4	33	71
1972	86	5	9	77	99
1975	102	5	9	n.a.	109

SOURCES : 1. S.K. Roy of CSIR in NATURE, May 1975.

2. Data collected from U,G,C.

**TABLE IV**  
**OUTPUT OF SCIENTIFIC & TECHNICAL PERSONNEL FROM INDIAN UNIVERSITIES**

Year	B.A.	B. Sc.	B. Sc. (Ag)	MBBS	BE/B. Sc. Engg. & Tech.	M. Sc.	M.Sc. (Ag)	Ph. D. (Sc.)	Ph. D. (Ag.)	MD/MS	ME/M. Tech. Engg. & Tech.	Ph.D Engg.
1947	n.a.	5,996	535	959	1,076	905	79	n.a.	n.a.	n.a.	30	n. a.
1952	28,705	11,087	870	2,164	2,882	2,129	223	108	5	113	118	12
1962	68,694	26,930	2,609	3,567	6,863	5,195	576	489	38	525	477	23
1972	212,944	111,798	5,600	9,524	17,315	15,951	1,496	1,311	267	1,420	1,051	110
1975	n.a.	95,382	3,966	10,144	12,537	17,341	1,511	1,484	289	2,204	1,228	136

SOURCES : 1. For data upto 1960, S.K. Roy, CSIR, in NATURE, May 1975.

2. For data from 1962 to 1970, University Development in India, Basic Facts and Figures, 1971-72, UGC, 1976.

3. Data for 1974 & 1975 collected from UGC Office.

I am presenting these statistical tables to make a few points not with the view to minimising in any way the progress that has taken place in these areas but to drawing some lessons, and wherever necessary, of correcting our course of action. The thinking people should sit back and analyse if anything has gone wrong and suggest appropriate remedies to improve the situation. Take for instance, the simple fact that before independence, the Indian education system, whatever its shortcomings, was able to produce scientists of the highest international calibre like C. V. Raman, M. N. Saha, Birbal Sahni, S. N. Bose, P. C. Mahalanobis, who were all products of our universities and, who functioned during most part of their life if not the entire life in the universities and brought lustre to themselves and to the country. After independence, a large number of universities and institutions of higher learning, engineering institutions, technological institutions have been established, (cf, table). The Central government provides substantial grants for the development and sustenance of education. So do the State governments. In spite of all the expansion and support, we seem to have stopped producing men of the calibre I have mentioned. We made some very remarkable contributions to science even when there was government indifference to scientific research. Now, one hears everywhere the complaint that the quality of work in the universities has gone down in spite of the increased funds and facilities available. **What is this due to? Is it a sociological malaise or undue political influence? Perhaps both.** Only the other day, our Prime Minister referred to the deleterious political influences in our university campuses.

As against this, the educational development of the country is **still in its early stages.** If, as we hope, we attain universal education in the country, the student population in our schools, colleges, universities, technical and professional institutions would be almost equal to half the population of India. Our present literacy may be one third or so. In terms of absolute numbers, the number of illiterates has been increasing since 1947. This shows clearly the great leeway we have yet to make in providing educational opportunities to the entire population. As education spreads, it is inevitable that pressure on professional courses will also increase, and this has to be catered to. The time is not far off when every district in the country may demand a University of its own with the associated professional institutions.

The question then arises if we are not able to meet the demand for work of those who have gone through our schools and colleges even at the present level of literacy, how are we going to meet the demand when we attain a hundred per cent literacy. Alternatively, will the socio-political system accept a situation where the major part of our population will be committed to unskilled manual labour forever as drawers of water and hewers of wood ?

### **What sort of technological knowledge should we have ?**

We are not a country living in isolation. Every citizen will rightfully expect the attainment of a certain level of education which will not only equip him/her with some knowledge but also with necessary skills to earn his living. How is this to be realised without the massive application of technological knowledge and skills ? In a free democratic society like ours, the rising expectations of the people have to be satisfied. Is it possible to do this without industrialisation of either the capitalist variety or the socialist variety? Although we may have come within the first ten industrialised countries of the world, we are still essentially an agricultural society, and industrialisation can be said to have just begun. If, as I say, technological knowledge and skills would provide us the main motive force of the growth of our society in future, it is essential that even today we should think in terms of how we channelise the efforts and in what direction we should move to meet the massiveness of the challenge before us.

Although in ideology the Western capitalist system and Eastern socialist system differ, in terms of the impact of science and technology, there is a lot of similarity. It is accepted on all hands that the Western capitalist system derives its strength from the positive application of technology to production. Similarly, right from the days of Marx and Lenin, the Communist doctrine stated in so many words that Communism and Science have to go hand in hand because each derives its strength from the other. As technology becomes more and more complex and the productive apparatus becomes vast and intricate, purely private ownership of the productive apparatus has become a thing of the past even in the Western capitalist system. Corporate ownership and professional management have now become the normal pattern. So also in the socialist countries, the power flowing from industrialisation has not passed into the hands of the proletariat, but into the hands of a professional class of managers,

scientists, technologists and engineers who control the means of production on behalf of the State. This great similarity of shift in the focal point of power and prestige in the two diverse socio-economic systems must have its own lessons to a country like India in shaping its future policy.

Is there a third alternative? I consider that the teachings of Mahatma Gandhi provide us with an answer. Whereas in both the socio-economic systems, I have described, it is machine and not man who controls the other, it was Gandhiji who thought of developing a socio-economic system based on man at the centre of the scheme of things. The Gandhian system of production essentially consists of a highly decentralised productive system where concentration of power either in the State or in any class of people whether it is capitalist, proletariat or intellectual does not take place. His approach, which he practised himself in the institutions he set up, was relevant to a particular situation obtaining at that time and may look to some people not so relevant today or in the future. I do not subscribe to this view. Few of our economists, sociologists, scientists or technologists have developed the basic concept of Gandhian approach, so as to modify and adapt them to suit a growing modern technological society.

### **The social impact of modern technology**

Indian Society is still essentially a rural one based on agriculture as its main activity. About three fourth of the population who live in the villages depend upon agriculture and related industrial occupations. By and large, this community has remained outside the pale of modern technological development. It is only lately that some changes have taken place in Indian agriculture, and products of science and technology are being increasingly used. High yielding new varieties of seeds based on genetic research, fertilizers produced in giant factories, pesticides and insecticides made by sophisticated chemical processes, tractors, electrical and diesel pumping sets which are products of modern engineering workshops have made significant impact on Indian agriculture. Technological gadgets like the transistor, radio, bicycle, motion pictures have made great inroads into the interior of the Indian rural scene. Every villager today knows the value of trucks, buses and the railways as his aids for transportation of what he produces and also for him and his family. Apart from the bullock cart which he still uses for his immediate requirements, these means of transportation based on technology

have made him socially and economically more mobile. It should not be surprising that in the next few years, the use of scooters becomes more and] more common even on the village roads. The social impact of the various technological developments I have recounted has not, to my knowledge, been adequately studied even in qualitative terms.

Side by side with their social and economic impact this has helped create greater political awakening among the people. Unfortunately, the frustration caused by the pressure of growing population and the unemployment and under-employment resulting from unplanned expansion of education, provides a fertile field for political influence which may not always be to the good. The situation is such that it could be easily exploited by the politician for his purpose. Caste, community, religion and other traditional sectarian interests have often been pushed to the forefront by the politician to improve and widen his following.

In spite of the fact that a large and diverse industrial base has been built up in the country, in relation to the vastness of our population, we still cannot consider ourselves as an industrial society. We are as yet in the pre-industrial state. Countries like the USA, Japan and Germany have gone two steps forward and they are now what could be described as a post-industrial society, where the emergence of a new class of people is quite clearly visible. In a pre-industrial society, power is derived from property ownership; in a post-industrial society knowledge is the hallmark of power. An industrial society is marked by corporate ownership of the means of production. This greatly dilutes the individual ownership of property. In a way, corporate ownership is a step towards socialisation of the means of production. But in a post-industrial society, the means of production are managed essentially by a technocratic class, a knowledge-class, on behalf of the large number of shareholders. The growth of this system has been described by Galbraith in his "New Industrial State". In our country also we frequently hear that our industrial enterprises should be managed by professionals rather than by family members. To a limited extent this is already happening. Also, one witnesses some members of controlling families going in for higher technological and professional qualifications and claiming to associate themselves with the enterprises they control, as members of the professional class.

## The role of technocrats

The increasing influence of the technocratic and professional classes in the government also is now clearly visible. At the dawn of independence, hardly any scientist or technologist or other professional men occupied any position at the decision-making levels—say as a Head of the Department or Secretary to Government. Today, one could count a dozen or so such men. The position of the technocratic-class is now firmly established and as we advance into the industrial era, and perhaps not in a too distant future into the post-industrial era, there will be increasing influence of this class at the decision-making levels not only in industry but also in government. We should, therefore, be prepared for some kind of confrontation if not conflict between the three types of decision-making classes: political decision-makers, the administrative-class and the technocratic-class. In a post-industrial society, both the administrative-class and the technocratic-class get merged into one as the knowledge-based class.

In the transitional phase of Indian Society, technocrats consider as their principal rivals those belonging to the administrative class. Since in a democratic set-up, the elected representatives constituting the political decision-making class seek to displace members of the administrative class, immediate rapport is established between the political decision-makers and technocrats in their common confrontation with the administrative elite. In the industrial field, the intellectual or the professional class has to reckon with the power of the ownership class, and it will not be too long before the former assume the superior role as the main decision-makers. In this case, the professional class will consist of scientists, engineers, accountants and managers. Where does the organised labour class come in this context?

One witnesses a significant change which is taking place both in the capitalist society like the USA and the socialist society like the USSR. The capitalist class and the labour class have both slipped from the position of primary importance giving place to the knowledge-class. What Karl Marx described as the dictatorship of the proletariat, does not seem to have the same force now in the post-industrial socialist society. The privileged class now consists of members of the Academy of Sciences, managers and technocrats of the industrial units. Increasing emphasis on management and



application of several management practices of the Western democratic countries in the Socialist industrial system has given the managerial class much greater importance than what was thought of by Marx. While some of these changes are visible in the horizon of the Indian society, the composition of the Indian society is such that most of the social theories and generalisations which may be true of **the capitalist West or Socialist East breakdown in India**. A survey of the complexion of the elected representatives of India's parliament and of the States legislatures shows that land ownership in rural India has a preponderant role in the decision-making process.

One often hears in India about technocratic class's antagonism to bureaucrats. Indian scientists and technologists do not seem to appreciate that it is modern technology which gives immense strength to bureaucracy and builds it up. Indeed, scientists and technologists become an integral part of such a bureaucracy. The very term 'technocrat' refers to technically or scientifically qualified persons occupying bureaucratic positions. It would not be fair to attribute the bureaucratic character only to a small group of people who may be in charge of implementing official rules, norms and procedures. The whole organisation of large modern industrial complexes or of government machinery has multifarious arms of a bureaucratic set-up such as, law, economics, accounts, science and technology and management. This bureaucratisation appears to be an inevitable concomitant of both the capitalist and the socialist types of socio-economic growth.

### **A possible alternative**

Is it possible for us in India to avoid such bureaucratisation? Perhaps, we should have a second look at the Gandhian approach. Two basic tenets of Gandhian economics seem to provide an answer. One is decentralisation of the means of production as against the heavy concentration that is almost an inevitable aspect of modern capital-intensive technology, both in the capitalist and socialist societies. The other is development of a technological system in which man is at the centre of the scheme of things and not machine, and in which man is the master of machine and not machine of man. Institutional framework needed to put into practice effectively these two basic features of an economic system which Gandhiji advocated have still not been worked out. Our technologists, scientists, engineers, economists, administrators and political decision-makers

seem to draw more upon the experience and knowledge either from the democratic West or the socialist East. They have not so far put forward the rudiments of a system which will provide an answer to the Indian social peculiarities. Our management training is mostly modelled on the Western pattern.

If modern technology is not to assume too dominant a role, and the bureaucratic class which includes both the generalists and the specialists is not to assume a dominant if not a complete hold on the society, the alternative based on what I have ventured to suggest has to be worked out soon. The practical evolution of a system like this will require an intensive study of its social and human implications. Before that happened, may be that Indian society will be overtaken by all the ills of the industrial revolution and the subsequent scientific and technological revolution as it has done in the so-called advanced countries. In a vast subcontinent with its enormous population, what would be the effect of such a phenomena taking place, is even difficult to guess ?

Perhaps, as a scientist and technologist, I would have been expected to welcome Indian society going on the same road as the advanced countries and to help establish a society where technology will assume primacy over industry, science over technology and the scientists and technologists will have primacy in the bureaucratic structure. But then I would be untrue to my own basic belief that the Indian social milieu requires an entirely new, hitherto unthought of approach in which the ills of large scale mechanisation based on modern science and technology do not result in man losing his significance and becoming a cog in between machines but continues to be at the centre of things in control of not only nature but also all that he has been able to produce and devise by controlling nature. Is it possible to harness science and technology in the evolution of such a society in this country?

We hear now and then some people saying so. But that alone will not bring about the desired result. Both the systems, one based on a free enterprise society built on competition and the other built on avoidance of personal stresses and strains and class conflicts would fail in India because both work in a centralised bureaucratic set-up. I think it would do us well to make an intensive and extensive socio-logical and socio-economic study of this basic problem to evolve models for institutions suited to Indian genius and climate so as to avoid the pitfalls and ills of either extremes.

## Need for sociological studies

While Gandhian concepts are relevant in their basic principles even today, there is need for their re-enunciation with such modifications as may be necessary in the changing circumstances. No society is static and no set of principles governing a socio-economic system is static. For example, a highly technological and capital-oriented product, polyester fibre, is now being introduced in the manufacture of khadi. It is an example of modification of a Gandhian concept to suit changing times. Gandhiji was one of the very dynamic thinkers and was never static in his approach. I believe, he would have himself welcomed modification in the implementation of his various concepts to suit the changing needs of society. But then it needs very detailed and careful study by sociologists, economists, scientists, technologists, planners and politicians for introduction of modifications which may be relevant to the socio-economic needs of a changing society, but at the same time having their firm foundations on the basic principles put forward by Gandhiji. I wonder if there is not total neglect in India of studies in regard to socio-economic changes that are taking place with a view to examining the forces at work transforming our agrarian society. Such studies will provide the basic data of the possible lines along which Indian society may march forward, the problems which are likely to be encountered and how to deal with these problems?

Anxiety is often expressed about the growing urbanisation in India, there is obvious necessity to contain this process before any major upheaval takes place. But it is only lately that attention is being devoted to improvements in our rural environment and the shift of economic growth centres from towns to the villages. But here again we are as yet at the very beginning of tackling the problem. It is a race between the fast growing urbanisation trend and the rather slow reversal of it. Much will depend upon which trend will win. In either case, we must be prepared to face the challenges of the consequences.

On the social plane, we have very special problems unique to our country which beat all modern socio-economic doctrines. In most of the industrialised societies, labour as a class has had a powerful voice in determining the socio-economic and political systems of their countries. In India, cultural, ethenic, linguistic, religious and caste loyalties provide emotional stimuli more powerful

and compelling than class distinctions based on economic considerations. With increasing political awareness, inadequate employment opportunities and economic growth, these loyalties burst out now and then and pose law and order problems for the government much more serious than the labour issue. Merely stating that casteism should be abolished is no answer to the problem. Here again, we have made hardly any studies which could be helpful to find some answers.

It has been claimed that the spread of the scientific temper may provide the answer. If that were so, there would have been no Jewish problem in Europe, no racial problem in South Africa and no Negro problem in the United States. Even to talk of scientific temper to ill-fed, ill-clothed millions has no relevance. Even our intelligensia has not been any greatly influenced by scientific temper.

On the contrary, another phenomena is at work, namely, with the growth of the population, further differentiation and fragmentation in the society is taking place in addition to what already exists to make the problems more complex, more involved and more difficult. It needs all the intelligence that we could command to ensure that the differentiation does not lead Indian society to a structure where people constantly fly at each other's throat.

### **The need for humanism—Gandhiji's techniques**

I now propose to deal with another important aspect of Indian society where science and technology by themselves reach their limits. Indian social mosaic, vast parts of which are made up of the various strands of ancient Hindu culture and traditions, is permeated by age-old philosophical and fundamental principles, the very quintessence of the Vedas, the Upanishads, the Bhagvad Gita, etc. The primacy of ethical values in normal everyday life and the need to follow *Dharma* without having to renounce the world but as an essential part of material existence is ingrained in every interpretation of basic Hindu doctrines and are the guiding factors of the Hindu society. These teachings stress the importance of *Satya* and *Ahimsa*, the two principal supports of spiritual life. They could be considered as the two legs on which every individual conducts himself through life. That we must be truthful in our words and deeds which, means that we should practise *Satya*, and that we should have reverence for all life i. e. *Ahimsa*, which provides us with a sense of unity with all that exists, are the basic principles which Mahatma Gandhi not only

adopted as his political motto for national movement but also practised them in his daily life. Why Mahatma Gandhi was so greatly concerned with the imperative need of ethics in Indian political life could be easily visualised if we just survey what is going around us in the country today. His approach to one of the basic questions of Hindu society—untouchability was not a merely political but basically a humanistic approach in the best traditions of Hindu religious tenets and supported by scientific findings. There is an old story about Shankara embracing a leper to demonstrate the basic human principles of equality and compassion. Gandhiji himself personally nursed and looked after a leper in his Sewa Ashram. His discarding of upper garments and adopting the loin-cloth, which had a profound political influence, and made him identify himself with the poorest of the poor in the country.

It is sometimes said that Gandhiji was taking the country backwards and that he was against modernisation. On the contrary he was for the demolition of all the pernicious customs which passed off as religious duties and the removal of evil influences of people who for their selfish ends put forward in their own way the interpretations and the practices of the great ancient teachers. He was, in my opinion, against conformity which was the main obstacle to social progress. When we talk of conformity in this context, it is the conformity to the degrading and absurd customs which make us belong to small social groups. Everyone of us, scientists not excluded, wishes to belong to a group and not be isolated because we consider therein lies strength. This is the principle of group dynamics in sociology. *Satya* and *Ahimsa* for Gandhiji were absolute and not exclusive. They cover the entire human race and not only sections of it. This explains why in his entire career of fight for freedom against the British, he never even once showed any bitterness or lack of understanding of the British people. Why then is our social fabric so ridden with all the evils of the caste-system acquired over a period of time? These evils are so enmeshed in our society that one often comes across even among those who are converted from Hinduism to other religions, cases of continuance of casteism in one form or the other. There is no dearth of saying that the system has lost its significance, has no contemporary value but all this seems to have made no impact. On the contrary, politics, slow economic growth and lack of adequate employment opportunities have not only accentuated casteism, but have in fact strengthened it.

Next to casteism, intolerance and indiscipline which it breeds, have become the most important problems of our contemporary scene. How do we deal with them? Has science and technology an answer as it is claimed they have? We take pride that our Védanta philosophy is amongst the best philosophical thoughts of the contemporary world, and as I said *Dharma*, *Satya* and *Ahimsa* are supposed to be our guiding principles and these conform to the basic determinants of science also. But yet we are completely unscientific in our living and in our attitudes to fellow-humans. What we see around us in terms of riots and agitations, killings and destruction of property in the name of class and caste show that neither ancient teachings nor modern science condition our thinking and action.

It is said that science and technology will modernise our society and make us rational in our outlook discarding superstitions, ignorance and obscurantism, etc. Jawaharlal Nehru was a great believer in this and spoke often of scientific temper. But after 30 years of phenomenal support to science and technology, this temper is still not noticeable. We have certainly acquired certain sophistication in science and technology and some of the materialistic attributes of the application of science and technology, but the temper of science seems to have remained elusive.

### **Humanism must go along with science and technology**

It may perhaps be due to the reason that the element of humanism, which ought to have gone along with the growth of science and technology, has not been taken care of. While science and technology may look after the body, it is humanism which provides the soul for the body to function on right lines. Without humanism going side by side with economic growth, science and technology and other modern instruments of development, any socio-economic superstructure built may crumble and collapse. When Gandhiji sent Harijan Sewa Sangh workers to go into the bastis and mohallas in which Harijans and the neglected lived, to carry out welfare activities, to alleviate their sufferings and bring them up, to become equal members of the society, it was mainly humanism which guided him. But today such an activity has been totally forgotten. The Prime Minister has declared that untouchability will be wiped out in five years' time. This is a good resolve. But unless members of the so-called classes demonstrate and translate into practice this resolution by actually carrying out uplift work

right in the locations where it ought to be done and on a country-wide scale, I feel that the noble resolve will remain only an intention. Such evils cannot be removed by government regulations. Their eradication needs action by society as a whole. Simple things like education, cleanliness, nutrition, proper accommodation and sanitary conditions of living should be carried to the very door of these people. One can then hope and actually see over a period of time the spectacle of a mass of humanity coming out of their life of drudgery and backwardness to better life. Application of simple principles and findings of science, simple technology, simple machines could indeed help a great deal in this process.

There is a school of thought particularly among scientists that every thing in the world can be interpreted in terms of scientific principles and anything which cannot be done so is irrational. If the rationalist is right, then human life should be considered as a simple biological process. The mere fact that man can control nature and turn it to his use, cannot completely take away certain aspects of life which may not be strictly falling within the realms of reason or rationality. It is the so-called irrational aspects of man that make him distinct from animals. I purposely used the term 'so-called irrational' because the more man probes into nature, the more striking is the manifestations of his ignorance of the basic natural phenomena. Often-times man drifts into the realms of metaphysics. But it is not necessary to get away from nature. If only man can adopt as his guiding principles, the materialistic attributes of science and technology and all the rational interpretation of nature that flow from this but also certain ethical principles which are outside the realm of science and technology but which govern his mind and heart. The full stature of man can only be realised if his rational nature as well as his spiritual nature are equally attended to and nurtured. Moral and ethical values, qualities of head and heart which govern man's relationship with his fellow-beings are as yet beyond the realms of scientific knowledge but are equally essential. Science does not by itself differentiate between good and evil but the differentiation between good and evil is essential for man to live happily in relation to himself and his fellow-beings.

I am not for a moment pleading for any religious interaction which men of religion and Godmen preach. But even an atheist or an agnostic will, in my view, recognise the limitations of science which I have pointed out and the need for ethical value in our daily

life. One may call it spiritual aspect of our life. An agnostic may give it a different name. It is not necessary for me to refer to the teachings of any particular religious order as all religions recognise the fundamental basis of humanism. It is not the lack of religious fervour or the ostentatious manifestations of religiosity such as rituals or going to a church, temple, mosque or gurdwara, in my view it is the absence of humanism that appears to be responsible for many wrong things which we notice in our society today. It is essential therefore that when we talk of the necessity of the spirit or the temper of science in order to help people discard superstitions, dead-weight of traditions and other obscurantist attributes, we should also stress the point that equally necessary is humanism. Science and technology themselves should be tempered with humanism, so that man does not become a mere mechanical automation but humane in his relationship with fellow human beings in his daily life.

In the context of what I have said so far, it will be pertinent to examine how our scientists function, in what directions they are able to influence government and society, and also what influences play on them. As I have already said, after independence the structure of science in India has undergone some very basic changes. Prior to independence, science in India was essentially academic and was centred in the universities. Science was pursued for its own sake. The scientific surveys like the Geological Survey of India, the Botanical Survey of India were established by the ruling power from the point of view of exploitation of natural resources of India rather than fostering scientific work. They functioned independent of the academic scientific community in the universities. The main characteristic of science in India at that time was its autonomy, (we hear quite a lot about autonomy these days) because of the total disinterestedness of the government. The scientific community functioned on its own, self-directing, self-regulating. It decided for itself what research should be undertaken. Some truly remarkable work resulted. Men of great international reputation like P. C. Ray, J. C. Bose, C. V. Raman, M. N. Saha, Birbal Sahni made their mark not because government was interested in them or in their work but because these men were intensely devoted to their scientific pursuits in the best traditions of science.

After independence, State support to science has grown enormously and a very large scientific community has come into existence.



We have the third largest complement of scientists and technologists in the world. Scientists and technologists now occupy some of the highest positions in Government available to anybody next only to the political bosses in the government. Having tasted power in the name of technocracy, members of the scientific community stake their claim to occupy the highest decision-making levels displacing the generalists. But, it will be in the interests of the scientists themselves to ascertain if this is not without its pitfalls and drawbacks. They must make up their minds whether their loyalty is to science or to the powers that be.

Right from the days of Galileo, scientists who were loyal to science and were not prepared to subordinate their scientific opinions to power, suffered. The confrontation and conflict between the scientific class and the ruling class is legion in the U.K., U.S.A., Germany and USSR. The best scientific brains in the world constituted the Manhattan project which developed the atom bomb. But these scientists had to carry out the wishes of the political decision-makers and the military leaders. The moment they asserted their difference and expressed themselves, they were shown their place—the case of Oppenheimer was only a symptom. The group of atomic scientists and similar active groups, Pugwash for instance, which started taking interest in the implications of modern scientific developments have, by and large, not made the impact on political or military decision-makers they expected they would. One could consider this as a defeat for the scientific community. In Germany, the very best scientists had to leave the country and migrate or in the alternative accept the dictates of the official ruling masters.

Even the pressure groups of scientists such as the Association of Atomic Scientists had only marginal influence in shaping or modifying Administration's policy in regard to nuclear research and development or developments in the field of rocketary, missile technology and space rasearch. Political points of view and the consequences of Russian achievements in these areas have been more important determining factors than the scientific or sociological factors. The scientists themselves have been divided on such questions. There is a large body of opinion in the West which is posing the question whether it is more wise and rational to spend large sums on space research—the various probes such as of Mars, Jupiter, etc., than to work for the removal of hunger and disease

from a large section of humanity which still suffers from these but to what avail. There has been no unified scientific opinion which could really influence the government. One of the side effects of the pressure from independent scientific opinion was the development of massive scientific groups in military establishments, to enlist scientific arguments in support of military decisions.

The concepts of science policy, science planning and introduction of similar thinking in the field of science have been the direct outcome of increasing governmental funding of science. Even the scientific academies which at one time used to be devoted purely to the advancement of knowledge have come under increasing influence of the governmental machine because the very expansion of science and technology resulted in bureaucratisation.

### **Scientists' role**

In most countries today where science and technology have grown to sizeable proportions including India, it is difficult to fix who speaks for science and the scientific community. Are they the great individual scientists by virtue of eminence attained by their outstanding scientific or technological work or the institutional scientists in the academies and professional associations; or the advisers employed in the government? Often times, the advice or opinions emanating from these sources could be conflicting, and sometimes cutting across group lines because the scientists have their own internal differences between individuals and groups, sometimes guided by questions other than academic. Every scientist, however eminent, must be prepared to suffer the consequence of his individuality or opinions however scientifically correct they may be, if he does not fall in line with one or the other of the scientific groups or the political and bureaucratic power. We have in India the example of a scientist like T.R. Seshadri, who could not see eye to eye with the governmental scientific organisations in their manner of functioning and was critical of the politician's interference and overlordship over scientific bodies, being singularly isolated to the extent that he had to undergo considerable suffering and die in penury.

The basis of science is facts, observations and not opinions, howsoever strong and widely held they may be. But we seem to be losing obedience to facts. Who can deny the great role of

Jawaharlal Nehru in the growth of science and its development in India, but it suited many people, scientists not excluded. to attribute solely to him the establishment of many scientific organisations and developments that have taken place in this country. For instance, the establishment of the Council of Scientific and Industrial Research. It is conveniently forgotten that the CSIR was established and the decision to establish National Laboratories had been taken very much before Jawaharlal Nehru became Prime Minister. Facts are facts; they cannot be obliterated to suit sycophancy. As a historian of great depth, Nehru himself must have felt amused with such things. Amongst those who preferred to adhere to their scientific opinions and convictions, the name of Prof. Meghnad Saha stands out eloquently. His clashes with Nehru in the Lok Sabha are well-known. Yet, Nehru had great personal esteem for Meghnad Saha. Another instance. One politician was being described as the father of the "Green Revolution" in India and the scientists and others who were responsible for the actual work were not even mentioned.

Where does the scientific community, which claims pre-eminence because it is supposed to shape the economic and social development of a society, stand in the circumstances? What I say in regard to scientists applies to other intellectual classes also. **But it applies** with much greater vehemence to the scientific community, because of the claim that in the modern world it is science and technology that shape society. Scientists are also made of same clay as others and power and office tempt them as much as these tempt others and corrupt them as they corrupt others. They cannot claim any more pre-eminent position so long as they are not prepared to stand up to pressures and do science as a knowledge pursuit. It is only such people who can derive the authority to speak and to be heard for their scientific opinion by virtue of their knowledge rather than any other qualifications such as power, office and position. So also if in their functioning, science societies and academies adopt criteria other than pure objective scientific merit, such as, expediency, favouritism, equivocation, opportunism, they run the risk of forfeiting their right to be heard and to speak on behalf of the scientific community.

The longing for power and official position among scientists not only warp and distort their scientific opinions but also their outlook. It is not uncommon to see some scientists building up pressures on government by lobbying at political level and also seeking the assistance of the press to build up their own image of appearing

all-important and to influence public opinion in favour of their personal causes. In an open society with a democratic form of government and a free press, there are many ways of building up one's lobby and these are well-known; but for senior men of science to have recourse to such methods appears to me, not only highly undesirable but in the long run is bound to do great harm to the progress of science in the country and the scientific community. These weapons are powerful but they are also double edged and can also act as a boomerang. There are instances of scientists putting across to the public through the press exaggerated and often distorted versions of events to give the impression that some great injustice is being done to them by political leadership or the **bureaucratic wing of the government**. **Sometimes a posture is adopted as if some assignment is being thrust on them like the crown on an unwilling Caesar.** If one is to be guided by all that appears in the press, one would get the impression that several top technocratic positions in our country are being occupied by unwilling occupants. On the contrary, while often some scientists eagerly look forward to and accept bureaucratic offices, when they get into situations where they have to answer for their lapses they take recourse to the plea that they are scientists, they have no experience of administration and they should not be held responsible for them.

The issues I have touched upon are relevant to the progress of science and technology in relation to India's social milieu. In no country in the world society is so simple or homogenous that sociological theories and hypotheses could be applied just as theories and laws are applied in natural sciences. But in a highly complex pluralistic society like India, where one can see, side by side, social structure as it existed 5,000 years back and segments of population influenced by and styled in terms of the most modern social trends, as I have pointed out, the criss-cross interplay of economic differentiation, religious differentiation and various types of sectarian interests based on caste, language, customs, etc., it is difficult to apply any simple sociological theories. When called upon to handle a multi-variable problem, scientists usually apply the method of dealing with one variable at a time fixing the others as constant. However, in the social physics of Indian society even such an approach becomes inapplicable because of the extreme complexities and the constant interaction between all the complex forces and also because the interaction is often more important than the factors themselves. Nevertheless, it is extremely necessary for sociologists

and other man of learning to study Indian sociological problems in depth and try to find solutions. Each one of the topics I have taken up today would need much more elaborate treatment to do justice to it. I have not suggested any solutions which could be applied straightaway but I have tried to indicate what, I think, could be the lines along which solutions could be sought for.

Before I conclude, may I once again thank Shri Dharma Vira ji, and his colleagues for giving me an occasion to share some of my thoughts with you. I must also thank the audience for bearing with me this length of time. Perhaps, I have inflicted upon the audience rather serious thoughts; but I felt that a time has come when I should give expression to some of these ideas for people to think. Many of you may not agree with all that I have said. Some of you may think that I have been somewhat cynical in my approach in respect of some issues; I have deliberately done so to provoke. If I have set in motion a thinking process, I should feel gratified. I would particularly call upon the younger members of the scientific and other intellectual pursuits and professions that in the interests of the future of the country, they should make distinct departures from the lines of pursuit of the present generation and help to mould Indian society into a more cohesive one, in which ethics and humanism would play as important a part as science and technology, if not more, in which socio-political tensions will be minimal, and the people of India would truly derive the benefits that can accrue from science and technology. □