SCIENCE FOR THE NATION

National Organizing Committee
Bharat Jan Vigyan Jatha
1987

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Contents

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Written by
Usha Menon, Delhi Science Forum
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1. INTRODUCTION

Science for the Nation'—is it not a paradox? How can science, the pursuit of universal objective truth, be limited by the boundaries of any ethnic, national or geopolitical entity? Yet, this paradox is easily resolved by the fact that our slogan of 'Science for the Nation'refers not merely to pure science, but to the whole gamut of pure science, applied science and technology. The close relationship of applied science and technology to social needs is certainly less problematic.

It is true that creative effort, including applied science and technology, flourishes when researchers are able to work under relative freedom, according to the needs of their respective disciplines. Yet scientific pursuit has been always affected by social factors, however indirectly. And today the interrelationship between science and society, especially between science and production has developed so far that scientific activity is getting organized as an extension of production in industrial laboratories. The antagonism between the internal and external needs of scientific work can be resolved if the external demands represent the genuine needs of society based on societal consensus, rather than the needs of a narrow section of society.

Indeed what is at issue is not the choice between the internal and external determinants of scientific activity, but how to combine them. And the great promise of science demands from us that we take steps to ensure the fulfilment of the social function of the science. The process of uniting theoretical and empirical knowledge has unleashed tremendous productive forces, undreamt of by earlier generations and the alliance of science and production promises today as never before that the age of want can end.

The fruits of this scientific and technological revolution are not automatically available to everyone. In countries where production is for profit, it has resulted in the transformation of science from a common pool accessible to the whole of humanity into private wells that benefit only the corporations that own them. In nations dependent on foreign companies for technology, it has made science become even more inaccessible to the rest of society.

OUR TASK

The experiences in our own country have stood witness to the goals which can be achieved by applying science and technology. The breaking of the century-long stagnation in agricultural production and increasing foodgrains production from 55 million tonnes in 1950-51 to 151 million in 1985-86 is a proud achievement. The eradication of a dreaded disease like small-pox and the increase in longevity from 27 years at independence to 55 years today is yet another. Our capability as a nation to gain mastery over advanced science and technology has been already established by the achievements in atomic energy, space explorations, etc.

Yet when we are faced by the hard reality of the lives of our people, the privations seem as great as the promise of science. Our people are ill-fed, ill-clothed and unsheltered. The percapita availability of foodgrains has been stagnating at 480 gms for the last 20 years. Our collective needs for communication and transportation are inadequately fulfilled. In sectors like health and education, there is a crying need for improvement. But it is not only the fulfillment of the bare minimum needs of our people that we desire, but the creation of a society with material comforts which provides the conditions for the spiritual development of all. As the frontiers of science and its potential advances, the gap between the reality and dream only becomes wider.

How do we bridge this gap?

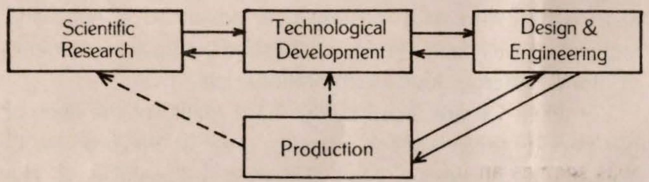
The struggle to bridge the gap between the potential and the actual has two dimensions. To begin with, we need to establish a system in which science and technology can be linked to national production. In a social structure in which this production fulfils the needs of our people this also means the creation of a system that can alter the lives of our people. The nature of national production, whether it expresses the needs of our people or that of a small elite, has also consequences for the type of S-T-P links established. But independent of these specificities, the establishment of a system which has the potential to fulfil national needs has many common problems which we deal with in this pamphlet *Science for the Nation*. In a companion volume, we discuss the problems and prospects of creating a *Science for the People.*

Yet this separation is essentially artificial. What are our 'national' needs, if not the needs of our people? Indeed they are so interlinked that even to create national capabilities of any kind we need to have a system geared to fulfilling the interests of the broad masses of our people. Thus a viable scientific capability to service a particular industry can be set up, only if the industry is large enough and the industry can be large enough only if it meets the needs of our people. It shows how only a system that meets the needs of our people can form the basis for a modern society utilizing science and technology.

THE LINK

Harnessing science and technology today means creating a system interlinking science, technology and production. This system includes scientific research and technological developmental activity. In order to introduce the inventions resulting from this research and development activity into the production process, it is necessary to have a range of special skills and capabilities such as design and engineering capabilities and machine building capabilities.

Thus when we talk about utilizing science to fulfil our national needs, we are discussing the means to establish the links between these different activities. Establishing the link obviously implies the existence of each of these capabilities. In the pre-independence period we lacked the capabilities, which made the country fully dependent on the colonial metropolis.



For creating a modern India, for utilizing the fruits of science and technology, each one of these steps is important. They are not to be conceived as merely conduits for the transmission of new products or processes, inventions produced through R&D work, but also as domains where thousands of minor innovations are introduced which modify and improve the existing production. These activities are also avenues for the application of science to production, in the sense that the scientific and technological experience and training as well as the empirical knowledge of those workers in the design and engineering and machine building sectors are applied to produce ever new changes. Without this continuous interaction between the different domains in the chain, no new production technologies or modifications in products will be developed and the dependence on foreign technology will remain.

SELF-RELIANCE

Why is it necessary to develop the scientific and technological know-how in our own country if we have to utlize the fruits of science to fulfil our national needs? Many think that the better alternative is a policy of relying on multinationals either by importing from them or by allowing them to set up production in our country. The essential question deals with the necessity to be self-reliant in order to have science and technology fulfil the needs of our country, in order to have 'Science for the Nation'.

The need to be self-reliant comes about because of the nature of technological know-how. The multinational corporations are indeed treasure houses of technological know-how, but it is not freely available to those who need it.

Ironically enough, the degree of availability of technology has reduced today, even as the world has been drawn together by technological advances in communication and transport. The barriers to the supply of technology arise both from the reluctance of the corporations to supply the technology as well as from the restrictions imposed by the home government of these multinational corporations.

It is against the interests of these corporations to supply the technology which would in effect undermine their export markets. They are forced to do that only in cases where they think that the market would otherwise be lost to indigenous producers. It also follows that when they do supply the technology it is given in such a form that the reciever does not pose a threat to the multinational corporation. That is the reason the idea that we can obtain the latest technology by importing it from multinationals is not valid. Thus, for example, in entering into collaboration with Suzuki it was said that we could have access to the most advanced know-how in the world which could provide us fuel-efficient cars. We find that the new model Maruti cars produced in collaboration with Suzuki have a fuel consumption of 26 km per litre while those being produced in Japan has a rate of 33.4 km/litre. The lag between production in India and Japan is such that within a year of the introduction of the first model in India it had already become obsolete in Japan.

The laws of the U.S. Government on the supply of defence-sensitive technologies is the classic example of governmental restrictions. These restrictions apply not only to the supply of techologies such as that embodied in the Supercomputer, but can extend to many items far removed from defence. The supply of plastic balloons necessary for cosmic ray experiments were once denied to India under the same restriction. Today these restrictions have gone so far that access is denied even to the results of scientific research, let alone to technology. These restrictions are not confined to those belonging to the socialist countries, but extends to third world countries that might be in disfavour.

Given the fact that any technology can be presumed to have military consequences, it can be argued that it is only a self-reliant development of science and technology that can make technology available to meet our needs. An interesing example is the case of some of the radar components supplied by the U.S. During India's conflict with Pakistan, the supply of the same was stopped by the U.S. However, when the component was indigenously developed on the basis of R&D work conducted in IIT Delhi, the U.S. Government was willing to lift the restrictions on its supply.

Even if such supply constraints did not exist and we took a decision to build our economy on the basis of imported technology, it would still be necessary to develop *our own* scientific capabilities and link it up with production—such is the nature of technology. In order to assess the technologies available in the world we need to have our own capabilities. And the technology supplied has no fixed fair price. It is essentially a rent extracted by those who have established a monopoly right to it on the basis of mutual bargaining strength. If we have the capability to develop the specific technology on the basis of our scientific research, we stand stronger in withstanding the pressures for higher price. And the price demanded is very often not merely in monetary terms, but a whole set of economic, technological and political changes. Thus in the early sixties, when we did not possess the know-how for the design of fertilizer plants, a consortium of American companies headed by Bechtel Corporation offered to set up five massive fertilizer factories in India. The price they demanded was not so much their fees, but changes in the policies on distribution, raw materials, etc. And part of the reason why we did not succumb to all the demands was that we had acquired some capabilities in fertilizer technology by the mid-sixties.

Apart from these problems which arise from the specific social conditions under which technology gets traded—under the dominance of the profit motive—there are general reasons which determine the fact that the linking up of science and technology to production is necessarily a linking up of indigenous science and technology to production. This is because the development of technology in other countries takes place in response to the needs and resources specific to that country. This means that in order to utilize the general principles generated by those experiences to meet the needs of our production we will need to develop our own technologies. One example will illustrate this case. Our needs for petroleum products are different from those existing in the advanced countries from where we have imported the technology for petroleum refining. We require more of the middle distillates such as diesel and kerosene, while in those countries the lighter distillates are more in demand. Given our specific demand structure, it would be advantageous for us to utilize the technique of hydrocracking, which was underdeveloped in those countries. In such a situation, the application of suitable technology could take place only on the basis of doing research and development on the hydrocracking process in our laboratories rather than using the more developed fluidized catalyst cracking technology available in a developed form. There are many such cases where our technological needs, which are different, require indigenous development rather than a reliance on imported technologies. Our relatively abundant supply of coal as compared to petroleum products, the availability of abundant sunshine, etc. means that we cannot wait for others to develop these technologies for us since their resources positions are different.

The utilization of science and technology for national development means a self-reliant path of development, an internal linking up of science, technology and production. What is important to stress at this juncture is that this self-reliance is not the same as autarchy, a total exclusion of all outside influences. A self-reliant path certainly wants to make use of the advancement made by humanity elsewhere without having to go through the costly process of repeating it. But a self-reliant path, unlike a dependent path, absorbs the imported technology, internalizes it, improves upon it and diffuses it through its scientific and technological infrastructure.

NATIONAL MOVEMENT

The effort to establish this link between science, technology and production was a part of our national movement and it was precisely this effort which the British government systematically sabotaged.

Colonialism brought us in touch with one of the most advanced nations of those days, a nation whose dominance can be attributed to her scientific and technological capabilities, a nation which used the fruits of science and technology to fulfil her needs. Yet the same nation, as the colonial master of our country, stood in the way of the utilization of science and technology to solve the problems of our people.

Even the British decision to provide modern scientific education has to be seen in the background of the demands raised by Indians. It was after the setting up of Hindu College in 1817 by Ram Mohan Roy that the colonial government agreed to provide modern education, including the teaching of science, by setting up Presidency College.

However, the scientific institutions that were established were cut off from any productive activity and the study of science was seen as an intellectual liberal pursuit of the elite or as a part of the training of government administrative personnel. To the extent that any scientific capabilities got linked to actual practice, these happened in spheres where it fulfilled the needs of the British empire, rather than national needs. Indeed, the first impetus for government involvement in agriculture, the setting up of agricultural departments, came in 1869, in response to the demands raised by the Cotton Supply Association of Manchester.

This linking up of scientific and technological capabilities to fulfil the production needs of British manufacturing interests is clearly reflected in the commodities chosen for special attention by setting up commodity committees. The earliest committee to be set up was the Indian Central Cotton Committee (1921), the very commodity which symbolizes the transformation of India into an appendage for supplying raw material for British industry.

The other committees and research institutes also reflect the same fact: to the extent that science and technology was linked to production it took place in order to serve British Imperial interests. The Sugarcane Breeding Institute (1912), Lac Association for Research (1921) and Indian Central Jute Committee (1936) are good examples. Almost one-third of the ex-

> Notwithstanding the renewed exertions of the United States since the close of the Civil War, we have still to deplore the long-continued scarcity of cotton and the consequent losses and sufferings experienced by our manufacturers........Your memorialists believe that India is the great source to which they must look for the large supplies that are so urgently needed.....The Association has, upon previous occasions, pressed upon the government the establishment of a Department of Agriculture in each of the provinces of India. They would now again urge the establishment of such a Department.
>
> **Memorial to the Secretary of State.**
> **The Cotton Supply Association of Manchester, 12 March, 1869.**

Foreseeing possibilities of strong opposition......of resurgent nationalism, the competing Foreign Combines have changed their tactics. Instead of importing their products entirely, they now try to produce them in the country, in alliance with Indian capitalists......and so secure the benefit of all forms of state aid.....It must thus be a matter of crucial economic policy for the rulers of this country to decide if they would admit, in this disguised manner, foreign capital and enterprise, in such a vital industry necessary for the very existence of the country itself, or whether we should be determined enough to establish a complete State Monopoly in this industry.

National Planning Committee, *Chemical Industries*, p.4

CURRENT SITUATION

In spite of the great strides taken after indepence, we find that the process of delinking India from a subordinate dependent position in the world economy has not proceeded far enough. Indeed there are enough indications to show that retrograde steps are being taken and dependent positions being reinforced.

The loosening of the links between our production system and our scientific and technological infrastructre and the strengthening of the links with the advanced countries can be seen in the following two important developments.

1. *Our scientific, technological, and design and engineering capabilities and machine building industries remain underutilized while the user industries turn towards foreign countries for the import of technology, designs, machinery, etc., which are available in the country.*
2. *The same underutilized indigenous capabilities built up as a result of the sacrifice and enthusiasm of our people are diverted to link with the global network of multinational corporations.*

Delinking

Among the scientific and technological capabilities which are not adequately linked to production facilities the following can be distinguished: (i) capital goods industry, (ii) design and engineering faciliites, and (iii) research and development. The current situation in the capital goods industry can be taken as an example of the extent of delinking that is taking place. This is exemplified by the situation of Bharat Heavy Electricals Limited (BHEL). Given the essential role the generation of power plays in the industrialization of a country, the importance of this public sector company which produces equipment necessary for the production and utilization of power can be understood. On the basis of absorption of technology imported from USSR, Czechoslavakia, etc., *BHEL established the capacity to produce thermal generation sets ranging from 50 MW to 200 MW, and by 1970 it started supplying power generation equipment to fulfil the country's enormous need for power. Its share in the supply of equipment increased from 30% in 1970-71 to about 95% by the late 1970s. But in 1985-86 only 78% of the total power equipment installed was supplied by BHEL.*

The low order book position of BHEL indicates the threat to the viability of the company. The capaicty utilization of 1988-89 and 1989-90 are expected to be low—48% and 41% in thermal and 32% and 38% in hydro. The wastage of national resources can be realized if one considers that more than 75,000 people are employed in BHEL, including more than 6000 scientists and engineers.

The underutilization of capacity in our premier capital goods manufacturing establishment coincides with a massive programme for the production of power. During the Seventh Plan, the capacity is to be increased from 42,5000 MW in 1984-85 to 64,736 MW in 1989-90, involving an outlay of Rs. 21,303 crore. This increased demand has not succeeded in providing better capacity utilization for BHEL, although it has provided more orders for foreign suppliers. This is in spite of the fact that BHEL equipment has been performing creditably. For example, the equipment supplied by BHEL for the Korba super thermal plant achieved a plant load factor of 103.4% in February 1986.

In a very similar scenario, a massive programme of investment in the fertilizer industry coincides with underutilization of capacity in the industries producing pressure vessels, pumps, compressors, etc. The Government of India is going ahead with a plan of setting up ten fertilizer plants based on natural gas obtained from Bombay High. It is estimated that this would generate a demand for capital goods of about Rs. 24,000 crore out of which two-thirds is likely to be imported. At the same time the engineering units which supply equipment to the fertilizer industry are in crisis. Thus for example, Bhart Pumps and Compressors Limited which has the capacity to produce 370 pumps per annum, had a turnover of only 135 pumps in 1984-85 as compared 202 pumps in 1983-84, and the stocks have been increasing resulting in losses. The situation of other supply units such as BHEL, Bharat Heavy Plates and Vessels Limited etc. are also not very different. The crisis affecting the small scale engineering units is even more severe.

Rapid increase in the installed capacity of electric power plants and fertilizer plants should have led to a corresponding growth of the capital goods industry, instead of underutilization of capacity. This under-utilization of capacity is also reflected in the overall poor performance of the capital goods sector. Thus for example, our machine tools sector, the heart of the capital goods sector, has been suffering from stagnating production since 1981.

This type of co-existence of underutilized capacity in the capital goods industry and utilization of imported equipment in the user industry is characteristic of the current situation in our design and engineering and consultancy service. The premier fertilizer consultancy organization, Projects and Development India Ltd., has the capacity to design two fertilizer factories per year, but has at present the work for only

Concern over liberal joint sector know-how import

By A Staff Reporter

NEW DELHI, August 4 ... rm bells are ringing in scientific ... les in the aftermath of liberalised ... on import of goods and ... hnologies, says PTI.

A section of the scientific ... fears that ...

already evident from what one CSIR director said: "Last year the ... requests for our ... have ...

... scientific and ... (CSIR) whose 40- ... laboratories have the specific task ... import substitution and developing indigenous technologies for industries.

"Technology import has now come under de facto open general licence ...," said a senior CSIR official. ... technology policy statement is ... and so is CSIR.

The negative impact on Indian Research and Development (R and D) is ...

No takers for home sponge iron

rly those involv- ... industries, food ... ing, costing ...

Also, the World ...

... such casualties is ... on one hand, certain indigenous technologies are also getting nipped in the bud.

One of them is SWAT-106, a CSIR developed chemical for improving flow of oil through pipelines.

SWAT-106 was poised to replace the flow improvers currently supplied by ...

... industry in Rajamundry in ... Pradesh that has been making silicon carbide crucibles for metallurgical firms in almost the entire country ... can no ... scientis... Anot... a fac... chlorisi... variety ... ductior ... indiger ... the Na... The ...

... of the ... the U.S. department of commerce, the department ... that a programme ... of the Programme for ... of Commercial ... (PACT) was in the ... would encourage the ... of the U.S. and ... consultancy firms. ... would be ...

companies. India and ... With ... signed ... for the ... fair ... to ...

NC Davy

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By Our Sp...

The National C... (Pune) has entered i... with Davy Mckee ... Davy Powergas ... for joint de... conversion ... Metha... ole...

23 JUN 1987 BS

Glindia-RRL project on vitamin A process

... CORRESPONDENT

... ctor of ... gar, in ... erme- ... up of ... cently ... work- ... abs to ... sed on ... ore cost ... min B-6 ... low costs ... sts hope ... soon.

search Laboratory (RRL) Hyderabad would help the coun... in getting indigenous processes ... many closely held drugs and f... mulations of the monopolistic m... tinationals. Dr Mitra and Dr A... Rama Rao, director of RRL, s...

RRL scientists are now con... trating on improving the lab-l... results to commercialise the vita... A process. Dr. Rama Rao said ... Glindia project started six mo... ago and the results achieved s... suggest that a production pla... could be available by the en... 1988. Glindia has so far releas... 50 lakh for the work.

Even the vitamin A process ... world monopoly of Roche and ... ers. India, at present, h... manufacturing vitamin ... technology which is ol... standard, he said ... natural lemon gras... he formulations. A ... und the Roche ... costly, Dr Ra... to him, the pilot ... n of vitamin ... RRL launch... which is a... erfecting ... natur...

US body to aid R & D work

... have been jointly identified ... which have already been ... agreed ... ces and the collabora... with the Soviet ... further period ... a further ...

THE ECONOMIC TIMES NEW DELHI TUESDAY AUGUST 18 1987 PAGE SEVEN

Indo-US vaccine project worries defence dept

NEW DELHI, Aug. 17.

Sections of the scientific community are perturbed about security and other implications arising out of the recent agreement on vaccine action programme (VAP) signed between the United States and the Indian department of biotechnology, says PTI.

Apart from enabling the U.S. to test several of its advanced and genetically engineered vaccines on Indian people, the VAP agreement gives access to epidemiological data, sera, and blood samples of the population that defence scientisits consider to be sensitive.

"I was shocked to see the agreement being signed on television," Dr P. K. Ramachandran, director of a research institute under the defence ministry said. "This is precisely the sort of thing we should avoid."

When asked about defence clearance, DBT secretary Dr S. Ramachandran said the projec was "approved by the cabinet which included the defence minister."

Dr V. S. Arunachalam, scientific adviser to the defence minister however said: "I am not aware of the details of the agreement, or what DBT wants to do."

The agreement envisages "cooperation across the entire spectrum of vaccine related technology, vaccine field trials and vaccine delivery methodology."

Under the five-year, 7.2 million dollar project, the U.S. has proposed to test vaccines against diarroheal diseases, canine rabies, viral hepatitis, pneumonia and whooping cough while "new areas of cooperation will be identified" as the project gets along.

The defence concern is about the enormous epidemiological data that will be collected as part of vaccine trials. Samples of blood, sera, and cells can tell a lot about the genetic make up of a population, its immune and antibody profile — collectively known as the "herd structure."

It is the "herd structure" that is responsible for giving Indians immunity against yellow fever. There has not been a single case of full-blown aids (acquired immune deficiency syndrome) in India because of certain genetic factors in Indians.

According to a former head of the national institute of virology, information related to herd structure is regarded as highly sensitive and access limited as knowledge gained from it could be used to alter the herd structure.

The U.S. move to fund 1.2 million dollars for establishing an epidemiology research and training centre near Madras is viewed with concern in this context. It has proposed to develop "a computerised data base on intensive health profile and demographic information of a well-defined population" not only near Madras but with the help of a mobile team "from other parts of India."

Because of its potential use of biological warfare specialists, no country gives away its epidemiological data, and for this reason India currently prohibits medical researchers from exporting blood, and sera samples. The VAP agreement has effectively removed this ban.

Because of its wide ranging ramifications, the Indian Council of Medical Research (ICMR), the primary agency concerned with health research, is also skeptical about the project.

ICMR director general Dr A. S. Paintal has made it clear that he will not allow any vaccine to be tried on Indians unless the same is also approved for use in the U.S. ICMR is opposed to foreign funding for epidemiology centre U.S. or for the vaccine trains.

Asked how the trials can be stopped when the agreement had already been signed, Dr Paintal said: "It was signed by DBT, not by me."

According to Indian scientists the genetic trials vaccine proposed to be tested here is similar to the controversial vaccine unsuccessfully sought to be tested rabues on cattle in Argentina last year

PRODUCTION OF MACHINE TOOLS

(Rs. Crores)

Year	Value of production
1970-71	43 (43.0)
1975-76	114 (65.7)
1980-81	196 (82.1)
1981-82	250 (94.3)
1982-83	270 (97.1)
1983-84	270 (93.0)
1984-85	303 (99.6)
1985-86	291 (86.2)

Note: Figures in brackets give the value of production at 1970-71 prices.

one fertilizer factory, with nothing more in the pipeline.

A similar fate has befallen those organizations which have developed new techonologies. Many indigenous inventions languish at the laboratory scale, with little hope of seeing their application in practice. Thus for example, National Environmental Engineering Research Institute (NEERI) has been working on various anaeroboic methods of treating municipal waste water including the UASB (upflow anaerobic sludge blanket) process. This method was first developed in 1970 in the Netherlands for the treatment of agro-industrial waste-water. NEERI has adapted this process successfully for the treatment of municipal waste water and the laboratory scale process has been functioning since 1985. Although the Ganga Action Plan as declared was a technology mission for cleaning up of the Ganga, NEERI has not been given the opportunity to try out its process. On the contrary, a Dutch consulting firm has been given the contract under the aegis of Dutch 'development aid'. NEERI has been completely excluded from the application of this technology. Thus while the Dutch consultants would add to their experience of working under tropical conditions and develop a technology package which can be sold all over the third world, NEERI and the Indian consultants have been prevented from gaining experience about a cheap treatment method which could have diffused throughout the country.

Under the current policy regime, this underutilization of capabilities is not confined to any particular industrial sector. This is reflected in the statement of one CSIR (Council for Scientific and Industrial Research) director this August: "Last year there were 70 requests for our processes. This year we have only four." The demoralization of our sciientists who have to work under such adverse conditions is an indiction of our policies that degrade one of the resources we are most proud of—our scientific and technical manpower which is the 'third' biggest in the world.

This increased tendency of linking up our production units with foreign sources of technology rather than with local sources is partly reflected in the increasing number of foreign collaborations signed every year. The number has increased from 526 in 1980 to 1041 in 1985. The relative share of collaborations involving foreign capital roughly reflects the control exercised by the foreign suppliers of technology. This has been also going up.

GLOBAL R&D

Another very disturbing trend which threatens the very foundations of our self-reliance is the tendency to convert our scientific and technological capabilities into extensions of the global network of multinational corporations.

Multinational R&D

Attracted by the cheap scientific labour and the scientific and technological infrastructure built up as a result of decades of planning, many multinationals have changed their earlier strategy of not undertaking research in India. Major R&D centres with an annual expenditure of more than one crore have been located in India by Ciba-Geigy, Glindia (Glaxo), Ashok Leyland, Hindustan Lever and Peico (Philips). *These companies not only use this research to buttress the monopoly position they have in the Indian economy, but also to serve their global interests.*

NO OF FOREIGN COLLABORATIONS

Year	Total no. collaborations	Collaborations with foreign capital(%)
1975	271	40 (14)
1978	307	44 (14)
1980	526	65 (12)
1982	588	113 (19)
1984	740	148 (20)
1985	1041	256 (24)

Thus for example, the R&D centre of Hindustan Lever (51% equity of Unilever, the biggest foreign company of India) in Bombay is primarily a part of the R&D network of Unilever, with a very intense flow of information with the corporate headquarters. The R&D plan of the centre is made in accordance with the R&D plan of Unilever and serves its corporate interests. About 30% of the research expenditure is devoted to projects unrelated to any of the existing business activities of Hindustan Lever in India, but is 'corporate' research undertaken in the interest of the corporation as whole. According to Hindustan Lever's annual report of 1982, "the Research Centre has extensive facilities for biological clearance work as an extension of the Environmental Safety Division of Unilever." This type of global orientation of research has been increasing in the last years.

Research with no production links in India is found among many multinationals whose main aim is to make use of the cheap scientific labour available in India. Thus for example, the investigations by Delhi Science Forum during the Bhopal tragedy revelated how the R&D centre of Union Carbide at Bhopal was testing pesticides for its principals. It is openly admitted that the R&D centre of Philips in Pune, working on ceramic materials is undertaking the research for its parent company. The most recent example is provided by Chloride India, which has advertised the research work it is doing for its principals in India. Yet such centres are considered part of our national research system and given subsidies and incentives.

With the increasing importance of biotechnology, it can be expected that there will be more and more multinationals willing to set up research centres in India, to collect germ-plasm, to do multilocational testing, etc. Union Carbide was conducting research related to identification and collection of germplasm for rice varieties in the strategic north-eastern regions. Richardson Hindustan Limited, another multinational has set up a natural products laboratory at Kalwa near Pune. Wimco a Swedish multinational is said to be setting up an R&D centre in the Andamans, which has a rich supply of various germplasms.

The global research activities of multinational corporations do not contribute to and they take the technological upgradation of our industry the cream of our scientific talent. This kind of 'internal brain-drain' creates a cancerous growth of showy R&D centres unlinked to the national production organism— produces a kind of *'science against the nation'*. These developments bring back memories of the colonial period when the Imperial Agricultural Research Institutes existed to fulfil the needs of the British empire.

Policy

The dangers inherent in allowing foreign companies to set up R&D centres was known to the policy makers in our country. The working group on 'policy in regard to execution and commercialization of R&D in the private sector industry' under the chairmanship of Dr. Y. Nayudamma, which submitted its report in 1974, made a clear distinction between the 'inhouse R&D units and autonomous R&D centres of foreign companies', and recommended that the centres should be strictly controlled. Indeed the distinction between R&D centres and in-house units working on problems related to the business activities is also faintly reflected in the regulations of the Department of Science and Technology, but is not implemented in practice. The regulations (regarding doing research on items not related to the business activities) on preferential treatment in licensing says that 'a foreign company' (as defined under FERA), can undertake R&D in areas covered by Appendix-I to the Industrial Licensing Policy Statement of February, 1973: '*If an undertaking is covered by the MRTP Act or is a foreign company and seeks to embark upon Research and Development activity in fields not covered by Appendix-I to the Government's policy statement of February, 1973, such undertakings will have to seek the prior approval of the Department of Science and Technology before doing so*'. In practice, this clause is never implemented. It is difficult to imagine that the Department of Science and Technology would have given permission to Hindustan Lever to utilize our scarce scientific manpower to develop the skin whitening cream 'Fair and Lovely', let alone to do environmental clearance work for Unilever.

Incorporation of National S&T System.

Recently there has been a tendency to extend the scope for the incorporation of our capabilities. It is not only the capabilities generated within the confines of the subsidiary in the underdeveloped country that gets incorporated, but also the research work done in the universities, national laboratories, public sector R&D units, etc.

Beyond the system of peer review, etc., which always existed to orient the research in our universities and national laboratories to the orientation existing in the advanced countries, today a direct means for orientation and control has emerged through the system of contract research. Thus, for example, Hindustan Lever Research Foundation set up by the biggest foreign company in Indian, has already supported more than 50 reserach projects mainly in agriculture and chemicals which included the collection of germ-plasm. Union Carbide R&D centre was receiving on a regular basis new pesticide molecules from its parent company and the field experiments for the same were conducted through agricultural universities and institutes such as Indian Agricultural Research Institute, New Delhi, Panjab Agricultural University. Ludhiana, etc. The most recent example of such sponsored research is the recently announced project of Regional Research Laboratory, Hyderabad to develop a cheap process for the production of Vitamin-A for its sponsor, the multinational Glaxo (Glindia). The results of the project which started nine months ago is

R&D activity of foreign companies or their subsidiaries in India, is carried out in two ways. viz (a) as in-house R&D activity and (b) by setting up autonomous R&D centres. The Committee is of the view that the two would have to be treated on a separate basis...........

The R&D Centres set up by the foreign companies as organisations sould be subject to a different set of conditions. They should be required to expose their research and development programmes in broad outline and make a report on results research periodically to a competent authority. It should be ensured that the work programme is related to the overall interests of the country and the results patented or otherwise available for exploitation in India on negotiable terms. The government may consider having nominee's on the Boards of Management of such R&D centres.'

Nayudamma Committee, 1974, p.37

expected to be made available to Glaxo by the end of 1988.

This policy of incorporation of our national scientific capabilities has to be seen as a part of a world-wide tendency. of incorporation of scientific research. This tendency is not confined to applied research, but extends to even basic research conducted in universities. Scientists in the U.S.A. have been disturbed about this new trend, which threatens the very basis of science as public knowledge. The most controversial example has been the payment of $70 million in 1981 by Hoechst AG to set up a department of molecular biology at Harvard University (Massachusets General Hospital). This payment gave Hoechst many privileges, including the exclusive option to develop any marketable or technique deveoped by the department and the right to scan all articles submitted for publication. Hence the struggle to utilize science for our national needs has to become part of an international movement of utilizing science to fulfil human needs rather than the need for super-profits.

Apart from this direct control of specific projects, there is also the possibility of imfluencing overall research policies. Representatives of multinational companies get involved in the various committees of the government and of national laboratories. In such cases, there can be a conflict of interest between commercial interests and national interests of developing indigenous S&T capability. One notes in this connection that the representatives of two multinationals, Hindustan Lever and ICI, find a place in the Science Advisory Council to the Prime Minister, while the wholly Indian private sector and public sector are unrepresented.

THE REASONS

What are the reasons for the capabilities developed since independence not being fully utilized by the industry? What is the reason that such a disjunction has developed between science, technology and production? The answer to such a question is naturally very complex, yet the pressing national need demands that we try to unravel the complexity.

The specific nature of our industrial and agricultural structure as well as the policy choices made have determined the tendency towards delinking. We can analyse the reason for the weak links in terms of the effect of this combination on the demand and supply of indigenous technology.

3. DEMAND FOR INDIGENOUS TECHNOLOGY

It is usually considered that the lack of competition in our industry has contributed to the low demand for technology in our economy and that the licensing system has played a crucial role in creating this lethargy towards innovation. But what is forgotten is that in the modern industrial structure as we know it in the twentieth century, it is not competition which plays the major role but rivalry. Modern corporations do not try to capture a bigger market for their products by making them cheaper through technical changes. Rather they resort to various means of non-price competition.

They create direct links with the consumer by advertising, by using brand-names, by promotion campaigns including seminars, etc. Lobbying with governments and payment of commissions, etc. are also an integral part of the strategy of these corporations to increase their market share and profits. In India obtaining production and import licenses has also become a component of the same pattern of non-price competition and erection of entry barriers. *The innovation strategy of these corporations is dovetailed into this monopolistic (oligopolistic) strategy of market domination.* This conduct of the corporations, flowing out of the given industrial structure, has very serious consequences for the demand for indigenous technology.

If the dominance by these monopolies is a characteristic of our economic structure, the other aspect is the dual structure, where along with large modern factories small, often 'traditional' industries, also exist.

The demand for indigenous technologies is created from within the dynmaic of the interaction of these two components of the private sector on the one hand and the public sector on the other hand. Superimposed on this the policy of the government functions to modify and alter the demand, although the essential parameters of this policy are determined by the very same structure itself. Some of the most pernicious effects of this structure can be looked at separately for the consumer goods sector and the machinery and basic goods sector.

CONSUMER GOODS

In the consumer goods industry, the demand for a technology is greatly influenced by its ability to provide a powerful brand-image. In our country utilization of foreign brand-names of the company or collaborator give added advantage to the manufacturer. People are prepared to pay a higher price for the same good with a foreign name. It has been estimated that colour television sets marked by a foreign brand name is priced 60 per cent more than a comparative Indian set. Within this structure the demand for indigenously developed technologies which cannot provide the foreign brand name is bound to be reduced. This phenomenon is very clear today in the craze for collaborations in televisions, two wheelers, cars etc.

The demand for foreign names has a negative impact not only in the industries being newly established, but also in the industries where foreign brands are already dominant. There are many multinationals such as Philips, Hindustan lever, Wimco, etc. who have a large market share of factory produced consumer products. These are standard products such as lamps, soaps, matches, etc., in which the multinationals are not generally interested in undertaking research. A recent study

SHARE OF FOREIGN COMPANIES IN SOME OF THE FACTORY PRODUCED CONSUMER GOODS IN 1983-84

Commodity	*Name and share of top foreign company (%)*		*Market share of foreign companies (%)*
Cigarattes	Indian Tobacco Company	(59.0%)	85.5%
Soap	Hindustan Lever	(50.3%)	
Cosmetics and toileteries	Colgate Palmolive	(44.4%)	86.0%
Shoes	Bata India Ltd.	(24.0%)	
Dry cells	Union Carbide	(47.7%)	
GLS Lamps	Philips (Peico+ELMI)	(40.6%)	
Packed tea	Hindustan Lever (Lipton+Brooke Bond)	(95.0%)	95.0%
Malted foods	HMM Company Ltd (Horlicks)	(57.7%)	77.0%
Milk products & baby foods	Food Specialities Limited	(25.6%)	49.5%
Synthetic detergents	Hindustan Lever	(58.1%)	62.6%

Source: Centre for Monitoring Indian Economy, 'Markets and Market Shares', March, 1986.

sponsored by the Ministry of Science and Technology 'Technology Evaluation and Norms Study in Electric Lamp Manufacturing' (1986), notes that:

> It is disappointing that after fifty years of lighting industry development in India there is no worth mentioning R&D department in any one of the units and even now everyone has to look for import of technology whether for any new product or new machine......
>
> Philips companies in India mainly concentrated on introducing different types of lamps and components and promoting the application of new lamps. They have great strength in product technology. On the side of manufacturing process they did not do much to build up the technical expertise needed in India. They do not have an R&D division in India. Nothing is heard about the developmental work done by their company in India even though it is one of the leaders in the world. (pp. 76-77)

The lack of interest of monopolies in undertaking research does not mean that there is no need to do research in these mature standard products. Soaps which consume scarce edible oils is a good example. The small-scale units in our country always used cheaper oils which included non-edible oils, such as neem. As early as 1954 government started research on utilizing non-edible oils for soap-making through KVIC (Khadi and Village Industries Commission) and the National Laboratories. Yet Hindustan Lever, the biggest consumer of oils for soap was not interested in doing research on the utilization of non-edible oils. It set up an R&D centre in 1959 with the idea of diversifying into new markets and when it did start its research in oils in 1964 it was done primarily to satisfy government demand. This indifference can be understood if we know how easy it was for the company to obtain oil. To quote the head of the buying department of Hindustan Lever, in the early sixties all that was needed was a telex to Unilever, London, for shipping palm, soyabean, or a coconut oil in the requisite quantities from the cheapest possible source to the two factories in Bombay and Calcutta'.

The market dominance derived by these corporations is such that even if others introduce new product innovations, they can be fairly confident to recapture the market. This is illustrated by the following cases—detergent powder was first introduced in India by Swastik but Hindustan Lever's 'Surf' became the leader. The detergent cakes Det and Bonus reached the market first but 'Rin' is the leader. The examples can multiplied.

The multinationals do not view product innovation as an important means to increase their profits in products in which they are dominant. They have much more powerful weapons in their hands for increasing their profits, namely supporting their brand name with more advertisement and strengthening their monopolistic trading network.

The importance of the trading network of MNCs operating in mass consumer goods is not recognized by many people. To take the example of Hindustan Lever (one reason for choosing Hindustan Lever is that it is the biggest foreign company), it has a wide network of more than 4000 stockists who are not allowed to stock any competing products. There are also other monopolistic practices involved in the operation of this network. The importance of this network to the success story of Hindustan Lever cannot be overstressed. Indeed, the semi-official historian of Unilever, Fieldhouse, called the sales network their most important single innovation in India! (*Unilever Overseas*, p. 164). And the network continues to expand. In order to meet the increasing competition due to the production of good quality soap in rural areas, Hindustan Lever has introduced a system called indirect coverage.

The directors want you to use an ingredient in the tonic to rhyme with 'brilliant' to fit into this promotional jingle.

The fact that it is the brandnames which contribute to the success of the multinationals in the consumer goods sector and not technology, is clearly revealed by the practice adopted by many multinationals of puttingout their production to small-scale companies. These include companies such as Hindustan Lever, Wimco, Bata, etc. It even includes companies such as Reckitt and Colman (Dettol) and Johnson & Johnson who have neither a licence nor a factory to produce soaps. This case is even more revealing of the strength of brandnames, because the production of these brands is not undertaken by an unknown small-scale company, but modern and well-known companies such as Godrej. But the former have something which Godrej does not have—a foreign name for which people are prepared to pay higher prices.

The trading nature of these monopolies (and their parasitic nature) is not confined to companies which produce soaps, shoes and matches or drugs. The activities of a company such as Philips which has a high-tech image is a good example of how widespread these activities are. While Peico (Philips) produced 880 thousand radio sets in 1984 it bought 744 thousand from other manufactures. Similar has been the case with lamps and tape recorders. The case of TV sets is even more interesting. As a foreign company Philips had neither a licence nor a factory to produce TV sets. Yet they sold 11,000 sets with their brandname, all bought from smaller companies.

The relative importance of brandnames as compared to innovations is reflected in the amount spent on advertisement in relation to the expenditure on R&D. The power of brandnames, often imprinted in our consciousness from colonial times, is supported by wasteful advertisement compaigns. Thus for example, Hindustan Lever and allied companies (Lipton and Brooke Bond) spent Rs. 15.3 crore in 1984 for advertisement and sales promotion, while less than a quarter of it was spent on research. If we consider the amounts spent on their dominant products, the ratio would be even less.

It is precisely these companies which have such largre market shares and earn super-profits that have the means to undertake research. But as we can see the very source of their super-profits—brand-names and marketing network reduces their incentive to do research or develop new techniques. When the commanding heights of our consumer goods are under foreign occupation, how can we expect adequate demand for indigenous science and technology?

The analysis might appear strange to those who have read advertisements by Hindustan Lever, about its contribution to the utilization of non-edible oils. Yes, they did undertake research when government controls were tightened in the mid-sixties in order to save foreign exchange. But the research conducted was nothing compared to that done in the national laboratories. As for the utilization of non-edible oils in production it was done by all companies in the organized sector. But this example shows how even when research and the linking of research to local production is necessary due to local conditions, how the specific character of our industrial structure reduced the demand for indigenous technology. And this is the story of the biggest foreign company with one of the biggest R&D laboratories in the country.

Small-Scale Industries

Unlike the monopolies, small-scale units have a great need for the introduction of modern science and technology. Yet the specific structure of our industries is such that they are unable to create adequate links with the scientific and technological infrastructure. The small-scale sector has to face the superior power of the monopolies in obtaining raw materials, in sales network, in brandimage, etc. and are forced to sell their products at a very low price so that they are left with very little resources for investment. Thus for example, the main raw material for soap making, hardened rice bran oil, is available to the small scale industrialist at a price higher than that available to large firms. These disadvantages arising from the existence of entry-barriers are added on to those which small industries suffer from due to the inability to enjoy the economies of scale.

The impact of the parastic monopolistic trading network and market dominance by monopolies on the development and modernization of rural industries can be imagined. A study commissioned by the Department of Industry in 1979 shown clearly how 60% of our soap production has to suffer from unequal competition. The only option available to these producers is to sink further in their living standards, to indulge in self-exploitation, and ultimately go bankrupt. P.C. Ray called the 'charkha', that is rural industries, the insurance against famine. Indeed the 1880 Famine Commission of the British also took the same position. *Today, when the spectre of famine again stalks our land, we have to ask the question—who will free our rural industries from the monopolistic clutches of these trading networks?* It is only after such liberation that enough demand can be generated on a wide scale for technological innovations from the small-scale industries.

Policy Regime

Government policy has attempted to curb the effect of these practices of monopolies but it has not been effective. For example foreign brand names were not allowed to be utilized in new collaboration agreements but brand names in use were allowed to be continued and names very similar to the well-known names were also allowed. The television industry is a good example of an industry in which the ban on the utilization of foreign brand names was most effective since it was a new industry, where the government did not have to deal with any established brand names. Not only was the utilization of foreign brand names not allowed, even three years ago the application of Peico Electronics and Electricals Limited for the production of TV sets was rejected since it had foreign equity. Despite this Peico managed to sell televisions under its brand name, by putting out the production to smal units like Orient Vision Limited at Hosur.

The attempts at curbing the restrictive trade practices of the monopoly business houses have been even more ineffective. The ineffectivity is illustrated by the case this August, when no punishment was meted out to Hindustan Lever for indulging in restrictive practices towards its dealers, and only a paltry sum of Rs. 10,000 ordered to be paid by this monopolist whose profits exceeded Rs. 3 crore.

In the current context of liberlization the existing restrictions are being removed one by one. In 1986, Peico (Philips) was given a licence to manufacture TV sets although not to use the brand name of Philips. Yet Peico advertises the TV displaying the brand name of Philips. Even this small restriction is to go soon, as the Department of Science and Technology has informed the Prime Minister that it would not be legally possible to prevent multinational companies from using brand names in the TV industry. In the last session of parliament the Minister of State for Science and Technology said that the policy of allowing foreign companies to use their brand names will be in the interest of the consumers!

Under such a policy, we cannot expect much demand to be generated for technologies such as that generated by CSIR.

CAPITAL GOODS

The demand for technology from the capital goods sector plays a very important role in the economy. The capital goods sector, that is, the sector which produces machinery, is the vehicle through which innovations get diffused throughout the economy, since the developments in the production of a particular capital equipment will have a positive impact on all the industries using that particular equipment.

The demand generated by the capital goods industry is influenced by the nature of the international industry dominated by a few multinationals. In the rivalry between these international monopolies, non-price factors play a very important role. The market for the technologies is created by providing tied credits, lobbying and influencing government policy, etc. The operation of these selling tactics distort the demand for technology generated by our capital goods industry. With the recent liberalization of economic policy whatever minimal shielding our economy had from these international factors has been removed.

World Bank

Among the factors used by the multinationals to influence the demand for their products, a very important role is played by the credits supplied by their home goverments, especially the credits routed through multilateral agencies such as the World Bank. World Bank loans are not just loans on which we have to pay interest, but they are loans given for specific projects and under specific conditions. These conditions result in the utilization of foreign consultancy, technology, machinery and equipments for the projects financed by World Bank loans.

Among the conditions put forward by the World Bank, the demand on international competitive bidding (ICB), on proven technology, and the preference for the appointment of foreign consultants as the main contractor have very serious consequences for the demand for indigenous technology. The insistence by the Bank on ICB appears as if it is a very competitive form of setting up a project, but nothing could be further from the truth. But before we look at the extent of distortions built into the system of setting up a project through World Banks procedures, due to which local suppliers of technology are forced to retreat under the monopolistic advantages of the foreign suppliers, it is necessary to look at the principle of ICB itself.

Under international competitive bidding the equipment supplied for the project, except a small portion reserved for local procurement, is to be obtained on the basis of global tenders where the lowest bidder is accepted. Given the economies of scale, earlier experience, etc., which the suppliers from the advanced countries have, usually they are able to supply the equipment cheaper. The lowest bids are chosen, although the local suppliers are chosen in case their prices are not more than 15% higher than the cheapest foreign supplier. That is, the World Bank allows a maximum of 15% of protection to the indigenous industry. In case the protection accorded by the local government is lower than 15%, then the lower extent of protection is given. The whole philosphy behind this is that protection is bad for efficiency in the industry.

To begin with, the argument is valid only if we assume that the international economic structure consists of small firms competing with each other. On the contrary, the international economy is today highly monopolized with only a few firms operating in each industry. Further historically, every country that has industrialized has done so behind the protectionist walls erected by their national governments. This was the case with Germany and Japan. Ironically enough, England, the classical champion of free trade, industrialized its country by protecting its textile industry from cheap Indian handlooms.

Hence it is possible to argue that the main purpose of this false argument is to open up the market in underdeveloped countries to which free access was lost after independence. The whole idea of international competitive bidding as a means of obtaining equipment for World Bank projects came up only when third world countries built up enough capability to supply capital goods. Even today when the World Bank is exhorting us to open our economies even further, even higher barriers are built up in the advanced countries against exports from the third world countries.

The complete loss of control over decision making and loss of national soverignty which result from the acceptance of World Bank loans makes it difficult not only to create a demand for indigenous technologies, but even to exercise our discretion in the choice of imported technology. The recent development in the modernization of our telecommunication networks involving a Bank loan of Rs. 450 crore is an eye-opener. According to the newspaper of September 30, the World Bank has asked the Department of Telecommunications (DoT) to float fresh tenders for selecting the optic fibre technology for upgrading the telecommunication network, because the Bank did not approve of the weightage accorded by the Department to the different suppliers. To please the Bank, it is not only necessary to go for global tenders, but the Bank's own assessment of the different suppliers has to be accepted. This is not the first time that the Bank has made such interferences. In this context we have to remeber that national sovereignty is a necessary pre-condition for applying science to fulfil national needs.

The fact that ICB and the other conditions put forward by the Word Bank create conditions under which technology and equipment supplied by local producers are rejected even when they are cheaper and technologically adequate can be illustrated by various examples. A most recent example is that brought out by the study commissioned by the Confederation of Engineering Industry ('Capital Goods Under Project Imports', August 1986) in connection with erection of the fertilizer project at Vijaipur. The Italian consultants Snamprogetti was appointed as the prime consultant for the gas-based fertilizer factory which started production this year. Projects Development Indian Ltd (PDIL) was the Indian supporting consultant. PDIL suggested that the ammonia coverters could be locally fabricated and welded together at site. This is a procedure which is approved by even the nuclear power plants in India, where the specifications are much more stringent. Snamprogetti did not approve. Since Snam as the Prime consultant has to give the performance guarantee, the opinion of Snam was crucial; otherwise the guarantee could be refused. An extra reason for accepting the suggestion of Snam was the fact that the c.i.f. prices of the imported one piece converter were 24% cheaper than the domestically fabricated equipment.

Yet the imported converters turned out to be very expensive. In order to ship the Vijaipur ammonia convertor weighing 420 mt from Kandla to Guna a special trailer had to procured, which could not take a slope of more than 2% incline. Since there were higher gradients at many places along the 1200 km route, *temporary* embankments had to be built including a purely temporary dam across the river chambal which had to be demolished after the trailer had crossed the river. The cost of transporting this equipment was Rs.8 crore while the c.i.f. value of the equipment was only Rs. 1.26 crore. If it is assumed that half the cost of transportation was for the construction of permanent structures then the cost of the imported equipment at site comes to Rs. 5.46 crore. The cost of the indigenous equipment including the cost of putting up a shop for site welding would have come to only Rs. 1.85 crore.

In this case it is clear that the disadvantages faced by the local producers are not merely on account of price. Even in cases where it would be in the user's immediate interest to utilize domestic technology and equipment, it does not take place. One way of achieving a better utilization of local technology is to unpackage the technology, so that what is locally available can be used. In order to do this it is necessary to have an Indian consultant who does not have a vested interest is producing a market for the equipments manufactured by the affiliates abroad. When a project is put up on a turnkey basis or with a foreign consultant as the prime consultant we do not have the possibility of unpackaging the technology. To a large extent the difference is reflected in the fertilizer plants put up at Vijaipur and Namrup. While 85% of the capital goods for the ammonia plant at Vijaipur is imported, only 30% of the capital goods at the Namrup plant put up by PDIL is imported.

Multinationals

Another factor which affects the demand for indigenous science and technology from heavy industry is the changing nature of our own capital goods and basic industries. After independence these were set up as symbols of self-reliance, against the opposition from multinationals who saw in it a threat to their markets. The technology made available by U.S.S.R. played a very important role in setting up these industries. Due to the setting up of supporting design and engineering and research facilities these technologies were also absorbed. An attempt was also made to import technology where available from western countries, without entering into dependent relationships.

But since 1974, a new tendency has been building up where these public sector units in the key areas of the economy have entered into comprehensive collaboration agreements with multinationals, sometimes getting involved even in equity participation. The nature of these agreements is such that the public sector units, instead of being bulwarks against the domination of our economy by multinationals, are becoming conducts for their entry into our economy.

Policy

In the case of capital goods also, the specific interaction of the conduct of international monopolies with government policy is only compounding the obstacles faced in creating an adequate demand for our indigenous technologies. Thus for example, in April 1985, Government of India announced a new liberalized impport policy, under which customs duties on the import of capital goods were drastically reduced from 105% to 43% for the import of capital goods under 'project imports' For specific industries it was even lower. Thus equipments imported for power projects have only 25% duty while for fertilizer projects there is no duty at all! In this liberalization the government has gone even further than the World Bank, since the Bank allows at least 15% protection for local equipment!

One of the main reasons for the liberlization in the policies toward multinationals has been the argument that we will be able to improve our competitinenss and improve our position in export markets. Yet it is shown by a recent study conducted by the Corporate Studies Group of the Indian Institute of Public Administration that under the liberalized regime, the foreign companies who were to earn us more foreign exchange have been spending more foreign exchange than they have been earning. And this negative performance has become even worse under the more liberal regime of the eighties. Thus for every rupee of foreign exchange spent in 1975-78 the foreign controlled companies earned Rs. 1.08, while in 1981-84 it went down to Rs. 0.76.

4. SUPPLY OF INDIGENOUS TECHNOLOGY

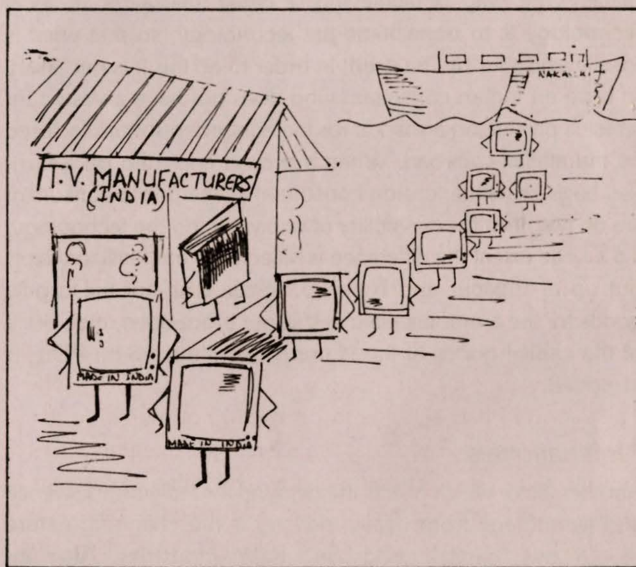
The lack of interest in indigenous technology is not only related to the circumstances determining the demand but also to the nature of the technology supplied in India. In the long-term the demand for a technology can be sustained only if it is cheap and efficient and technologically dynamic. There have been various factors operating within our economy which have prevented the technology supplied being cheap and dynamic. In order to attain these two goals, it is necessary to have some minimum size of production, given that standardization can further cheapen the products. Larger market sizes also make it possible to introduce specialization which is necessary to achieve technological dynamism.

For many products the existing market is too small to be able to set up factories which make use of optimum scales of production. Since most of the technology which we import is developed in advanced countries with larger markets, we have often to scale down these processes to our market sizes, with the necessary loss in the advantages of scale. Yet with a better distribution of income, even the existing national income can generate enough demand in many of the mass consumption goods and thus create a large market for the capital goods and technology supplied to modernize these industries.

Thus for example, the Indian tractor industry produces about 60,000 tractors in 17 units which have a total capacity of more than one lakh tractors. The biggest units have the capacity to produce 10 to 15 thousand tractors per annum, while many have as little as 2-3,000. Yet it is estimated that an economic unit should have a capacity of 25,000 to 40,000 per year. With a different rural system, the demand for tractors could have been higher which could have sustained more viable units. And if the existing production had been in two or three public sector units, then also viable scales could have been achieved.

TECHNOLOGICAL FRAGMENTATION

Unfortunately the combination of production structure and policy is such that today even the potential of the existing market to generate cost-efficient and dynamic technology is not utilized. By standardizing the technology used in a particular industry the potential of the given market size can be utilized. On the contrary, the market is fragmented between different types of technologies and sizes so that any inputs supplied suffer from the problems of a market even smaller than what it actually is.



Thus for example, the tractor industry suffers not only from the existence of 17 sub-optimal units but also from technological fragmentation, with the tractors being set up with technology imported from USA, UK, USSSR, Japan, Germany, Czechoslavakia and Poland as well as indigenously developed technology. This fragmentation increases the cost of any components which have to be manufactured in India. Such a high cost input cannot be sustained for long, and the alternative will be to choose components imported from the parent company. Such a fragmented industry cannot also justify the investments necessary in setting up design and engineering units, which by coupling with the result of R&D can introduce a dynamic tractor industry.

Instead, if the industry had been set up in a planned manner on the basis of the indigenous technology developed, or atleast on the basis of one carefully selected imported technology which is then absorbed, these problems of technological fragmentation could have been avoided. The lowering of the cost would have widened the market for tractors further and thus set up a process of self-sustained growth. But such a policy of centralized pruchase of technology and diffusion requires an effective planning system based on social control of the production units. *A fragmented decision mak-*

ing structure in a regime where the source of innovation is external leads to technological fragmentation.

DIFFUSION

The problem of technological fragmentation is not a factor that is confined within the parameters of a particular industry, but it is a problem located at the level of the whole industry and economy. When an economy develops essentially on the basis of endogenously produced technologies, there are factors operating which ensure that there is an enmeshing of the different technologies available. But when an imported technology is introduced into the system, there are no spontaneous market forces operating to ensure that this type of linking up will take place. The more advanced and sophisticated the imported technology the less will be this spontaneous tendency. It is only couscious social intervention which can ensure that the imported technology does not remain an isolated intervention in the economy, but diffuses through the economy.

Thus for example in the case of the tractor industry, the development of components such as engines and brake and clutch systems have elements common with the two-wheeler and car and truck industries. Again there are various components that are common to the whole of the engineering industry. Further back, special steels, special techniques of forging, welding, etc. are also involved in the production of a new type of tractor—techniques and materials with a potential impact on the whole of the industry.

This type of interlinking is to be traced not merely in the modular engineering industries, but also in the integrated process industries. Thus for example, the generation of catalysts for the fertilizer industry has created a knolwedge base that can be applied to various other catalytic processes, in petrochemicals, alcohols, etc.

The extent of diffusion possible from an imported technology is determined to a large extent by the stage in the innovation chain from where the technology gets imported. Thus the possibility of diffusion is greater if the design for a plant is imported rather than the plant itself and it is even higher in case the basic know-how is transferred. Hence a know-how that is centrally purchased for the industry by the R&D wing of the industry in collaboration with the rest of the industry has the maximum possibility of diffusing throughout the economy.

The effectivity of such a process of 'technological convergence' can be increased by carefully orchestrating the choice of technologies used in various related industries. *This integrated planning recognizes the fact that the economy is an organism and not an aggregate mixture of sectors which can be parcelled to various 'aid' giving agencies.*

Although at least till the mid-sixties some kind of planning was carried out, there was very little recognition of the need to coordinate the choice of technology within an industry or across industries, since the focus was on acquiring capabilities. Later in relation to specific industries, the question of standardization was discussed, but it did not find reflection in actual policy. Further, in a background of weakening planning mechanism, the policy recommendations as reflected in the Technology Policy Statement did not have any basis to function.

Yet there have been some instruments of policy which have had the effect of reducing technological fragmentation. Within a general import substitution regime, the demand was raised that indigenous non-availability of equipments and technologies had to be proven before imports were allowed. The other was the emphasis put on employing Indian consultants during the Fourth Plan period. In the early phase of our post-independence industrialization, the projects were executed on a turn key basis by foreign consultants. The shift in emphasis made it possible to unpackage the technology and utilize locally available inputs. Yet these policies were being introduced in a system where the basic economic structure was fragmented. Hence what essentailly resulted were high cost capabilities.

The supply of these high cost indigenous capabilities allowed the government to bargain with foreign suppliers of technology, who were not willing to supply the technology. But the creation of such capabilities for the generation of technology did not create the conditions under which it can become cost effective, dynamic and link up with the different sectors in the economy and diffuse through the whole system to upgrade the whole economy.

CONTRADICTION

Apart from these specific factors which affect the demand and supply of technology there are general factors which are of importance. In a country setting out on a path of industrialization, it is inevitable that the technology supplied locally will not be commercially tried out and proven. All other conditions being equal, a user prefers to obtain a technology which has been already tried out else where and debugged, rather than local technology that has reached only the stage of pilot plant or prototype. Unlike the counterpart in the advanced country who is already operating at the frontier and has no choice other than to utilize untried technology, the industrialist of an under developed country has his technological options open. This disincentive in an under developed country adds an extra reason for the introduction of planning to ensure the utilization of indigenous technology.

The tendency of the producer is reinforced by yet another factor. The technology imported has a higher efficiency than the locally available ones, but the utilization of this technology usually has the negative consequence that the machinery and other inputs needed will have to be imported. Therefore the total social benefit would not be as high as could be expected solely the basis of the increase in productivity achieved in the individual unit. Yet an individual entrepreneur will take the decision only on the basis of the increase in productivity in his own unit, and not on the basis of the total effect on society.

This inherent contradiction between the immediate needs of the user industry and the needs of general economic development can be resolved by making the decision making of the user industry a part of the common decision making mechanism. The economic structure which developed after independence contained this contradiction between the interest of the individual industrialist and the general common needs of technological upgradation based on indigenous technology. The contradiction was sought to be solved through a sytem of physical controls, licenses, etc. However, given the basic nature of the contradiction, the system of controls introduced as plan instruments have proven ineffective. In a situation where the market has not been growing due to the skewed income distribution, this basic contradiction has only got further strengthened.

CONSEQUENCE

What is the consequence of the fact that the capabilities we have built up in machine building, design and engineering and research and development are not being linked to production?

The dependence on imported technology rather than indigenous technology has enormous consequences for the balance of trade crisis we are facing. In 1985-86 our imports exceeded our exports by Rs. 8748 crore. The real financial cost of the technology imported is reflected not in the fees paid for the technology but in the foreign exchange spent on the import of raw materials, components etc. Thus, according to the study by the Corporate Studies Group, foreign companies (former FERA companies and subsidiaries) spent Rs. 286.32 crore on the import of raw materials, etc., as compared to Rs. 3.04 crore payment of technical fees and royalty.

The under utilization of our capabilities is not only reflected in the under employment of the scientific and technical sectors, but also in the general under employment of our scientifically trained labour force. Compared to some of the developped countries the number of scientifically trained personnel in our country is not large, we have only 3.9 scientists, engineers and scientists per thousand of the population as compared to Canada (289.3) Hungary (173.7), Japan (312.8), Sweden (262.4) and USSR (116.1), The existing scientific labour force is absolutely necessary for the upgradation and modernization of our country, yet they get unemployed due to the policy of delinking. Apart from the under utilization of the trained labour force in our country, such a structure also results in brain drain. It is not only the attraction of higher emoluments that induce our trained labour force to leave the country, but also the lack of opportunity to effectively utilize their capabilities. It is short-term and in effect anti-national view that looks at the foreign exchange repatriated by these personnel without considering the great loss for the long term development of the economy. Yet this flow can be reversed only by changing the general tendency towards delinking.

Another very impportant consequence of the under utilization of the capabilities we have built up in the country is that it can undermine the very capabilities themselves including science itself. There is an organic link between science, technology, design and engineering capabilities and production. Absence of the link between any of these sectors results in the stunted development and destruction of the very capabilities. The weakening of the S-T-P link has very serious consequences for the diffusion of technology throughout the economy. Even the imported technology remains an island without invigorating and modernizing the economy.

BASIC RESEARCH

Our call for 'Science for the Nation' is not a purely utilitarian slogan where science is seen as an instrument to fulfil immediate national needs. It also includes the call to create a scientific enterprise in the country that is part of the international scientific endeavour. It is an affirmation of our essential human quality, our ability to enter into a dialogue with nature, to comprehend the laws of nature.

This basic research is not to be confused with undirected research. Indeed the research effort which falls under basic research needs to be directed towards obtaining powerful clues to the nature of reality, rather than to mindless extensions of well-established results to even more phenomena, which might have no useful application. The excellence of our basic research, where work on problems of universal concern is undertaken, would also determine the ability of our universities to retain our best minds and create a 'Science in our Nation'. Echoing Acharya Jagdish Chandra Bose, writing in colonial India (1913), we can say "Is your university always to be a preparatory school for the foreign universities which have a world status? Will you never be able to make your work so distinguished that, instead of there being a constant export of foreign students to other universities, there should be an interchange?" The high level of teaching such a university can produce, where students come in touch with first-hand knowledge, is a crucial factor in upgrading the general technical level in the whole country, whether in research, design and engineering or production.

Even as this enterprise of scientific research is undertaken as a spiritual mission, it is not without its roots in practical activity. Many problems thrown up by the needs to create specific products and processes often require basic research before further development can take place. The direction of this oriented basic research, is strongly affected by the S-T-P links which exist in the country. If a vigorous applied research which deals with the problems faced in our production system existed, it could form the basis for stimulating new lines of basic research. The lack of an adequate S-T-P link in our country limits the base available internationally for basic research. Here we can see that there is no contradication between the creation of 'Science for the Nation' and 'Science for Humanity'.

The given economic structure in our country is such that it does not effect an adequate linking up of science, technology and production. Before us lies unfulfilled the task taken up by our patriots almost a century ago, to establish that link.

5. WHAT IS TO BE DONE

What can we do to change the situation, to ensure that the link between our scientific and technological capabilities and productive capacities are adequately established? The attainment of political independence was necessary to create the basis we have today. What do we need today to utilize this basis, without which the very capability we built up might get degraded and destroyed, forcing us again into subordination? Some of the following are steps which can be taken up immediately, while others are of a more long-term nature.

Capital Goods

Demand from the World Bank and other financing agencies that the conditions attached to loans be withdrawn. There should be no global tenders and no insistence on proven technology. International loans should be considered as loans given to a sovereign power on which interest can be paid and not as instruments for undermining our plans for technological self-reliance. In case the Bank rejects the demand to remove conditions, cancel the loans from the Bank.

Appoint Indian engineering agencies as prime consultants for all projects. No turn-key projects should be granted to foreign consultants.

When technology has to be imported for uprading our capabilities it should be done centrally by a group consisting of the relevant research and design organizations and not direcetly by the consuming industry. There has to be concomitant intensive R&D programme to absorb and improve upon the imported technology, so as to avoid repetitive imports and dependency.

R&D units of public sector units must have significant involvement in decisions relating to acquisition of foreign technology and in negotiations pertaining to it.

Import of technology should take place only on the basis of a long-term perspective plan. The criteria and the procedures used for importing the technology should be made available to the public.

Scientists, engineers and government employees associated with the import of technology should have the freedom to participate in any national debate on the choice of technology.

Consumer Goods

Nationalize all monopolies.

Ban the utilization of brand names. Consumers should be proteced by developing and strictly implementing consumer protection laws.

Scientific Infrastructure

R&D centres by multinational corporations should not be encouraged. They should be as open to public scrutiny as national laboratories. The board of directors should have governmental representation.

National laboratories and universities should not undertake contract research for multinational corporations.

Planning

There should be comprehensive integrated long-term planning.

Instead of delicensing industries as today, industrial licences given should specify not only the quantity to be produced but also the type of technology to be used so as to avoid technological fragmentation.

Key industries like machine—building, steel, chemicals, etc., should be under state ownership.

Apart from the plan co-ordinated at the central level, it is also necessary to build adequate flexibility at the local level so as to adapt to local needs and resources. An important part in this process is to be played by those directly involved in the production process through full worker participation.

WHAT CAN WE DO ?

The struggle to utilize science and technology for our national needs, the struggle for self-reliance is too important to be left to bureaucrats, managers, politicians, experts, etc. We have to form groups within our people's science organization, institution, factory or neighbourhood to take up the cause of science for the nation. In order to fight for self-reliance, we need to inform ourselves. Through study, collection of information and critical thinking we can understand enough to take steps to intervene on issues which affect us.

We cannot adequately inform ourselves unless we absorb the experiences and insights of our people. Their struggles have to form our source of strength and inspiration and guide us in our attempt to achieve self-reliance.

We need to go to the people with the information we have collected, with the insights we have gained. The people also require counter experts. Agitating on policy issues and informing and mobilizing the people are both essential.

Let us begin with products and production processes we are most closely associated with—the factory or the laboratory we work in, the oil seeds pressed in our neighbourhood, the pesticides we use. Is the best method being used ? If not, why not ? Who benefits from the methods used ?

- Let each group focus on a particular multinational. What is its contribution to our country ? Has it brought in a technology which we did not have ? What is its impact, the impact of its brand name on the small-scale sector, the public sector and on the Indian industry ? Has it complemented or destroyed the development of indigenous capabilities ? The control of information itself forms one of the sources of power of multinationals. Let us break that monopoly.

From study let us begin campaigns—campaigns against the setting up foreign companies that throttle our national industries, campaigns to avoid the use of products with foreign brand names, local campaigns that can grow into national campaigns. Let us start a new swadeshi movement to utilize our common human heritage of science for the benefit of our people, our nation.

6. GLOSSARY

1. c.i.f. price:

Price which includes the cost of the product, insurance and freight. This price does not include the customs duty to be paid. Therefore whenever the cif price of an important equipment is compared with that of a local product, as in the case of World Bank projects the effecet of customs duties put up to protect the local producer is nullified.

2. Economies of Scale:

When the scale of production of a firm is increased its total production costs tend to increase less than proportionally with the output, resulting in a lower unit cost of production. These economies are also applicable to marketing, administration etc. The existence of these economiese give an advantage to the larger units. These economies are the result of the technical nature of the organizational structure and independent of the ownership pattern of the unit. Thus these economies are enjoyed whether the firm is privtely owned or publicly owned.

3. FERA

Foreign Exchange Regulations Act 1973. One of the objectives of the act was to guide foreign investment into high priority areas in the export and high technology sectors, given in Appendix I of the Industrial Licensing Policy Statement Section 29 of FERA requires all foreign companies to dilute the foreign share holding to 40 per cent. An exception is made for high-technology and export-oriented companies which were allowed to maintain upto 74 per cent foreign ownership. An unfortunate consequence of FERA is that foreign companies are treated as Indian companies once they bring down their foreign equity below forty per cent, eventhough they continue to be as tightly controlled from abroad as before. On the contrary, in many other countries such as Japan, Australia and U.S.A., a company is considered as a foreign company even if only 15 per cent of the shares are held by a foreign shareholder.

4. Competition / rivalry:

When the number of firms selling in a market is so large and each individual firms share of the market so small, that no individual firm is able to influence the price, the market is considered to be competitive. In a competitive market, the price is given to the individual producer. The structure of such a market is different from a market in which the firms are so large that they are able to influence the price of the commodity and the fortunes of other firms. In such a market the firms would still use various means to improve their position including changing prices or non-price means such as advertising.

This type of 'competition' is known as rivalry. While the competition characteristic of the first type of a market can be an efficient allocator of resources, the second type of market actually wastes resources for eg. through competitive advertising, low utilization of capacity etc. The confusion between these two types of behaviour can lead to wrong policy options. Very often in the name of introducing competiton, rivalry is introduced which has no positive contribution to increased welfare.

5. Monopoly / oligopoly:

A monopolistic market is said to exist when any of the firms possess some power over the price. They are price-makers. The presence of this market power distinguishes a monopolistic market from a competitive market. A situation in which only one firm exists is a special category of monopoly which is absolute. Unfortunately there has been a tendency to use the word monopoly only for this extreme situation and to use the less offensive word 'oligopoly' for a market dominated by a few firms.

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(2) [illegible]
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(4) [illegible]
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