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Editorial

A Problem in Management

Elsewhere in this Issue we have given the personnel and terms of reference of the Enquiry Committee under the chairmanship of former Chief Justice Shri A.K. Sarkar appointed by the Prime Minister to look into the affairs of the CSIR. The appointment of this Committee is earnest of Government's anxiety to get at true facts of the situation in this premier scientific organisation. Considering the charges and counter charges that have figured in press and the parliament during the last two years it was but inevitable that the Government should have to allay the fears of the public and do something definite to remedy the situation. The Committee consists of Members of Parliament known for their positive and robust attitude to the affairs of the country, and scientists who are un-committed to any partisan standpoint in the controversy. The eyes of the entire scientific community inside and outside the CSIR are focussed on the deliberations of this Committee. Many hopes are entertained and we sincerely hope that they will be fulfilled.

It is already more than four months that the Committee was announced and as far as is known it has yet to get into stride. Considering the difficult and complex task before the Committee, it would be unrealistic to expect it to pronounce its verdict in the stipulated period of three months. Whenever an institution, public or private, is as sick as CSIR is reported to be, a close look into its management is called for. We wish the Committee well and sincerely hope that it will recommend measures which will rejuvenate this most important public sector organisation for industrial research in the country.

Is the CSIR, concerned as it is with industrial research and development, rightly located as responsibility of the Ministry of Education? Is not there ample justification for applied sciences and technology, in view of their importance, deserving a separate Ministry? Has the Governing Body of the CSIR functioned as an effective policy formulation and implementation body as contemplated in its rules and bye-laws? With a galaxy of ministers, eminent scientists and top industrialists who have little time to spare has it not been more of an ornamental facade? Do the contradictory decisions taken by the Governing Body on vital issues do credit to its management function? The Board of Scientific & Insdustrial Research as the principal scientific advisory body of the CSIR is well constituted but vital scientific matters are kept outside its purview. Is there sufficient compulsion in the rules and procedures to enforce its statutory position? If it were so, perhaps the subjective element in the present controversy would have been tempered with scientific reasoning.

Is the structure of CSIR suited to its function as a technical coordination and policy formulation body? Is the system of central functioning as an administrative secretariat appropriate? What is the status of the Directors' Conferences—are they mere social get-togethers? Are

the CSIR programmes related to the needs of industrial development and planning? Is there any provision for active participation by the working scientists at various levels in the framing of the policies and programmes of the organisation? If it were ensured, considerable frustration of the younger scientists would have been avoided. Are the coordination links of the CSIR with other technical and research organisations and the planning and development authorities effective or are they mere administrative formalities?

Is not autonomy of the CSIR organisation as a Registered Society unreal, and in some manner worse than that of a government establishment? Is the working scientist in CSIR free to express his views on the working of the organisation.

We do not expect the Sarkar Committee to be able to deal with hundreds and thousands of real or imaginary irregularities but we do expect it to look into the management aspects of this premier scientific organisation and ensure that this management is carried out with efficiency and objectivity in keeping with the requirements of a modern scientific research organisation.

N.P. GUPTA
President, ASWI.

Frankly speaking

We have received a communication from Shri R. Sambasivan from Fysiske Laboratorium, H.C. Orsted Institute, Kobenhavn, Denmark who is on extraordinary leave from the Publications & Information Directorate of the CSIR. Although the scientist was engaged in the field of scientific journalism, he developed interest in the field of lasers, obtained facilities for stay and passage abroad from the Danish University. He is facing difficulties because study leave has been denied to him on the argument that his field of study is of no interest to his employer organisation. While other countries encourage scientists to acquire specialisation in fields different from their own, it is surprising that in India the scientists should be discouraged by denying facilities like study leave. The question of study leave to a scientist employed in a public utility concern, when allowed to proceed abroad to specialise in any branch of applied science, has lately been the subject of controversy between the administrative authorities and the scientific community. The authorities employ the yardstick, that study leave can only be granted, if it is in Public Interest and also in the interest of the organization in which the scientist is employed. The working of the rule presents no controversy, when the organization by itself sponsors a scientist on deputation. This acid-test of the study leave rules is seriously called into question where the mission of the scientist proceeding abroad is either not directly related or falls outside the immediate scope and function of his organisation. Administrative authorities have invariably failed to evaluate the scientific merits of such cases in a correct perspective.

Often a scientist may develop special research interests in a branch of Applied Science, not strictly related to work in the organization he is employed. While pursuing his newer research interests, the scientist may get meritorious recognition abroad, and may even specialise in that discipline. The concerned local authorities invariably deny study-leave since no 'organisational interest' is involved. It is here we believe that their assessment is superficial and deleterious to the wider interests of Science.

When the scientist proceeds abroad in a field of applied research of recent origin (e.g. Holography), for which no recognised schools of advanced research exist in the country, and the field has immense potentialities of technological application in India, his training should certainly be deemed to be in public interest. Instead of quoting rules and procedures, his official status in the organisation must be overlooked. In the case of institutions like the CSIR, Defence Science Organisation, which encompass research institutions of various disciplines, any particular branch of applied science can be fitted into the purview of the larger public interest. It is with this wider perspective, that the question of study leave must be approached. After all the study leave gives only limited monetary benefits to the scientist in the form of average-pay paid in Indian currency to his dependents (wife and children) in India. When a foreign Government is prepared to pay for stay abroad and passage from/to India for the scientist (in fact the country gets a man trained abroad at no cost), is it unreasonable to expect that our Government should extend monetary benefits of study leave, so that his dependents in India do not suffer financially.

Science Education in India*

Rais Ahmed**

I

Let me say right away that science education in India is just riddled with problems. It is difficult to even sort out the major problems from the minor ones because they are really interconnected. On the other hand, scientists, educationists, parliamentarians and even the lay public have discussed these problems for nearly twenty years without coming in sight of the elusive solutions. This has led to some amount of discouragement which sometimes borders on cynicism. The feeling is that we all know what is to be done but we refuse to do it, or are prevented from doing it by vested interests.

However, I am not inclined to enumerate or discuss these problems today. I would rather raise a point which, in my view, has far greater significance for the future of science and social development in India. My contention is that the concept of science which we usually have while discussing science education, is a very narrow and mechanical concept of science. We ignore or shy away, or perhaps fear a live and dynamic concept of science because it might sweep away the cobwebs of irrational thought and belief, because it might expose to light the mysterious and the irrational which is often very dear to us. My contention is also that unless we conceive of science in its fullness, particularly in respect of its role in ideology and culture, we shall not free the human soul from the bondage of dogma and of established belief, restraining creative energies required to lay the foundation of a new social order. If we confine ourselves to the stultified image of science, then even if we succeed in the fruitful application of scientific knowledge, we shall only have achieved what others did one or two centuries ago, and it will be a pale achievement compared to the potentialities.

II

In order to clarify what I wish to say, allow me briefly to discuss the nature of science.

In my view, science is basically a search for truth. In science we make detailed investigations of parts in order to arrive at an explanation of the whole. We try to work out an explanation of phenomena in general. We re-examine observed results and carry out further experiments or observations to reject or verify the initial hypotheses. On the basis of this groundwork we put forward theories and tentative laws of nature. This, obviously, means that science is rational, the basis of acceptance or rejection is logic, reason and experiment. This also means that science "reveals" some aspect of truth and thereby makes it possible to pose a number of questions which could not have been imagined earlier. There is the likelihood that answers to some of the questions may upset earlier theories. Thus the search for truth becomes everlasting. This is a far cry from the concept of an immutable and revealed truth.

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*Paper presented during the 'Science Week' to mark the Twentieth Anniversary Celebrations of the ASWI.

** Professor of Physics, Aligarh University.

Science also challenges established positions consciously; nothing is sacrosanct. Fearless pursuit of knowledge for the unravelling of the mysteries of nature is the very essence of science. Therefore, there can be no fixed position or dogma in science. If I may so put it, science is a flowing river, a growing and developing body of knowledge, theories, methods and attitudes. It is not stagnant. It is not all there, created complete on the first day. It is in the nature of science to be flexible, ready for change and accommodative of many points of view. Science is the name of the consciousness that there are and will always be unsolved problems; it does not claim perfection; it is not a closed system.

I hope I would be better understood now regarding what I mean by the fullness of science. The body of knowledge is the "hardware" of science, but in my view the method of science and the attitudes or philosophy on which it is based, constitutes the "soul" of science. The teaching of factual physics, chemistry or biology does not, therefore, constitute the teaching of science. This concept of science was in fact the original concept of science when it was more realistically called "natural philosophy". In my view, there are historical reasons why we departed from the original concept, but perhaps a gathering of scientists would agree with me when I say that physics+chemistry +biology+mathematics is not equal to science.

I am not a historian of science, but perhaps I am not wrong in saying that it was the natural philosopher who was persecuted, tried and often burned on the stake, and not the scientist in the narrow sense of the word. The hardware of science was, in a measure, acceptable to society and it became a great contributory factor in producing the industrial revolution and its aftermath. But the explosive potentialities of explicitly accepting the surpremacy of reason were clearly realized even at that stage: a world-view based on reason would not accommodate revealed and immutable truth, it would not stand for dogma and blind faith, it would not accept that a system of thought could be closed and complete without necessity of amendment and modification. In short, such a worldview would shake the foundations of "religion" and classical "spirituality" and a society whose moral and ethical values were part and parcel of the religious system of belief, would fall to pieces. The limited and hardware view of science had therefore, to be invented, to allow the hardware to develop without threat to the "established" framework of beliefs, so that limited science and unlimited dogma could coexist. This was the situation in Europe when through the East India Company and the British Government "science" was imported in India. Science inertial and conservative forces were just as strong here as they were abroad, it is understandable that the bare bones of science were identified as the whole of science in India. In independent India too we seem to be confined to the same idea; we are keen to accelerate our economic development through the application of science, and we seem to be indifferent to the greater potentialities of science bringing about a social and cultural revolution such as may help us to give a far greater impetus to creative scientific ideas and their eventual application.

In my view, if as an under-developed country, we are interested in bringing about a rapid social and economic transformation, we must revert to the natural philosophy concept of science. For one thing, the hold of reason in a limited territory of thought will always be tenuous if unreason is allowed to rule in all the surrounding area; even decisions pertaining to the social application of science are likely to be based on vague hunches and beliefs rather than on a reasoned analysis of the facts of a situation; worse

than this, perhaps those sections of the society whose interests may temporarily suffer from certain logical decisions about the application of science may succeed in hoodwinking the public and the parliament through the rousing of emotion or of irrational sentiment based on a false sense of religion, age-old custom, ancient civilization, language, or even nationalism. For another, the habits of thought well suited to dogmatic belief and bigotry are the very opposite of the open mindedness and willingness for change required for the flourishing of science. In an atmosphere pervaded by obscurantism the urge for critical examination and creative thinking is bound to suffer, and we must end up by having a body of scientific personnel who has memorized scientific facts, who can reproduce these facts more or less like sacred texts but who cannot think for itself and is devoid of new ideas. This I fear, is already happening to our country we are actually experiencing the fact that the limited and mechanical concept of science makes science a prisoner of conservative forces; it disables science from making the constructive social contribution of which it is capable. Conversely, science has the potential of being an excellent instrument of social progress provided the whole of science is propagated and it is allowed to fully take part in ushering in the rule of reason everywhere.

III

It only remains for us to examine if such science as we have been discussing could be "imparted" through the normal educational processes. In my opinion it can be done.

First of all we who call overselves scientists have to examine our own conscience and conduct, and see that we struggle within ourselves to eradicate ideas and actions which are not based on reason. Secondly, if we are convinced that the image of science would be incomplete and only partially useful if the educational process only deals with the store of hard facts and theories accumulated in various disciplines, it is within our power to decide that through text-books and syllabi we shall strive to paint a living picture of science. I am quite sure that out of the time allotted for the study of science, 10 to 15 per cent could be devoted for a broader treatment of each discipline showing its history, its method, depicting the struggle of ideas in the past and the present phases of the discipline, and indicating its sociological and cultural implications. The same holds true for course books in which living science, dynamic science, could be presented, not by adding one or two chapters, but by using a new outlook for the presentation of the respective disciplines. On the one hand, I can see that the new orientation would require the exercise of deep creative initiative and it won't be a simple task—for one thing, because such an approach is not found in the usual books. But, on the other hand, I am sure that this is not beyond our means to achieve. I would rather say the scientists may take this up as a challenge, i.e. they should immediately take up the writing of at least a few books of this type. When these books are available, and if they are of a proper type, it would be relatively easier to pursuade the boards of study to recommend some of them. I believe this is an excellent area for the book committees of the NCERT to enter, at least on an experimental basis—by commissioning a few authors to write at various levels in selected disciplines.

In my view, only active participation of scientists in the struggle for rationalism, for the application of scientific method in sociological and ideological matters will ensure modernity and a contemporaneous understanding of men, matters and nature, which is the crying need of Indian society today. This is a sphere in which science education can and must play its specific part.

'A la Bastille ! French students revolt

Teaching facilities are poor, but what they resent most is the paternalism of the university system

HOWARD BRABYN

of the New Scientist Paris Office

The entrance to the vast modernistic block of the Faculte des Sciences which overlooks the Seine from the Quai Saint Bernard is guarded by half a dozen students of Paris University. Visitors are directed across the dusty, unpaved courtyard, now carpeted with revolutionary tracts and old sandwhich wrappers, up a temporary wooden staircase and into the concrete and steel building. On the fourth floor a classroom, litered with empty Coca-Cola bottles and sleeping bags, serves as a temporary press office. In a large, untidy scrawl on the blackboard is the slogan "Vive la Commune du 10 Mai."

Cutting short an incoherent political harangue from the bearded student press officer, I cornered 24-year-old chemistry student Bernard Schaver in an endeavour to find out what the science students really wanted; what they considered to be fundamentally wrong, not with the world at large but with their own faculty. Schaver is the younger son of upper working class parents. His father holds a minor executive position in a large electric cable manufacturing firm and his elder brother is an electronics technician. He is paving his own way through university, working 20 hours a week as an assistant in one of the laboratories of the faculty. He lives in an unheated, seventh floor attic room, with no running water, for which he pays the equivalent of £3 a week.

Schaver did not take the usual route to university. Instead of entering a lycee and taking the baccalaureat, he went to an e'cole communale and then took a four-year course at an e'cole nationale professionelle where, at the age of 19, he obtained the Brevet de Technicien superieur (approximately equivalent to the Higher National Certificate). He told me that he did not want to run the risk of failing the bacclaureat examination and finding himself both unable to enter university and with no qualification at all. With the Brevet, he was both sure of being able to obtain a post as a technician and also of being eligible for the university. As he has a part-time job, Schaver is allowed to spread his studies over a longer period than is normal. He has been at the faculty for five years and has one more year to go to complete his course.

I asked him what changes the students wanted in the university. He admitted that they had been justly criticized for not formulating their demands clearly. It is only now that they are really getting down to this. Pressed for specific demands he produced what added up to a formidable list. It included bringing the syllabus up to date,

more teachers who should have some pedagogical training, more facilities of every sort, but with a special emphasis on libraries, and finally, the inculcation of a true university spirit to replace the present "accumulation of facts" attitude.

On the question of teaching he told me: "I personally criticize both what we are taught and the way instruction is given. My background is a much more practical one than most students have and I had some difficulty in adjusting to the very theoretical nature of the teaching here. The university is designed to turn out teachers rather than practical scientists.

"I have about four hours of lectures, four hours of practical work and two to three hours of supervised study per week. Lectures given by the professors are very poor. Often the material is not sufficiently up to date and there is no analysis or critical approach. The lectures lack dynamism and are more like dictations than lectures.

"Lecturers are attended by anything from 150 to 500 students. In my first few weeks at the university I attended lectures in an amphitheatre designed to hold 300 students. It was so crowded that I couldn't even see the lecturer. The assistants who conduct the practical work and supervise our studies vary considerably, but on the whole they are not very good. This is not their fault. They have no special teacher's training and are often ex-students who are taking a higher qualification or are engaged on research. It is virtually impossible to obtain personal advice from a professor. The assistants are usually willing to help, but they have little time to spare for particular problems."

Schaver was less concerned than I had expected him to be about the material facilities of faculty. Perhaps this was due to the fact that the science faculty in which he works was built only two years ago and indeed is not yet quite finished. However, laboratory time is limited and strictly allocated and it appears that a student can never make up any time missed. My impression is that the facilities are not comparable to those available in English universities. Schaver's biggest complaint was the lack of library facilities. In the faculty itself there is one reference library containing only 150 books and many of these are out of date. There are other specialized libraries elsewhere in the university but these are usually reserved for postgraduate students. Schaver felt that in this one respect the science students came off very badly in comparison with those in other faculties.

With a larger population, Great Britain has some 200,000 university students as compared to the 600,000 in France; yet both countries turn out annually about the same number of people holding degrees. This is almost certainly due to the much more severe system of selection for university entrance in Great Britain. In France student have always been opposed to the introduction of any form of selection. I asked Schaver for his views on this point.

He replied: "Personally, I think that some form of selection should be introduced, but only after the method of selection has been very carefully defined" He stressed that this was a very personal viewpoint and added that he thought that at least 90 per cent of students would be opposed to any limitation on university entrance.

Schaver returned time and time again to the point that what the students wanted to see was a change in the "spirit" of the university. They feel that they are not receiv-

(*Continued on page 20*)

Conditions for Success in the Economic and Social Developments of Nations Through Science

by

J. SPAEY

Chairman of the OECD Committee for Science Policy

DEVELOPMENT THROUGH SCIENCE

A New Factor

There is one essential conclusion which emerges from the work carried out under the auspices of the Committee for Science Policy of OECD, and that is that we are witnessing important changes in every one of our countries in all spheres of human activity.

The Committee has been able to focus on one of the aspects of this development, that is the increasing, and in certain respects, the decisive place taken by science and technology in the development and organisation of industrialised societies.

This change, because of its magnitude and complexity, has all the appearances of a new process of development. Provisionally it might be qualified as development through Science, or in other words, the continuous acquisition of skills and new methods and their systematic development.

The reports presented to the Ministers described in detail the differences in this process of development in the various Member countries and the sectors and areas in which they are more or less pronounced. A study of these differences and their causes led the Committee to seek remedial measures.

The concept of "technological gaps" has thus been gradually replaced by a more positive and, doubtless, more fertile concept which we might term conditions for success in innovation.

The Committee noted that these conditions were present in differing degrees in most of our countries; but in certain countries; some of them were not, or were not adequately, fulfilled; and this explained the relative inadequacy of the economic results.

CONDITIONS FOR SUCCESS

Conditions for success in development through science centre on several main themes.

Education

The first is education. A modern industrialised economy needs many scientists, engineers and administrators with a university background. It also calls for a large number of well-trained technologists. An educational system which can provide schooling beyond the age of eighteen for the majority of the young and re-train a growing number of adults, is therefore, essential.

Fundamental Research

Higher education is inextricably linked to fundamental research. The latter is consequently, a second theme.

Fundamental research is the backbone of higher education. It is also the starting point of the process of industrial innovation. For these two reasons, it occupies an essential place in the conditions for economic and social success and is a long-term investment for our countries.

This must, not, however, lead one to forget the value of its ultimate purpose, which is to

meet the need to know, and constantly to go beyond, the questions which man poses about himself and the universe. For many centuries, this elan for knowledge created a universal community among all scholars.

Transfer of Technology

This world community of pure science is, today, spreading to technology. This leads us to the third condition of success; the transfer of technology.

In a world the unity of which is growing, no nation can cover individually all the stages and all the highways of technological progress. Each must assimilate the progress made by others and use it as a stepping-stone to pass in his turn through new stages. This applies even to the most advanced countries and undertakings.

But if the transfer of technology is to be effective, there must be active participation by the "transmitter" partner and 'receiver" partner. The 'receiver" country must organise itself to assimilate and adjust foreign technology to its requirements; it must, therefore, have a scientific and technical potential that is well developed and well distributed among undertakings, universities and the State. In other words, a potential for original innovation is essential in order to profit by the innovation of others. The "transmitter" country has its own reasons for opening up its technological progress to others if viable trade is to be established in both directions between valid partners.

Choice of Objectives

The fourth condition for success is the will of the nations itself to progress. If this will is to be more than an expression of good intentions, it must assume concrete form in objectives which meet the needs of the community.

It seems clear that Research and Development, when based on national objectives, involve the whole community in an effort towards progress by stimulating the creative spirit. The programmes inherent in national objectives include R and D government contracts which allow enterprises and other research centres to accelerate the process towards advanced technology, the strategy of progress and prospective management. They procure government supply contracts for industry, thus providing the initial financing of new lines of production.

The driving forces of national objectives are maximal when the industrial sectors which are to become the instrument of their fulfilment are those where technical progress has the widest impact on the technology ot all the other sectors. This seems to be very much the case in our era in electronics and data processing as well as, generally speaking, in the mechanical engineering and electrical industries.

When national objectives are non-existent or inadequate, men with the desire for knowledge and innovation—and they are to be found in every nation—have a tendency to disperse their efforts, very few of which find the means required for success. The most inventive minds are discouraged and are tempted to emigrate.

Size of the Market and Enterprises

However, even a country which has national objectives and a high scientific and technical development can still produce poor economic results. This implies a fifth condition for success: the size of the market and the enterprises.

Industrial innovation pays only when the technological breakthrough accomplished in the laboratory can be used to advantage industrially and commercially at the level of large unified economic complexes.

It is well known that the size of a market, if it is to be effective, depends on the number of inhabitants, their per capita income and the uniformity of demand and regulations. In this connection, the present Euro-

pean market contrasts with the American market for obvious reasons. Furthermore, the structure of industry corresponds very naturally to that of the market. Everybody knows that the watertight compartments of the European area are a serious barrier to the establishment of a properly-dimensioned industrial structure.

Organisation and Management

Lastly, it should be noted that the conditions for success which I have just listed can have neither a decisive nor a lasting effect unless they are integrated in an organisation and management appropriate to the objective pursued. This is a last but essential condition for success in development through science.

Commercial success in new lines of production is the results of a continuous process which, from the outset, is most often a scientific discovery or a technological breakthrough achieved in the laboratory but which continues in the industrial and marketing stages. These are long, costly and problematical. Hence, the capacity of an enterprise to succeed in original innovation depends on the degree of excellence of its strategy and the value of its management just as much as, and perhaps, more than, on its research potential. Mastery of the most modern techniques of programmed management is essential.

Nor it is any less important for government departments, whose duty it is to promote technological progress and the organisation of national programmes.

It is in the United States, it seems, that these conditions for success have been combined to the best advantage in the last two decades. Sectoral studies show that most of the recent breakthrough in technology and commercial successes based on original innovation have, in fact, taken place in that country not only in the sector of computers, electronic components and scientific instruments but also in other scientific industries such as the pharmaceutical products and man-made fibres industries.

As opposed to this, technical success is more evenly divided in the more traditional industries. Europe and Japan, in particular, occupy a favourable place.

However, economic growth does not appear to be definitely linked, at least in the short term, to national performance in original innovation. But in the longer term, some countries might become uneasy about a trend which would make them specialists in the traditional commodities and increase their dependence on the advanced industries.

It is for that reason that the Committee for Science Policy considers that the objective of all governments should be to carry into effect the conditions for success in each Member country or in the groups of Member countries.

The carrying into effect of this objective is likely to strengthen considerably the links of solidarity between our countries, and, as consequence, to put the friendship which binds them on a lasting basis.

RECOMMENDED ACTION

The Committee for Science Policy, after an analysis of these conditions for success, thought it should make known some of its views on the action to be taken and the policy to be followed.

In this connection the conclusions of the Committee lead implicitly to the need for a proper division of responsibility for national and international action.

It is clear that every government must take such action as can be effectively carried out at national level. The transfer of resources from national to international level together with institutional co-operation must be reserved for action which exceeds the possi-

bilities of an individual country or urgently requires a "concentration of brainpower."

But national action can be given very effective support by means of international discussions on experience and joint studies.

Action at National Level

Mention must first be made of the concrete measures which can be taken at national level.

The Committee underlined the necessity of tightening links between the scientific and the general policies of governments. This applies particularly to the two main fields in which the scientific policy of States is deployed:

The policy for higher education and fundamental research;
the policy of industrial expansion and technological innovation.

In the fields of higher education and fundamental research, the reports have shown how necessary it is to adopt the universities to the growing needs of the nation and how they may derive benefit from a management and organisation based more on precise objectives and rational policies. It also appeared that the promotion of fundamental research often meets with obstacles which result from too wide a dispersion of resources and from the inflexibility of some administrative or financial mechanisms which curb the necessary converging of the fundamental disciplines or the launching of new orientations.

In financing fundamental research, an effort should be made to reconcile to the maximum the natural demands of the free development of scientific thought with the requirements of new knowledge which springs from the pursuit of national objectives.

With regard to the policy of industrial expansion, the Committee emphasises the need for participation by all countries in the process of original innovation and its promotion by national objectives, government programmes and State markets.

The right conditions for bringing continuity into the process of innovation from the laboratory stage to that of winning the market should also be ensured.

Fiscal, financial or structural measures, among others are required to promote the development of industrial production units of adequate size, the enlargement of markets for advanced products, and the spread of modern management methods in undertakings.

Action at the International Level

Next, what are the measures to be taken in the sphere of international co-operation?

Let us first examine the broadest-based action, that of this Organisation and all its Member countries. The Committee believes that OECD is in a position to perform three essential functions to aid the efforts which are calculated to create in all our countries the necessary conditions for success in development through science.

1. The first of these functions concerns joint studies and discussion on national experiences.

It is what the report call a "form" "or centre of discussion" for scientific policy. The work of the last two years has shown the need for careful new studies which would come within the scope of this activity.

It is proposed, among other things, to make a comparative study of the university structures of fundamental research and the reforms which have taken place in Member countries in this area. The new universities, in particular, would be carefully analysed, as would the statutory and financial provisions adopted in the various countries.

These studies would be conducted discipline by discipline, with the same care as the sectoral surveys on technological gaps which have just been completed. They could be supplemented by a pilot-action, which would be limited in scope and experimental in character for the promotion of certain programmes by appropriate procedure and expenditure.

2. The second function is to identify methodically the objectives which are common to several countries and can, therefore, be the subject of inter-country co-operation in research, development and innovation. It also consists in laying down the most appropriate methods of cooperation and evaluating the necessary means.

The report enumerates a series of subjects in which the Member countries might thus explore together the possibilities of co-operation as they see them without any preconceived idea as to the form of the action to be taken or the institutions which might be required to carry them out successfully.

3. The third function is related to one of the principal objects of OECD, which is to promote the liberalisation of trade between Member countries. It is to draw up agreements among countries with a view to facilitating the transfer of technology.

In this framework, two subjects are envisaged, for non-protected information and for protected information respectively.

The first concerns the drafting and conclusions of agreements on technical accounting and reciprocity between the systems of disseminating scientific and technical information by computers with which countries or groups of countries are now being equipped.

The second concerns the preparation of negotiations on the conditions of access to patents and technical information which are the property of governments and whose use is subject to their decision because of public expenditure on research from which they derive.

Apart from this action, which falls within the terms of reference of OECD, it seems necessary to examine the conditions that are most favourable for institutional cooperation between certain countries or groups of countries, notably with a view to surmounting the obstacles arising from the size of a country and the fragmentation of markets.

These obstacles are to be seen chiefly in the big technological projects, the major equipment for pure science and large-scale public services.

The measures for economic, technological and scientific co-operation which have been taken, hitherto, in the various organisations, do not appear to have yielded all the results which were expected from them. A more effective intergovernmental co-operation seems to demand a more integrated approach, in which it would be possible:

* to carry out jointly-finaced Research-Development programmes;

* to foster mergers of enterprises belonging to different countries in order to reach competitive dimensions;

* to organise government procurement of new products and to break down the fragmentation of the market in advanced technological products.

This action would assume a broad identity of views on common objectives, extending to a group of sectors in technology and in the industrial economy.

Reproduced from OECD Observer, No. 33, April 1968, pp. 32-34.

Note on the Future of the WFSW

The present difficulties of the W.F.S.W. are due largely to the fact that the present circumstances are widely different from those of the first years of the foundation of the Federation. It was conceived of as an extension of the Association of Scientific Workers in Britain to other countries, necessarily immediately after the war, to Europe and America, in the industrialised countries with strong formations of scientists and technologists closely related to industry.

In the subsequent years, the impact of events introduced other problems and other areas, notably countries of the ex-colonial world such as the Middle East and China. In different ways they have brought new problems to the Federation. At one time it seemed that there was a possibility of building up a strong, united WFSW including all these areas and in fact, covering the whole world. This, however, has been hampered for a number of reasons basically owing to the quarrel between Soviet and Chinese governments; but additional difficulties have arisen due to the Middle East quarrels between the Arabs and the Israelis.

With the new world picture we require to reconsider the whole function and even the existence of the WFSW. The division of the world into the industrial world and the Third World is itself a new factor depending very largely on science. Science was originally limited very largely to the industrialised world and, for the past fifty years, this has included the Soviet Union and, more recently, the other Socialist countries. Now China and Cuba have been added because they contain the ability and the planning necessary for an autonomous science. At the same time, effectively, science in the rest of the world, the so called "free-world", has come completely under the influence of the U.S.A. What this means for science is set out in my paper to the Budapest Symposium of September, 1965. Effectively, it means that science in those ex-colonial countries has to work with American apparatus, American methods and a 'brain-drain' of individual scientists to the United States. It implies the domination of explicit anti-communism under the detailed control of the C.I.A. In this respect the government of Israel plays a notable role in organising congresses and publishing material for the reconstruction of the Third World under capitalist auspices.

The struggle in the WFSW is not so much to improve the conditions of scientists in the industrialised countries, but to see that its aims are possible of achievement throughout the Third World. In this matter it necesrarily comes into conflict with the aims of the Chinese People's Republic who refuse to recognise all international organisations which do not follow their lines and naturally oppose all their activities.

We have, therefore, in the world three if not four different international organisations with different aims. The first set, with which the WFSW has maintained links with difficulty, are these who are associated with the United Nations, especially UNESCO. They are not really distinguishable from the second set, those in the control of the U.S.A. seeing that the U.S.A. is the largest contributor to the United Nations Agencies and, in fact, nothing can be done in the Uni-

ted Nations without the consent of the U.S.A. government. However, to a certain degree, pressure can be exerted by the other nations in the United Nations to counter U.S. policies.

The third set are those associated by the name Pugwash, which goes slightly wider and includes effectively the Soviets and some of the European countries but, so far, neither China nor many semicolonial governments.

The fourth group is represented by the WFSW whose policies we are just now discussing. It is clear to us that what we desire to achieve is a world science approximating as much as may be to the Charter of the Federation. What is the best way of reaching these aims in existing circumstances? The methods we have used heretofore have shown themselves to be of very limited value. We have called a number of world conferences and they have revealed two major deficiencies; first as to composition—the delegates mostly represent the old guard of European scientists, the United States scientists are just the relics of the American A.Sc.W. very largely crushed, but not killed, by the McCarthy era, although now showing some possibilities of revival around the agitation against the Vietnam war. The Third World is hardly represented at all nor, of course, are the Chinese. Those that can come to our meetings from Africa or Latin America are much too few, nor do we possess, even if it were desirable, the means to pay their fares to bring them to our congresses. They themselves are in no position to call the congresses in their own countries. The People's Republic of China have called a scientific conference but this is of a characteristic Chinese form, more of propaganda than of scientific value and largely concerned with the denunciation of the Soviet government.

It is doubtful whether a more positive action of the Federation would meet the wishes of the European members, such as the A.Sc.W. in Britain, mostly composed of technicians in any case, who have not yet seen the relation between scientific and political factors and, in this sense, the very existence of the A.Sc.W. is put in doubt. On the other hand the Chinese solution in a slightly different form, that put forward by Castro and Che Guevara, one of armed resistance, has yet to gain any adequate support even in the most favourable countries of Latin America,

The struggle between these different views presents for the moment a choice of almost unacceptable alternatives, yet one of ultimate importance. In the meanwhile it may serve to split the progressive scientific movement throughout the world.

I consider it would be advisable for the next two years at any rate, to concentrate rather on developing and increasing the separate national organisations of scientists whatever their character, than to attempt to create an international unity which will remain, in the present set-up of power, largely illusory.

Consequently, I would advise no more international congresses but those which are at most continental in scope. The essential feature is that the formation of these meetings should be in the hands of actual scientists native to the country where the meeting is to be held and not inspired from outside. Where these cannot be found, recourse might be made to existing organisations such as Pugwash.

At a later date it may be possible to effect ad hoc cooperation with such bodies for specific purposes, such as securing peace in Vietnam or solving the problem of the spread of nuclear weapons and antiballistic missiles which threaten a new and vastly greater arms race.

In any case, those who have the interest of the World Federation at heart, will have to judge in every instance, what measures to adopt in the circumstances.

J.D. BERNAL November 1967

SCIENCE ROUND-UP

CSIR ENQUIRY COMMITTEE

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Chairman:

Shri Justice A.K. Sarkar, retired Chief Justice of the Supreme Court of India.

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Shri S.S. Bhandari — Rajya Sabha
Dr. K. Ramiah — Rajya Sabha
Shri P. Venkatasubbiah — Lok Sabha
Shri K.P. Singh Deo — Lok Sabha
Shri Chandrajeet Yadav — Lok Sabha
Shri Inderjeet Gupta — Lok Sabha

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Prof. M.G.K. Menon, Director, Tata Institute of Fundamental Research, Bombay.

Dr. M.S. Swaminathan, Director, Indian Council of Agricultural Research.

Dr. P.K. Kelkar, Director, Indian Institute of Technology, Kanpur.

Member-Secretary

1. Shri S.K. Sarkar

Terms of Reference

(i) To review the personnel policies followed at various levels with reference to the Rules and Regulations in force and in particular, to look into the allegations of the irregularities brought to the notice of Parliament from time to time and to suggest any remedial measures necessary:

(ii) To enquire into the adequacy or otherwise of the existing policies in respect of payment of royalty, having regard to the following object prescribed in the Memorandum of Association of the Council of Scientific and Industrial Research:—

> "the utilisation of the results of the researches conducted under the auspices of the Council towards development of industries in the country and the payment of a share of royalties arising out of the development of the results of researches to those who are considered to having contributed to the pursuit of such researches."

(iii) To review the overall functioning of the Council of Scientific and Industrial Research and to suggest ways and means of improvement.

* * *

25 YEARS OF CSIR

The way to self-reliance can be made smoother and shorter through greater involvement of scientific research in economic development. It has been estimated that the country could save between Rs. 700 crores and Rs. 800 crores in terms of foreign exchange during the next 10 years if indigenous know-how could be developed to undertake designing, engineering and consultancy work. Another important direction in which the joint endeavours of science and industry can bring major benefits to the country is import substitution. With the help of the national labora-

tories, it should be possible for industry to produce some of the components and spare parts which it will need in increasing numbers in future.

Hitherto, external aid has been an important factor that has prevented an intensive as well as a wide application of indigenous know-how and expertise to industrial development. An important ingredient of the aid given by the advanced countries is technical know-how. In fact, the wholesale import of such know-how is a significant feature of the many aid agreements and collaboration arrangements that this country has entered into. To a large extent, this heavy reliance on foreign technology was due to our eagerness to industrialise the country as rapidly as possible. We did not hesitate to accept assistance for this purpose, whatever its terms and conditions. In the process, our will to do things ourselves was enfeebled.

(*Ref* : COMMERCE, Vol. 117 No. 2989, August 17, 1968 pp. 352).

* * *

The Plan for Industry

An increasing number of foreign collaborations has been a conspicuous feature of the industrial growth in the last decade. Several factors have contributed to this phenomenon. The scarcity of foreign exchange has considerably contributed to this trend. Foreign collaboration brings with it whole or part of the foreign exchange required for setting up the enterprise. In addition, it often bestows the advantages of know-how of the foreign collaborator. These advantages, coupled with the association of the name and the reputation of the foreign collaborator, provided a decided advantage to the Indian enterprise. However, such foreign collaboration has been secured at a cost to the economy. In a number of instances, the cost of capital goods imported under collaboration schemes are much higher than they need be. Moreover, collaboration also involves a commitment of foreign exchange on recurring basis not only in terms of dividends, but also often in terms of components, spares, etc. With the diversified industrial structure that exists now, the need to secure foreign collaboration with a view to find foreign exchange for the capital goods has substantially diminished. It is, therefore, necessary to have a more selective approach to foreign collaboration in future. Foreign collaboration in the production of any consumer goods, whether it can be produced within the country or not, should be ruled out, except in the interest of larger exports. Also, foreign collaboration in directions in which indigenous effort can immediately or within a short time provide the services or goods or a substitute for them ought not to be allowed.

Import of foreign technology will, however, continue to be required, though here again adequate consideration has to be given to the utilisation of domestic technology. In sophisticated fields where the development of appropriate domestic technology is bound to take time, the importation of technology would be advantageous. In other words, the approach to importation of foreign technology has to be selective. Firstly, there would be no case for foreign collaboration in industries where there is adequate know-how already developed in the country. Such collaboration would only involve avoidable out-flow of foreign exchange. Secondly, even where foreign collaboration is agreed to for the purpose of primarily securing advanced technology, care has to taken to see that the benefits of collaboration are widely available for future development in the same industry. Repetitive collaborations for the same know-how by different parties has been too common a feature in the past. This not only involved repetitive payments for the same know-how, but also deprived the possibilities of building up on the acquired know-how through local effort.

Thirdly, it has been observed that where foreign collaboration is involved, there has been an attempt to impose a variety of goods and services, in terms of capital equipment, engineering charges, consultancy services etc. from abroad, at considerable foreign exchange costs, even when such services and goods could have been locally procured. At a time when our consultancy organisations and engineering industries are looking out for orders and are burdened with unutilised capacities, this kind of situation is highly detrimental to national interest. We have, therefore, to evolve a policy which while keeping it open for the free flow of technical know-how and experience from advanced countries in fields in which we do need them, avoidable expenditure of foreign exchange by way of unnecessary and repetitive collaborations and the consequent importation of capital equipment and services are scrupulously avoided. This would on the one hand call for a careful examination of proposals for foreign collaboration and on the other call for a positive effort in terms of developing our own consultancy services to fill the gaps where they exist.

(*Ref*: Eastern Economist, Vol. 51 No. 7, August 16, 1968 pp. 390)

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TOWARDS EROSION OF PLANNING

As one goes through the document (Annual Plan 1968-69). chapter by chapter, what strikes him most is the almost complete passivity that marks the document. As was well known in advance, the Annual Plan is, by and large, confined to the continuation of schemes and projects which have spilled over from the previous years. No major new scheme has been included in the Annual Plan and in every sector, "anticipations" have been kept to a modest level because of the well-known paucity of resources.

Of course, it would be absolutely wrong to blame the Planning Commission—at least, the re-constituted Planning Commission—for this paucity of resources. If the paucity of resources predetermines the (modest) size of the Annual Plan, one can hardly blame the Planning Commission for this.

But one would certainly expect the Planning Commission to warn the Government and the nation of the grave consequences implicit in the erosion of the developmental effort in the economy. Instead of meekly submitting to the constraint imposed by the paucity of resources on the developmental effort, it should have fulfilled its duty of suggesting various ways and means of solving the crisis of resource mobilisation which threatens the very economic destiny of this country. If the Planning Commission does not do this, whom else does it expect to do it? When the whole nation is concerned about the mess in which we have landed ourselves, the Commission betrays (at least in this document) not a trace of such concern. Perhaps, it sees no problems; if so, it is not surprising that it does not offer any suggestion for the solution of the problem of resource mobilisation or any other major problem.

(*Ref*: COMMERCE, Vol. 117 No. 2989, Aug. 17, 1968 pp. 371.)

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TOWARDS SELF SUFFICIENCY

India and Pakistan have good reason to feel euphoric about the 1967-68 food grain harvests. They are going to exceed by far the all time record harvests of 1964-65. In India the yield of all food grains in 1964-65 was 89 million tons, but this year's harvest will certainly reach 95 million tons and some estimates put it as high as 100-105 million tons. Likewise, in Pakistan the 1964-65 harvest of wheat was 4.5 million tons and 11.7 million tons of rice. Last year, the yields dropped to 4.3 million tons and 10.7 mil-

lion tons respectively, but this year the wheat harvest should be well in excess of 6 million tons and the rice harvest should exceed 12 million tons.

How have these remarkable increases in cereal production been achieved? Three factors can reasonably be eliminated. The weather this year has been good but not distinctively better than in 1964-65. With so many unemployed in both countries, it is difficult to believe that the record harvests have resulted from more manpower on the farms and, although irrigation has been increasing steadily, irrigation, of course, makes its greatest impact in bad, not good, seasons. Fertilizers, improved seed strains and possibly improved plant protection seem to be the answer. Both India and Pakistan have imported Mexipac wheat from Mexico (Nature, 218, 214: 1968) and Pakistan has Irri rice from Japan, but new strains alone cannot be the answer because Mexipac needs quite large applications of fertilizers and without them it is probably less successful than the strains grown previously. The fact that the greatest increases of production have been achieved on the larger and better managed farms, usually owned by the rich and politically powerful, who stand a better chance of getting new seeds and fertilizers which are both in short supply, supports this conclusion.

Ironically the prospect of a record harvest is presenting the Indian and Pakistan Governments with economic problems. In India, for example, if the harvest, in fact, turns out to be 10 million tons above the previous record the Indian farmers will have generated, at the cereal prices fixed by the Government, the equivalent of about £ 400 million of new wealth. Much of this will clearly literally be eaten on the farms rather than coverted into cash, but there is the very real problem that the farmers will spend the extra rupees in their pockets on imported goods such as fertilizers and agricultural machinery and this will worsen the country's balance of payments. Furthermore, the United States sells wheat to India for rupees and then gives the rupees to the Indian Government. Should the United States decide, in view of the record harvest, to reduce wheat supplies the Indian Government will lose this subsidy and at the same time, have to buy more wheat from its own farmers at prices that it guarantees.

(*Ref*: NATURE, Vol. 218, May 25, 1968, pp. 713)

* * *

West Germany—

A BOOM PROPELLED BY TECHNOLOGY

Bonn: Economic observers here feel that West Germany might soon see a technology-propelled economic boom. The thinking is based on certain clear formulations. The first of these can be traced in the general state of the economy and the foreign factors playing on it; the second can be discerned in the climate for scientific research that prevails here; and the third is the evident determination of the Government to increase the use of industrial computers, through the building up of a chain of computer centres throughout the country. The fruitful efforts of Herr Stoltenberg, Federal Minister for Scientific Research, in co-ordinating the different branches of industrial and scientific research as well as measures to stop the so-called "brain drain" from the country, are contributing their share to technological development.

The West German economy has currently extricated itself from its recent recession and is enjoying a controlled bullishness of considerable potential. Industrial investment has experienced one of its sharpest rises in recent history—from the minus 15 per cent low in 1967 it has shot up to plus 6 per cent in 1968.

A healthy slice of the DM 1,300 million increase can be deemed to have effected a proportionate increase in investment research. Capital spending on new plant and equipment will total some DM 22,000 million this year and is expected to rise further.

Another important factor has been the inflow of capital into the country in the past few months, with all that this implies in terms of potential economic expansion. The national currency today ranks as one of the world's stablest currencies. In addition to the many advantages that such a position brings with it, one beneficiary undoubtedly is the technological field. In the present era of installation of more and more modern and sophisticated production hardware, investment in such types of capital goods is a basic prerequisite of progress and efficiency in industry.

The effectiveness of the post-war technological progress in Germany comes mainly from one over-riding factor. It is the high priority that commercial economics has played in the pattern of investment in research.

Amongst experiments currently being undertaken towards this end the following are worth noting: Working in conjunction with research in the atomic centres of Juelich and Karlsruhe, the Hamburg atomic research centre is about to start activity on the eventual production of the world's first power producing nuclear gas turbine reactor. This is a project which will reduce the cost of electricity by some 60 per cent, with all that this implies in terms of cheap power for industry and for other applications such as economic nuclear ship propulsion. Research in other fields such as chemicals, synthetics and electronics, also project a picture of considerable promise.

(*Ref*: Commerce, Vol. 117 No. 2988, August 10, 1968 pp. 303).

(*Contd. from page 8*)

ing a university education in the general sense. There is no real dialogue with the professors and students are simply condemned to a number of years of painfully accumulating facts for examination purposes.

This is the real crux of their discontent. They feel that they are not given the adult treatment to which, as university students, they are entitled. Resentment has been fermenting for years and the violence of the recent explosion was due to the feeling that only a display of brute strength could shake the rigid paternalism that permeates France from the President downwards. It is more than just coincidence that their revolt came after exactly 10 years of Gaullist rule. Their protest is against the patronizing complacency of state and university much more than against specific failings such as overcrowding and poor facilities. The students have picked France up by the scruff of her neck and shaken her head. And France will never be quite the same again.

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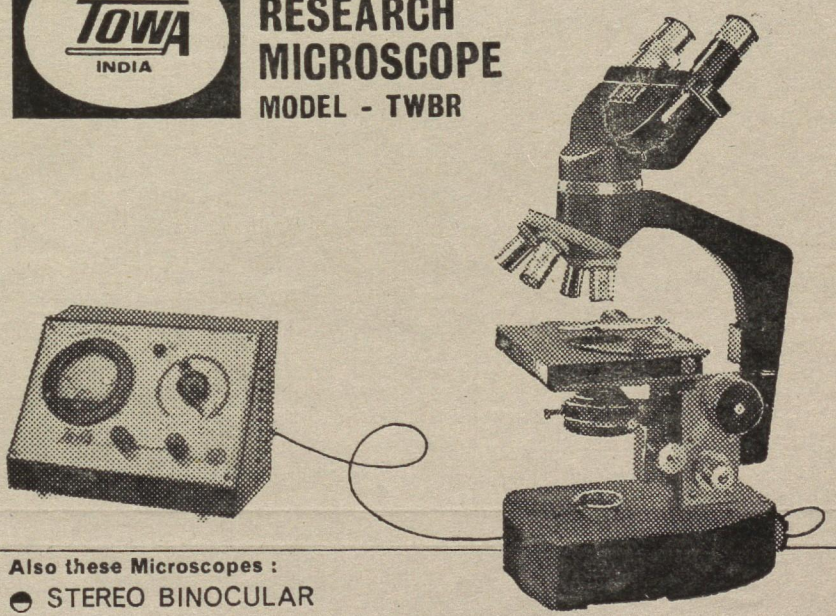

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