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feature articles

Science Policy in Under-developed Countries*

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"Today between 15 and 30 of the 120 countries of the world, with less than one-third of its population, possess practically all of its science. They spend more than 95 percent cent of the world's research and development funds..... Furthermore, these countries reaped in the past and are now reaping most of the direct economic, political, social and general cultural benefits of scientific research.....

The other countries—approximately 100 in number—with about two thirds of the world's population, share in various degrees the remaining one-twentieth of the world's science".[1] (Steven Dedijer in "Under-developed science in under-developed countries").

Those countries now characterised as under-developed or, more euphemistically, as the LDC's were once the proud seats of ancient civilisations. The achievements of China, of India, of the Middle East, of Latin America, and even of little Sri Lanka had much to contribute to the knowledge of modern man. However, casting aside mere sentimentality, it is necessary to admit that these ancient civilisations and their technical achievements were based upon empiricism, removed from science and scientific methodology as we know them today, from the processes of observation and experimentation, hypotheses, theory, verification and prediction which constitute the essence of that technique we use today to understand and control the world around us—namely, the scientific approach

Historically, for reasons that time does not permit me to analyse here, the development of modern scientific methodology occurred in Europe, spurred by the Renaissance and by the Industrial Revolution. From this stage onwards science begins to play a significant role as a factor in the social process—linked closely to the latter by its handmaiden: technology. In my opinion, it is necessary at this stage to clarify certain misconceptions that exist among our policy-makers regarding the relationship between science and technology and to correct the unduly sharp dichotomy that has been drawn between them. Both science and technology are today social activities. However, scientific activity relates to the exploration of the laws of nature and of society, whereas technology exploits these laws for the specific needs of society, particularly in the production processes. The two interact with each other and are closely interdependent. For instance, the Industrial Revolution and the invention of the steam engine led to the work of Sade Carnot and the development of the science of Thermodynamics, which in turn reacted upon and improved the efficiency of industrial processes. It is the failure to comprehend this relationship that has often led to such ambiguous classifications as basic, applied and development research. I quote from the Rutherford Memorial Lecture delivered at the University of Delhi in 1968 by the well-known physicist J. M. Ziman. His remarks are applicable to under-developed countries such as ours:

"I am speaking now of research without any more conscious aim than the understanding of how things are, or were, or might be. When money and men are short, it is by no means self-evident that an institute of theoretical physics, or molecular biology should take precedence over a tractor factory, a hospital or a school of civil engineering.

I simply cannot understand the intellectual snobbery of those silly people who give more credit for the discovery of another meson than for the design of a suspension bridge, and who cannot see that a zip fastener is a far more beautiful idea than a zeta function.

But the utilitarian argument against basic research can be carried too far. A certain amount of fundamental research must be sponsored in a developing country for a number of excellent reasons. In the first place the education of technical experts—engineers, doctors, agricultural advisers, even government administrators—cannot be left entirely in the hands of technologists of their own practical kind. Modern engineering, for example, requires the exercise of skills and the application of knowledge, acquired from pure physics, chemistry and mathematics. The rapid development of new techniques can only be exploited if the practitioners are adequately trained in these fundamental disciplines by teachers who are themselves in close contact with the latest theoretical principles. Only those who are actively engaged in research can truly absorb and re-transmit these new principles as they arise.

From a purely practical point of view, also, it is impossible to import technical know-how, and to apply it successfully, if one does not have available locally a corps of learned men to whom one can appeal for guidance on matters

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of pure scientific principle. Science-based technology is not a lusty crop of rules of thumb.....it is a delicate plant, which thrives only when tended by mixed teams of experts, including those impractical specialists to whom the buck can be passed when fundamental principles are at stake."

In the early days of science, the individual scientist could afford the luxury of working in his own laboratory, untrammeled by social demands and directing his activity to areas where curiosity led him. Today, particularly since the Second World War, science has developed into a viable social activity. For instance, the "pure" research of Hahn and Meitner led eventually to the release of atomic energy, which has transformed the face of the earth, posing the threat of the destruction of human civilisation itself—while simultaneously holding out the possibilities of a world of plenty in a saner society of the future. The solid state research of Bardeen and Brattain produced the transister which has in a similar traumatic fashion ushered in the age of electronics. In so far as science and technology have developed into social activities, by their very nature revolutionary and dynamic, they must and do necessarily interact with social and economic processes to the same degree as factors such as capital accumulation, supply of labour and other resources, land ownership and utilisation, population growth, political and legal systems. **Science policy** is an umbrella study and activity covering all the above fields which contribute to human welfare, with special reference to the dynamic role of the scientific process. In so far as scientists in their ivory towers can no more divorce themselves from the dynamics of social change and politics, planners and politicians can neither afford to ignore the role of science in social and economic development. In brief, science policy may be defined as a techno-economic policy, which concerns itself with the structure and organization of science and technology within a changing socio-economic structure.

The figures quoted by me at the beginning of this address, supplemented by further data compiled by Steven Dedijir [2], clearly show that under-developed countries are also countries without science. For instance, in 1960, while the USA, USSR and France respectively expanded 2.8, 2.3 and 2.1 % of their GNP on research and development, the corresponding figures for Ghana, the Philippines and Pakistan were 0.2, 0.1 and 0.1 %. Sri Lanka, on a rough estimate expands 0.25 % of its GNP on R and D. Science and technology are intimately linked with economic development—particularly with industrial growth. This has been the experience of the west. However, with the process of colonisation which was accelerated during the turn of the century, the fine balance which existed between domestic agriculture and handicrafts in the colonies was destroyed by the neglect of the former and by the subjection of the latter to competition with cheap, machinemade commodities from the West. Ever since, the colonial powers have resisted the introduction of industry into the colonial world and retained them as sources of raw materials and producers of commercial agricultural crops. This is not a climate conducive to the growth of modern science.

Once again to quote Stevan Dedijir [3]: "In under-developed countries there is less awareness in general public opinion of the importance of science, and this is intimately and reciprocally connected with the low priority given to science in development policy and to the carelessness about the cultivation of a scientific potential necessary to produce that science. The farmer, the craftsman, the educator, the civil servant and the politicians in these countries do not see the relevance of science to their concerns. And of course, in under-developed countries, there is not a scientific public...

The embryonic science developing in this environment will show in every one of its cells, that under-developed countries have underdeveloped decision-makers on science, under-developed research councils and science advisors, under-developed administrators of science and under-developed scientists. It is not that scientists in under-developed countries are technically untrained or technically incompetent, it is rather that being a part of their national culture, they will themselves lack, or will not be able to impose or recreate in their society and culture, so alien to science, those fundamental orientations which are necessary for really productive research."

Another constraint upon the development of science and technology in the Third World, which is a further heritage of colonialism can be summed up in the words of the recent Pugwash Conference of Scientists held in Madras: "In most LDC's the colonial powers created and left behind them a national elite—highly westernised, relatively privileged and divorced from the people. This elite and its successors constitute the bulwark of neo-colonialism in many LDC's, and prevents the development of specifically national economic and social forms." It is this phenomenon which partly leads to that attitude of mind which looks upon everything western as superlative and makes even certain members of our scientific community turn their backs on the challenges posed by the anti-scientific attitudes prevailing in the under developed world. There is no need to stress here the innumerable obstacles science and scientists have to face in countries such as ours—obstacles ranging from the lack of what might be called a scientific climate, the lack of sympathy and understanding on the part of governments to scientific research and the lack of awareness in general public opinion of the importance of science. Scientists of the Third World also suffer from the frustrating effects of isolation—the lack of communication with colleagues involved in their specific fields of research, the difficulties of international travel, and often, the lack of proper access to the world's scientific literature.

There is a growing consensus of opinion in under-developed countries that the artificial transfer of technology from the advanced countries—whether by governments or through the exploitative practices of multi-nationals—can only have, in the final analysis, a debilitating effect upon the receiving country. An appropriate technology must be

based upon a judicious inter-mixture of advanced technology, adapted to the specific needs of the country, with small-scale production units that utilise the traditional empirical techniques already existing with the injection of the proper scientific know-how. Production is a social activity. We must first and foremost focus on people, on the needs of the majority rather than those of an elitist minority.

While science is, or should be, an international activity, it must not be forgotten that the dichotomy of the rich versus the poor countries is one that affects scientific and technological activity as well. The latter do not exist in a vacuum. Academic and scientific colonialism is as much a reality as socio-economic neo-colonialism. While we of the Third World absorb and adapt to our own requirements the best products of western science, it is in our interests that closer links should be forged between the scientific communities of the poorer countries. We, in Sri Lanka have already entered into an Indo-Sri Lanka Scientific and Technical Co-operation Agreement with our neighbouring sub-continent, and it is useful to mention here that Science Policy constitutes one of the agreed projects for co-operation.

It is my own opinion that such Scientific and Technical Co-operation Agreements should be set up on a regional basis, between countries of the Third World, with a proper co-ordinating centre.

However, since science is a social activity, closely dependent on the social framework within which it works, co-operation between nations is a necessary but not a sufficient condition for development. Scientists of each non-aligned nation must concern themselves with the socio-political forces operative in their own country as well as in the Third World They must be participants in that historic social transformation which aims to create a rational milieu, a society free from the exploitation of man by man. This is one way in which they can help to eliminate the constraints and obstacles that stand in the way of the free flowering of science and technology in the presently under-developed regions of the world.

References 1. DEDIJER, S. Under-developed science in under-developed countries. Minerva II 1(Autumn 1963) pp. 61-81.
2. DEDIJER, S. Ibid. 3. DEDIJER, S. Ibid.

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Inaugural Address by the Honourable T. B. Subasinghe, Minister of Industries and Scientific Affairs, at the Special International Sessions on Scientific and Technological Co-operation among Non-aligned Countries*

Permit me on behalf of the Government and myself personally to welcome all our guests from abroad who have come here in response to the invitation of the Sri Lanka Association for the Advancement of Science to participate in this seminar of scientists from the non-aligned countries. This gathering and the discussions that will ensue may be considered the prelude or the curtain-raiser to the very significant event that will take place in this city of Colombo in August. That is the Fifth Summit Meeting of Non-Aligned States.

We take pride in the fact that Colombo has been chosen as the venue for the Summit Conference. I think all of you will agree that the non-aligned movement which originated in the 1950's in the face of frowns, cynicism and opposition from some quarters which considered themselves as possessing an inherent right to determine the policies of our countries and even our fate, has today become a very effective factor in the sphere of international relations.

The number of newly independent and developing countries (still developing because their natural development was forcefully arrested by world imperialism) treading the path of non-alignment have increased during the past twenty odd years. In August, we expect there will be about 85 countries participating in this Conference.

It would not be incorrect to state that this movement has brought together many nations which had been originally separated from one another, in a number of continents. It would also not be incorrect to state, that in a divided world when a sharp polarisation and confrontation was the order of the day, that non-aligned countries by their joint attitudes and efforts have in some measure aided and encouraged the tendency towards peace, security and detente. They have also consistently supported the struggles for national liberation and the right of every nation to determine its own future. Our contribution to create a sense of sanity in international relations has not been insignificant. In playing this role, naturally our countries have been brought closer together at state levels.

Whatever our political systems and social structures may be, between us we have an identity of interests. We have to make our independence secure and real. The rising expectations of our people must be fulfilled. We must step into the modern age in as short a time as possible. For this we must develop our productive forces. We have to diversify and develop our economies. There are a hundred and one things to be done before time runs out.

Having been under colonial and imperialist domination, sometimes our orientations in economic and trade relations, education and even in cultural attitudes have been towards the metropolitan countries which ruled us. There have been little contact between the peoples of our countries. Complimentary economic, trade and technological relations have not been developed adequately between our countries.

*. Sponsored by the Sri Lanka Association for the Advancement of Science, 30th June - 5th July 1976.

However, in recent years, with the onset of the economic crisis in the developed countries, we have been so severely affected, that we have now begun to re-examine anew our own mutual relations and our relations with the more developed countries which shaped our destinies for a long time. We are now demanding a new economic order based on equality and justice. This is a very desirable, healthy and historically necessary development.

Looking back on the history of our continents, the Americas, Africa and Asia, alive to the contribution of our ancients in the field of agriculture, irrigation, architecture, astronomy and many other fields of human knowledge, none can say that we lacked innovative capabilities.

In the contemporary world too, our intelligentsia have not been incapable of mastering modern science and technology. Very important original contributions have been made by scientists of the so-called developing countries to the body of world knowledge.

In this context, in my opinion we have adequate capabilities to develop our own indigenous technologies. We have the capacity to benefit from the more advanced technologies of the developed countries. A proper balance can be struck between the adaptation of simpler indigenous technologies and the utilisation of advanced technology. Amongst ourselves we could transfer technology from one country to another. Together we could also determine how the most advanced technologies from industrialised countries could be adapted to the conditions of our own countries and on what terms and conditions we should adopt them.

In our own countries, we have ample natural resources. We have very intelligent human resources in plenty. We have trained technologists and we could help each other in training more. We must recognise that amongst ourselves, many of our countries have reached different levels of development. Some have made greater progress than others.

In the development of our resources for the good of our people, cannot we co-operate with one another more closely and consciously? All the necessary pre-conditions are there for such a development. The opportunities are very wide indeed. Being aware of the thinking of our own scientists in Sri Lanka and may I say the politicians as well, it is our firm conviction that there should be a much closer contact amongst our scientists and other professional groups involved in developmental activities. It is because of this confidence that the Sri Lanka Association for the Advancement of Science has sponsored this seminar with the full support of the Government. We are happy and thankful that such a large number of scientific personnel from our fraternal countries found it possible to be with us. There is a wide range of subjects for discussion. I am sure the exchange of opinions and experiences that will take place in this seminar will be very fruitful for the future. I wish your deliberations all success. I also hope that during your stay in this island country you will be able to familiarise yourselves with the life of our people and activities in different fields.

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Research, Science and Technology

by Sumitro Djojohadikusumo
Minister of State (Research), Indonesia

Indonesia's Development Pattern

Indonesia's future development depends critically on its ability to make the best possible use of its natural resources, in perpetuity with a minimum of waste and for the benefit of the greatest number of people. It can only be done by broadening the scope of human activities and by raising the quality of human resources. It is in connection with the development of our natural and human resources that the role of research, science and technology comes to the fore.

With regard to Indonesia's resource base and potential for economic growth, until recently the bulk of production and export comprised mainly of agricultural commodities. A shift is now taking place which is structural in nature and with important ramifications for future developments. It opens up greater possibilities for growth and for the strengthening of our balance of payments, but it poses riddles from the viewpoint of population and employment. The leading growth sector are now and will be the "new", i.e. non-traditional sectors connected with the extractive industries: oil, minerals and timber. These are capital intensive and dependent on high technology. They are not very labour absorptive until the stage will be reached when the secondary effects of forward and backward linkages of industrial activities generate sufficient results. This takes a decade and longer, perhaps for the greater part of the 1980's. In the meanwhile the larger number of the population find their livelihood in the traditional sectors of agricultural production. Here technology is often too simple and the increase in productivity can barely keep up with population growth. Such a situation of "technological dualism" creates social tensions leading to serious frictions if it is not mitigated by appropriate policies. The answer is or should be to reinvest rapidly adequate ratios of the incremental benefits from the growth resources to broaden our economic basis, in other words to diversify in a "horizontal" sense by expanding the range of agricultural activities (with increasing

emphasis on food production) and equally in a "vertical" sense to accelerate the processing of commodities and to engage in "downstream" operations within the country. This can subsequently contribute to self-generating forces in the manufacturing sector.

Research Policies and Programmes

Research programmes under the general direction and co-ordination of the Minister of State for Research are grouped in two broad categories: the short/medium term programmes and those concerned with longer term problems. The first category is directly connected with the operational objectives of the present Second Five Year Development Plan (covering the period 1974/75—1978/79) and thus also includes those activities which are expected to be of importance in the next 5 year sequel. Simultaneously the research and studies of a longer term nature relate to problems concerning the role and significance of and the relations between natural resources, population and technology, their interaction and likely impact on "long-term growth perspectives". There is of course an intertwined relationship between the problems and research programmes being categorized respectively as "short/medium term" and "longer term".

Current policies and programmes influence the distant future to an important degree. Our present decisions and actions inevitably affect the course and pattern of our society through the next decades. It is therefore pertinent to ask ourselves continuously what the major implications are of current policies.

Conversely, longer term studies designed to provide us with perspectives of the future help us to envisage some of the requirements that it will pose in the course of time. Such perspectives give additional dimensions to the context within which we must take action now or in the intermediate term to ensure that future requirements can be met.

For the purpose of determining research priorities in agriculture, industry and mining with their cross-sectoral linkages, panels were set up in 1974 and continued this year, comprising research workers from national institutes and government laboratories, from various universities, and representatives from ministries and industry. The results of the panels' workings and procedures will be used and tested for the direction and budget allocations of programmes and projects in the coming fiscal years. Particular attention will be given to the existing capacity for conducting research and to the monitoring aspects of research activities and their results.

The nature and scope of longer term research and studies were mentioned earlier. They focus on the workings of long-term dynamics of population growth, natural resources and technology in their interaction and with special regard to their impact on ecology and environment.

* The various parts and 'components'' of each programme can be and are in effect implemented by different institutions. They are, however co-ordinated and supervised by the office of the Minister of State for Research, who determines their scope and terms of reference and allocates their respective budgets.

The following programmes have been designated as national priorities and are being implemented under the direction of the Minister of State for Research:*

1. a comprehensive inventory and evaluation of natural resources,
2. a study on long term growth perspectives,
3. an assessment of requirements for scientific and technical manpower for the period 1975—1985
4. the development of a natural network system of scientific documentation and information,
5. the development of a national system for standardization and for calibration and instrumentation.

The first three programmes are of course inter-related. Studies on longer term perspectives will gain in substance and significance as guide posts for policy, when more and better basic data resources become available.

In conjunction with the on-going population studies, the research programmes should provide us with more specific indications as to the future manpower requirements in the scientific and technical fields. The last two mentioned of the above programmes are connected with the servicing functions of research, science and technology. Their importance will increase as progress is made in research and industrial development.

Within the scope of this discourse I would like to draw particular attention to the importance and urgent relevance of a comprehensive inventory and a proper evaluation of natural resources. Our knowledge and understanding of existing global resources are at best very hazy. That pertains in particular to the situation in developing countries. Yet, in the coming decades the political economy of international relations will centre on the role and relative importance of materials resources. Considerations of resource policy and resource management will largely determine the behaviour of nation states on the domestic level and in external affairs. The big and powerful nations and the small and weak alike, the industrially advanced and the developing countries, the resource rich and the resource poor,—we see all of them engaged in ceaseless exhortations for a "rational approach" to resource policies. Without fail, each of them is prone to give a different interpretation of what such a rationality entails. It would seem to me that the undertaking of a comprehensive inventory of resources and a detached impartial evaluation of their future potential constitute a field where international co-operation is urgently required. The advanced technologies developed by the industrial societies can be of invaluable assistance to governments of developing countries in their efforts to ascertain their resource potential on a more factual basis, provided always that such assistance is designed to develop and improve the national capabilities of developing countries to conduct and extend their own resource inventory. In such a context the results of co-operative endeavours, reinforced and supplemented by regional arrangements, will generate a shared knowledge and enhance a better understanding of the world's resource potential. Both the developing and the developed nations stand to gain. This in turn may

contribute to some workable consensus as to the desired rationality in resource policy. Appropriate modalities for collaborative arrangements in resource inventory could mitigate the acrimonious postures of confrontation between resource-owning and resource-searching countries. Hopefully in the little time left to mankind, inclinations towards confrontation (ever latent where resources are concerned) may give way to accommodation on mutually acceptable terms of equity.

The Indonesian programme for resource inventory is divided into four interrelated sub-groups:

1. land and water resources,
2. vegetation, i.e. crops and trees, with emphasis on the central role of forestry resources,
3. aquatic resources, viz. the marine environment as well as the conditions influencing inland fisheries,
4. energy and mineral resources.

Having outlined Indonesia's development pattern in the light of her natural and human resources, I would like now to refer to the Indonesian Government's explicit concern regarding the serious problems of soil erosion, water conservation and water management. The Indonesian Government has recently made a major policy decision designed to intensify and multiply under a co-ordinated and integrated approach the current programmes for the prevention of further soil deterioration and for soil regeneration, land reclamation, reforestation as well as for research and technology application pertinent to existing and potential water resources.

With regard to forest resources, the countries of Southeast Asia specifically the member countries of ASEAN— have probably the world's last highly economic reserves of tropical hardwood timber. This refers in particular to the species belonging to the dipterocarpa family. There are in effect three tropical hardwood zones: the Amazon basin, West Central Africa and Southeast Asia (West Malaysia Serawak, Sabah, part of the Philippines and where Indonesia is concerned mostly in Kalimantan and Sumatra west of the so-called "Wallace-line"). Southeast Asia's forests are of higher economic value by far as they comprise homogeneous timber areas, while those in the Amazon Basin and in West Central Africa contain variegated wood species per given acreages. The dipterocarpa species are very suitable for mass production of plywood and veneer. They can float, are resitant to damage by insects or fungi and can be transported in bulk.

Here too, a comprehensive forest-inventory as the basis for intelligent forest management is long overdue. Factual information in this important sector is inadequate and part of what is available is already dated. We can already witness some specific cases where at certain points sustainable timber output declines as harvesting efforts increase. Even more crucial is the environmental impact of expanding output. In addition to the decline in the sustainable output of timber, if harvesting is too intensive, there can be serious adverse effects on agricultural production outside the timber sector and on human settlements in view of our transmigration programmes, if failure to observe sound silviculture practice leads to continued soil erosion and flooding.

Therefore, in the light of what is currently being done to forest resources in tropical zones by the combined effect of modern technologies applied by transnational enterprises engaged in forest exploitation and too primitive techniques of shifting crop cultivation by local populace, I do not hesitate to classify the forest reserves of developing countries as depletable resources if only to maintain a persistent policy alert of the dangers (social, economic and political) of ecological overstress in an environment where human life is already caught in the maelstrom of mass poverty and malnutrition.

National Programmes for Mapping and Survey

This programme has recently been reformulated for implementation in the immediate future. It is designed to extend the whole of the Indonesian territory by updated maps than can meet the standards of present and future requirements. The programme is considered an integral part of national policies on research, science and technology, and is therefore also placed under the supervision and direction of the Minister of State for Research. Comprehensive mapping and surveys are in fact a prerequisite to the proper implementation of an inventory and evaluation of Indonesian natural resources. Negotiations are in an advanced stage with the World Bank and the Governments of Australia and Canada for assistance in carrying out coordinated mapping and survey activities. If the programme can be started in 1976, as it is hoped, then by 1980 the entire territory of Indonesia will be covered by modern updated basic (planimetric) maps on the scale of 1 : 100,000. These can then serve as a more reliable foundation for the preparation of thematic maps in connection with the requirements of topography and hydrography, geologic surveys land use and socio-economic studies.

The mapping programme is to include the use and application of modern remote sensing techniques entailing satellite imagery (E.R.T.S.), high altitude aerophotography and photogrammetry in order to reinforce and to facilitate field surveys and ground truth investigation and interpretation. As part of the preparations and in anticipation of the full implementation of our mapping programmes, the I.T.C. of the Netherlands is currently rendering assistance of great value related to training programmes in the fields of geodesy and cartography.

The Choice of Technologies.

The scope and need for developing and selecting technologies must be viewed in connection with the problem areas, the short and medium term policy objectives and the long term goals such as identified in the foregoing observations. It is a fallacy to assume that we can do without some of the latest advances in technology. Developing nations, such as Indonesia, need to further their capa-

bility in advanced research and science and to adopt advanced technology, at least in selected areas. For certain productive sectors, vitally important to growth acceleration, there are in fact no alternatives. In concrete terms let me only mention geology, geophysics, and geochemistry, biology and biochemistry, metallurgy and mineral technology; the application of space technology to assess vegetation, earth, water and marine resources; research in the climatological aspects of meteorology as there seems to be ongoing atmospheric changes of a structural nature in monsoon areas, thus directly affecting food and other crops as well as habitation.

In a great number of cases, of course, scientific research and technology originating in advanced countries need to be adapted to prevailing conditions and requirements. Adaptive technology must take into particular consideration the quantity and quality of available labour, the need to use local materials, and the likely effects on the balance of external payments, while aiming at the adherence to standards of quantity and quality of output.

Again, as an illustration of the Indonesian case, research and adaptive technology involve post-harvest activities in the agricultural sector (storage, processing, distribution), agro-based industrial development, the development of suitable building material for cheap housing, and the like.

In view of what has been said about the natural resources, attention must be given to the adoption and the application of what may be called "protective" technology in order to conserve natural resources and restore and regenerate to the extent feasible the resources already depleted.

Institutional Framework

Scientific research and technological development in Indonesia have in the past suffered from fragmentation of research organizations and duplication of activities. Many of the institutions were really not viable through lack of qualified research workers more than anything else. Even within individual government departments (ministries) there was a proliferation of research institutes engaged in unrelated programmes of activities.

In the absence of coherent policies and priorities, not much could be done for the systematic development of scientific research personnel. With the formation of the Second Development Cabinet a beginning has been made with more systematic efforts to rectify the situation.

All research financed with public funds, i.e. research by government departments, universities and national institutions (not connected with departments or universities) has been placed under the co-ordination and supervision of the Minister of State for Research, who designates the scope and nature of programmes related to development objectives and stipulates the relative sets of priorities. Since the beginning of 1975 all institutions and agencies within any one department have been brought under one co-ordinating centre within that department with budgetary control of its research and development activities. Most recently the government has taken a major policy decision amounting to a fundamental re-organization of the institutional framework on the national level. The several national institutions concerned with research, science and technology which hitherto operated fairly independently under separate charters are to be brought under one National Centre or Agency for Research, Science and Technology and their activities to be gradually integrated in accordance with the research programmes specifically designated as national priorities.

The National Centre is also intended to be the focal point for the further development of an effective scientific research community. It was emphasized at the outset that this should be for some time to come the over-riding priority consideration in our science policies. The Centre would be charged with monitoring international developments of scientific research and technology, with a view to those considered suitable for adoption, adaptation and application. It is to serve furthermore as a clearing house for documentation and scientific information as well as for consultations in order to assess the needs for research and technological development felt by social and business groups within our society. Finally it should support and reinforce research programmes carried out by department units or university centres.

21 years of Service to Science and Industry*

by S. F. Laurentius
Director, Ceylon Institute of Scientific and Industrial Research

The World Bank Technical Mission in its report dated June 1952 presented to the Government on the Economic Development of Ceylon stressed the need for an autonomous Applied Scientific Institute as part of the infrastructure necessary for industrial development.

At the time of the studies by the World Bank Mission, the Industrial Research Laboratory and the Rubber Service Laboratory of the Department of Industries were operative and were under the purview of the Ministry of Industries, Industrial Research and Fisheries. What presumably prompted the World Bank Mission to recommend the creation of an autonomous Applied Research institute was that the output of the existing research organisation had little or no effect on the pace of industrial development or on the strengthening of existing industry nor did it originate proposals for new industries.

* The Ceylon Institute of Scientific and Industrial Research celebrated its 21st anniversary in May 1976 with a 3-day Seminar and an Exhibition.

What followed was a firm recommendation by the Mission that Ceylon immediately establish an Institute for Applied Research. With acceptance of the proposal by Government and with legal sanction of an Act of Parliament, the Ceylon Institute of Scientific and Industrial Research, without any fan fare, opened its doors for service to industry, through applied scientific research and development, both in the public and private sector, on 1st May, 1955. The Act provided for a Government donation of Rs. 5 million payable to the Institute in annual instalments of Rs. one million with provision for further financial support after the first five year period. The Act also permitted the Institute to charge its clients for services rendered.

Under the Act, the management of the Institute was entrusted to a Governing Board. The majority of the members of the Governing Board were appointed by the Minister in charge of the Institute and other members were appointed by the Prime Minister and the Minister of Finance. The Minister in charge of the Institute at the present moment is the Minister of Industries and Scientific Affairs.

At the beginning of operations in May 1955, the combined staff with the Director, numbered 23. This number included a Chief Research Officer, 8 Senior Research Officers, 9 skilled Assistants and 4 supporting personnel. At the close of the year, the staff had increased to 37.

The Institute commenced its activities in rented out premises of approximately 5,000 sq. ft.* In addition, Government permitted the Institute to use part of the workshop of the Industrial Research Laboratory and the Rubber Services Laboratory at Kalutara. In 1957, the Institute moved to its own buildings which provided for a working area of 48,850 sq. ft. Equipment for the laboratories, pilot plant and workshop was obtained as a gift from the United Kingdom under the Colombo Plan as well as from other aid sources, such as the I.C.A. of the U.S.A. and the Asia Foundation. The biggest donor was the United Kingdom which gifted unit process equipment, workshop machinery and laboratory equipment valued at Rs. 1,120,000/-.

Today, twenty one years later, the Institute has a total staff of 237. Of this number 71 are in the scientific officer grade of whom 14 have had post-graduate training abroad and 13 are currently undergoing training abroad. Due to circumstances beyond our control, the Institute until very recently could not embark on a phased developmental programme of training for its staff. To CISIR this is a big handicap as we believe that the standing of a research institute depends on the reputation of its staff. It follows then that an industrial research and development institute must be staffed at all levels with the best qualified people available and must remain so in the environment of rapid technological change. Hence the continuing need for upgrading of staff at all levels, a deficiency which is only now being gradually overcome.

* In area converted to its use largely through the efforts of its own staff.

The Institute is now organised into functional groups by process and product, and by scientific specialities. There are 14 technical groups as well as the library, providing a range of disciplines, skills and services under one roof, which is difficult to duplicate or come by anywhere else in Sri Lanka. This juxtaposition of different disciplines makes it simple for CISIR to harness a multi-disciplinary team for investigation of a problem as and when necessary.

Over this last period of six years, we have been given increasing financial support by Government on a continuing basis (this year's budgeted financial provision is in an amount of Rs. 6.05 million) which has enabled CISIR to formulate a long-term programme of work as well as recruitment, training of personnel, expansion of working space and purchase of equipment to meet with the requirements of our programme of work. However, with non-availability of foreign exchange, CISIR has to depend for its training programme on the availability of scholarships awarded by outside agencies.

Our Objectives

It has been said and is still being said that CISIR has been specifically set up by Government for carrying out applied research having a bearing on the problems of local industry. CISIR should also provide the base for the industrial exploitation of locally available raw materials by way of new manufacture or as substitutes for imported raw materials. As such, CISIR should concentrate all its energies and funds on mission-oriented research, preferably over a three or four year life expectancy at most, for realisation of targets. However, too strong an insistence on short-term considerations has its own pitfalls.

We can do so and we do so by investigating problems of a basic nature with no prospects of immediate application or even of application in the foreseable future.

CISIR has all along held that such long-term basic studies are necessary, within limits, as they add to the status of the Institute and to the prestige of our scientists among their peers and remove that sense of isolation so common among scientists in the Third World. Success in such studies is also a source of satisfaction to the individual scientists in that he has made a worthwhile contribution to the existing store of knowledge in that particular field.

Besides such theoretical studies provide us with an opportunity of training our young scientists which is an objective of the Institute. The results of these studies are published in scientific journals both local and foreign and serve as one of the recognised means of communication between our scientists and those working in the same areas in other laboratories.

Coming back to the main activities of the Institute which account for the major proportion of our expenditure —these are directed towards carrying out investigation and research into available raw materials, improvement of existing technology, and working on product development

from new or existing raw materials. These are obviously of importance to a developing country as such investigations may result in development of a new technology or in upgrading the quality of products or may bring about a reduction in the cost of production.

At times, it may be just a change of technique that is required to serve the same ends. Equally important is the maintenance of quality of industrial products as well as that of the raw materials which are transformed into finished products. This requires testing for conformity to standards or specifications.

Tea Industry

As benefits the importance of tea, coconut and rubber to the economy of this country, CISIR has devoted a considerable amount of time and funds to investigations into the technology of these primary products with a view to increasing their value added component. Not many of the members of the general public would be familiar with Ceytea. This is an instant tea powder manufactured in Sri Lanka solely for export.

CISIR was commissioned by T.R.I. in 1958 to investigate the process of manufacture of Instant Tea from green leaf, in contrast to instant teas on the market which are prepared from black tea. Almost three years and hundreds of experimental runs later, we were able to present a final report to the T.R.I. giving details of process equipment and conditions of operation required for the production of good quality instant tea from green leaf. Today's production of Ceytea is based on the process developed by CISIR which was handed over by T.R.I. to CeyTea Company for commercial exploitation.

Another new product, a tea drink, has been developed by CISIR for distribution in the form of a bottled product. The distinctive feature of the product is that it can be chilled without the onset of creaming and sedimentation which is a feature of a normally brewed cup of tea. The product is now being manufactured by the Ceylon Breweries under license from CISIR.

CISIR has been successful in formulating a blend of aromatic oils for use with black tea to give a product comparable with the well-known scented teas such as Earl Grey. This is now at the stage where commercial production is awaited.

The Coconut Industry

Our studies into coconut and by-products with the same endview have resulted in marketable products derived from the coconut sap. Investigations into the sterilizing and bottling of toddy were undertaken way back in 1956 and by 1960, CISIR had worked out the process details, equipment and operating conditions for this process.

Today, every producer of bottled toddy, coconut or palmyrah, is using the CISIR process for manufacture and, according to information we have received, Malaya too is using this process for production of bottled toddy. Over the last five years, this product had a sale turn-over of approximately Rs. 8 million bringing in an excise revenue to Government of over one million rupees. A similar process for bottling young coconut—thambili and kurumba water has also been successfully worked out.

With the current increase in the price of sugar, many District Development Councils as well as Co-operative Organisations have set up units for the production of sugar and treacle from both coconut and palmyrah saps. In 1957, CISIR set up a station at Kakkapalliya with the aid of special funding from Government for investigation into the processing of coconut toddy for the production of sugar and treacle. At the time of completion of our work, the economic of production of sugar from palm-sap was not favourable to the potential producers and this work was not exploited.

Almost fifteen years later with the astronomical hike in sugar prices, the manufacture has proved attractive to the small producer and numerous units have been set up and are in operation.

CISIR has now developed a heat-sterilized bottled Coconut Cream as an answer to the enormous waste of oil that occurs with the use of coconuts in the household when coconut milk is extracted for use in cooking. The amount of oil that is now wasted in the residue has been estimated at 30,400 tons annually which is a sizable quantity in relation to the exports of coconut oil. With central processing, residual oil of good quality could be extracted by further processing of the residue.

Pilot plant trials for production of bottled coconut cream have been carried out in collaboration with the Coconut Processing Board at their Mirigama Mills. Consumer acceptance trials, which have been completed, indicate a favourable response to this product. A decision is awaited from the Coconut Development Authority as to the future of this product.

CISIR has also investigated the possibilities of extracting oil and edible protein from the wet processing of coconut. Similar investigations have been mounted in other countries, including U.K., America, Germany and India. There is no question but that this separation is technologically feasible. It is the economic feasibility that is in doubt.

The Rubber Industry

The main interest of our rubber technologists and scientists has been to increase the use of rubber in the manufacture of rubber goods both for local use and for export. With this end in view, CISIR provided local manufacture with a compounding and testing service. The objective was to provide formulations for new products hitherto not manufactured in Sri Lanka, to undertake experimental compounding followed by testing, to improve the quality

of the products manufactured, and to test the products of local manufacture for conformity to predetermined high quality standard.

CISIR was closely involved with the formulation of the proposals for setting up the first bicycle tyre and tube factory in this country. The Institute was requested to prepare the project report setting out the technical requirements and economic prospects for such manufacture. CISIR was associated with company staff in the commissioning and handing over of plant and equipment. This assignment was again in recognition of the skills available with CISIR in the field of rubber technology.

In view of the need to remove or minimise our dependence on imported rubber rollers for use with our rice hullers, CISIR experimented with various formulations for the production of rubber rollers. A formulation which resulted in a rubber roller comparable in performance to the imported product was finally evolved.

Work continues at CISIR in the area of rubber technology—both on rubber latex and dry rubber. Suitability of latex for sizing paper has been investigated as well as for bonding plywood.

Minor Crops

Besides our investigations into these major plantation crops, CISIR has also taken up for study the minor export crops i.e. essential oils and spices, under the sponsorship of the Ministry of Plantation Industries and the Ministry of Planning. Our main objective was to effect improvement in the technology now existing in the spice and essential oil industries. CISIR was successful in designing a still for the leaf grasses embodying many departures from the existing stills. The innovative features were the incorporation of a latent heat-exchanger between the vapour outlet of the still and vapour inlet to the condenser, and an air-cooled aluminium tube condenser. This in effect minimised the dependance of the distillation operation on the availability of large quantities of water—which could be critical in times of prolonged drought. A further advantage was the reduced capital cost of the still. These stills are now in operation in the field.

Another still has been designed and tested for the distillation of spices such as nutmeg, pepper, cloves and cardamom. These spices contain a comparatively large proportion of fixed oils and the still has been found to be extremely efficient on these materials.

CISIR is studying the chemistry of these spices and essential oils. Methods have been developed which give more accurate and more reliable data on the major constituents of oils such as cardamom, citronella, clove, fennel and cinnamon leaf and bark than was possible with the usual wet chemical methods. CISIR has now the expertise required for the assessment of quality in essential oils and the ability to monitor the performance of clients producing these oils for export and indicate to them methods of improving their products to the level laid down by the export standards.

The upgrading of essential oils and the production of aromatic flavour chemicals from such oils is engaging the attention of CISIR scientists. A variety of aromatic chemicals have been prepared from the major constituents of cinnamon leaf oil, but this work as yet is at bench scale. In this area, CISIR is endeavouring to provide a research base in the country for developing new products with emphasis on their quality.

Sereh, the name by which lemon grass is known, is indigenous to Sri Lanka, but no organised attempt to grow and harvest this grass for extraction of the oil had been made. In November, 1962, CISIR in collaboration with the Department of Agriculture undertook an agronomic study of the crop together with bulk scale distillation of the grass at the Dry Zone Research Station at Maha Iluppalama. CISIR fabricated the still for distillation of the grass and the first crop was harvested in May 1963 and distilled. The quality and quantity of oil recovered indicated the commercial potential of this grass. Continuing studies over a period of approximately three years provided sufficient data to establish lemon grass as a cultivable crop and lemon-grass oil as a 'new' essential oil for local use and export.

A considerable amount of time and money has gone into the study of de-toxification of cassava and the development of products such as starch, sago, glucose, dextrins from cassava. For the record, an information bulletin on the production of starch and sago from cassava was put together by CISIR in 1957. The District Development Councils have taken the responsibility of progressing our production data on glucose and sago to the stage of small scale production. The process for the preparation of de-toxified starch and flour has now been firmly established and is available to interested parties. CISIR has shown that incorporation of cassava starch and sorghum flour at a level of 10% into wheat flour for bread making is quite feasible and the product is acceptable. Were this to be followed up, the savings in foreign exchange on the import of wheat and wheat flour would be a sizable rupees seventy million.

Miscellaneous Products

There are many other products which owe their genesis to work done at CISIR. To name but a few, Cancelling Ink for use of the post-offices, Wire Drawing Lubricant for use by the Steel Corporation, Grafted Latex-emulsion Paints, Arc Welding Rods, Duplicating Ink and Turkey Red Oil. These latter are all manufactured under license by the private sector and substitute for imported products using locally available raw materials. The Industrial Development Board is setting up the plant for production of Turkey red oil as a proto-type for subsequent release to the small industrialists.

Service to State Corporations.

No account of CISIR work would be complete without reference to the assistance rendered by us to the public industrial corporations.

Paranthan Chemicals benefitted from the expertise of CISIR rubber technologists who assisted them by formulating a suitable Ebonite Compound and establishing the conditions of re-lining these electrolytic cells with this compound. Were it not for this, the Corporation would have been compelled to send these cells abroad for re-lining at considerable cost in foreign exchange as well as production loss through down-time. The re-lining of cells is now done at Paranthan using the know-how developed at CISIR.

CISIR scientists and technical assistants together with chemical engineers from Paranthan investigated the conditions for manufacture of potassium chlorate using the excess chlorine produced at Paranthan. After a study of the systems, CISIR and Paranthan staff fabricated the equipment required for this conversion, carried out trials and successfully established a process for production of potassium chlorate.

The Tyre Corporation leant heavily on the rubber technologists of CISIR right through the formulation and the planning stages of the project. CISIR staff participated in all aspects of the preparation of manufacturing specifications and actively participated in tyre testing work carried out locally by Soviet technical personnel.

CISIR has been interested in the possibilities of rubber wood pulp for production of paper. CISIR had investigated this raw material rather extensively in its laboratories and had established the quantities of chemicals, the physical conditions for effective pulping and tested the quality of the paper produced from rubber wood pulp. Even though the available literature carried reference to the use of rubber wood for production of pulp for paper manufacture and the laboratory work at CISIR also supported the published information, rubber wood was still suspect. It appeared that nothing short of large scale mill trials would be necessary to assess the potential of rubber wood as a source of paper pulp. 23 tons of rubber wood chips were transported to Valachchenai. 4.5 tons of rubber wood chips were pulped in each digestor and paper using 100% rubber wood pulp was formed on the paper machine after a number of adjustments were made on the machine. The interpretation of the results has brought out views which would require further clarification, but the main issue that unmixed rubber wood pulp could produce an acceptable paper on mill scale equipment has been proved technologically possible.

It would be of interest here to mention another instance of CISIR work lying fallow for a number of years. We commenced investigations into the extraction and concentration of local vegetable tannin materials as a substitute for the imported wattle extracts. These investigations culminated in a final report in which we put forward concrete proposals for extraction of tannin from local materials. We are now informed that the Leather Corporation is planning to undertake extraction of tannin material on a commercial scale.

Other Services

Two other very useful services made available to the country by CISIR are the testing of raw materials and products for conformity, and the technical Library Services. The latter is much in demand by members of the public as it provides many enterpreneures with advice and technical information and also the use of library facilities.

The standards for manufactured products are formulated for Sri Lanka by the Bureau of Ceylon Standards (an organisation which came into being following on a CISIR report and which draws heavily on CISIR expertise for assistance), but CISIR provides the testing services. In cases where no proper standards exist or where no proper testing methods are laid down even these have to be devised by CISIR. In 1975, more than 1,550 test reports were furnished by the CISIR. This service is of great assistance to small industrialists.

Over the years CISIR has built up a considerable body of expertise in electronic instrumentation largely as a "fall-out" of the on-going research programme of the section. There is now a steady increasing influx of electronic instruments into the country for use in laboratories, hospitals and industry. CISIR gets frequent calls for assistance for the repair and maintenance of these instruments—including S.O.S. calls from the hospitals.

CISIR is the only Institute which has available standard equipment for use in the calibration of electronic measuring instruments.

In May 1960, CISIR successfully launched the Productivity Association of Ceylon as a necessary factor of industrial development. CISIR along with the Productivity Association organised two management seminars, one conducted by a team from Stanford University and the other from Israel. Both were well supported by local industrialists and added to the stature of the Productivity Association. Here again, the Productivity Association is now a fully fledged body, and is making a valuable contribution to the industrial sector.

Support for science is at best given grudgingly, because most countries are not sure in measurable terms as to what extent scientific achievement and the county's development can be correlated. The difficulties and at time disappointments at the 'small' returns from the country's investment in science and technology have to be faced in increasing measure by developing countries and at times the experience can be frustrating. This shows up in the allocation of funds for science in national budgets of developing countries.

Our preoccupation with Government support is understandable because this is our main source of funds. Over the period of 20 years, Government provided approximately Rs. 31.2 million for both operational and capital expenditure i.e. as 0.018% of the G.N.P. of the country, at factor cost price for the years 1955—1974. Our operational expenditure for this 20 years period amounted to approximately Rs. 27 million. Over the past 20 years, the annual government contribution to the Institute at constant prices increased from Rs. 1 million in 1956 to Rs. 2.3 million in 1974. i.e. 2.3 times, while its operational expenditure increased 5 times. In any scientific activity, there is a determinant of productivity known as a "critical mass." Below this level, it is quite likely that any research group would be sterile, and unless adequate support is forthcoming to maintain our strength above this critical mass, we may end up by being non-productive.

A strong scientific and technical base is one of the staging areas for national development and growth. Public resources are indispensable in achieving that strength. We appreciate that in the context of more pressing social needs expenditure on research and development is now looked on as a discretionary category of public investment as, by and large, research and development does not play a highly visible role in the process of economic development. It is for this reason that research and development require very strong advocacy to win out in the competition for resources and what greater measure of advocacy can we urge than our record of achievements.

We are using this occasion and we take this opportunity to place before the country our record of service in relation to the funds made available to us by Government, in other words, investment utility. What transpires from all this is that we can only give service to the extent that Government and industry appreciate our services and support our activities. Need we stress the obvious, or to put it in another way, can we be more obvious?

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දියුණුවෙමින් පවතින රටවල විද්‍යාව පිළිබඳව රජයේ ප්‍රතිපත්තිය කුමක් විය යුතු ද?

ජාතික විද්‍යා සභාවේ සභාපති ආචාර්ය ඕස්මන්ඩ් ජයරත්න සමඟ ආචාර්ය කාර්ලෝ ෆොන්සේකා පැවැත්වූ සාකච්ඡාවකි.

ප්‍රශ්නය:— දියුණුවෙමින් පවතින රටවල විද්‍යාව පිළිබඳ පැහැදිලි රාජ්‍ය ප්‍රතිපත්තියක් තිබිය යුතු යැයි ඔබ හිතා සිටින්නේ මක්නිසාද?

පිළිතුර:— දියුණුවෙමින් පවතින රටවල පොදු ලක්ෂණයක් වන්නේ දිළිඳුකම හා ඉන් පැනනැඟි ඇති රෝගපීඩාදිය, මන්දපෝෂණය වැනි ප්‍රශ්නයි. එම ප්‍රශ්න විසඳීමට ඇති ප්‍රබලම ද්‍රව්‍ය වන්නේ විද්‍යාවයි. සංවර්ධිත රටවල කැපී පෙනෙන ලක්ෂණය වන්නේ එම රටවල විද්‍යාව ඉහා දියුණු තත්වයක තිබීමයි. විද්‍යාත්මක පර්යේෂණ සඳහා ලෝකයේ වැය වන මුදලින් 95% ක් පමණ වැය කරනු ලබන්නේ මේ රටවල් වීසිනි. එම විද්‍යාත්මක පර්යේෂණ වලින් ලැබෙන ආර්ථික, සාමාජීක, දේශපාලන හා සංස්කෘතික ඵල ප්‍රයෝජන බොහෝ සේ භුක්ති විඳින්නේ ද ඒ රටවල් ය. සංවර්ධනය වෙමින් පවතින රටවල් ද ඕය ප්‍රගතිය අපේක්ෂා කරන්නේ නම් ඒ රටවල් ද විද්‍යාව පිළිබඳව පැහැදිලි රාජ්‍ය ප්‍රතිපත්තියක් අනුගමනය කළ යුතුයි.

ප්‍රශ්නය:— දියුණුවෙමින් පවතින රටවල රාජ්‍ය ප්‍රතිපත්තියක් ලෙස විද්‍යාව යොදගත යුතුයැයි ඔබ කිව්වා. නමුත් එසේ කිරීමෙන්ම පමණක් විද්‍යාත්මක සොයා ගැනීම් වල ප්‍රතිඵල භුක්ති විඳීමට පොදු මහජනතාවට අවස්ථාවක් සැලසෙනවාද?

පිළිතුර:— විද්‍යාව දියුණු කිරීම රාජ්‍ය ප්‍රතිපත්තියක් වූ පමණින් ම විද්‍යාත්මක සොයා ගැනීම් වල ප්‍රතිඵල පොදු ජනතාවට භුක්ති විඳින්නට ලැබේ කියා සිතීම මුලාවක්. රටක සම්පත් අතලොස්සක් අතර නොව පොදු මහ ජනතාවගේ සුභ සිද්ධිය සඳහා යොදු ගැනීමට ඇප කැප වූ රජයකට විද්‍යාත්මක සොයා ගැනීම් වල ඵලයන්ද පොදුවේ ජනතාවට ලබාදීමේ වැඩවිළිවෙළක් යෙදීම දුෂ්කර කාර්යයක් නොවේ.

ප්‍රශ්නය:— විද්‍යාව සඳහා වෙන් කරන මුදල් වැය කළ යුත්තේ මූලික පර්යේෂණ සඳහා නොව බහුජනතාවට කෙටි කාලයක දී ඵල ප්‍රයෝජන ලබා දෙන නව තාක්ෂණික කටයුතු වල විය යුතු යයි රාජ්‍ය පාලකයන් අතර මතයක් තියෙනවා. ඒ ගැන ඔබේ අදහස කුමක් ද?

පිළිතුර:— මේ පිළිබඳව මුලින්ම කිව යුත්තේ මූලික විද්‍යාත්මක පර්යේෂණ ලෙස හඳුන්වන පර්යේෂණ හා තාක්ෂණික සොයාගැනීම් පිළිබඳ පර්යේෂණ අතර අවධාන විගුහයේ දී පැහැදිලි වෙනසක් හෝ පරස්පර විරෝධී වෙනසක් නැති බවයි. විද්‍යාවේ මූලික අරමුණ වන්නේ සොබා දහමේ හා මිනිස් සමාජයේ යථාර්ථය නැතිනම් නියම ස්වභාවය අවබෝධ කර ගැනීමයි. තාක්ෂණික ශිල්ප ක්‍රම වල අරමුණ විද්‍යාත්මක දැනුම සමාජීය අවශ්‍යතා සඳහා විශේෂයෙන් ම කෑම බීම, ඉදුම් නිවුම්, ඇඳුම් පැළඳුම්, බෙහෙත් පෙත්, පොත්පත් ආදිය නිෂ්පාදනය කිරීමට යොදගැනීමයි. මේ අනුව මූලික විද්‍යාත්මක පර්යේෂණ හෝ තාක්ෂණික සොයා ගැනීම් අතර පැහැදිලි වෙනසක් නැති බව පැහැදිලිය.

ප්‍රශ්නය: — එසේ නම් ඔබගේ අදහස අනුව ශ්‍රී ලංකාව වැනි දියුණු වෙමින් පවතින රටකත් මූලික විද්‍යාත්මක පර්යේෂණ කිරීම අවශ්‍ය වන බව ද?

පිළිතුර:— ඇත්ත වශයෙන්ම එය එසේ විය යුතුය. මා එසේ කියන්නේ කරුණු කිපයක් නිසයි. ඉන් පළමුවැන්න ඉංජිනේරුවන්, දෙවැන්නා වෛද්‍යවරුන්, තෘතීයික උපදේශකවරුන් වැනි පුද්ගලයන් පුහුණු කිරීම හුදෙක් එම වෘත්තීය වලට අයත් පුද්ගලයන්ටම භාරදීම සුදුසු නැති නිසයි. වෛද්‍ය වෘත්තිය, ඉංජිනේරු වෘත්තිය ආදී කුසලතාවයන් හොඳින් හැදෑරීමට මෙන්ම විද්‍යාව, රසායනික විද්‍යාව, ගණිතය වැනි මූලික විෂයයන් ද හැදෑරීම අත්‍යාවශ්‍ය වන නිසයි. මේ විෂයයන් හොඳින් ඉගැන්වීය හැක්කේ එම ක්ෂේත්‍ර වල ප්‍රායෝගික වශයෙන් ඥානය සම්පූර්ණයෙන් ම අත්‍යායනය කිරීමට බැරි නිසයි. මක්නිසාද කිවහොත් යම්රටකට ආවෙනික වුද, සුවිශේෂ වුද, ප්‍රශ්න විසඳීමට එම රටවලටම අදාළ වූ තොරතුරු රැසක්ම අවශ්‍ය වෙනවා. මේ තොරතුරු ලබා ගැනීමට අවශ්‍ය වන විද්‍යාත්මක පර්යේෂණ කළ හැක්කේ ප්‍රශ්නයට අදාළ රටේ පමණයි.

ප්‍රශ්නය:— ඔබ කියූ කරුණු වලින් පැහැදිලි වන්නේ රටක විද්‍යාව පිළිබඳ ප්‍රතිපත්තිය එහි සමාජ ආර්ථික කරුණු වලින් වෙන් කළ නොහැකි බව නොවෙ ද?

පිළිතුර:— ඇත්තෙන්ම, ඒ මතය මම සම්පූර්ණයෙන්ම අනුමත කරනවා. කොටින්ම කියනොත් රටක තාක්ෂණික ආර්ථික ප්‍රතිපත්තිය ඒ රටේ විද්‍යාව පිළිබඳ ප්‍රතිපත්තිය විනා අන්කිසිවක් නොවේ. එහි හරය වනුයේ එම රටේ මෙනෙවන සමාජ ආර්ථික වාතාවරණය අනුව විද්‍යාව තාක්ෂණික ඥානය සමග ගැලපීමයි.

ප්‍රශ්නය:— තුන්වන ලෝකයේ රටවල භාවිත වන විද්‍යාත්මක හා තාක්ෂණික ඥානය පිළිබඳ තත්වය කුමක් ද?

පිළිතුර:— මා මීට පෙර සඳහන් කළ පරිදි තුන්වන ලෝකයේ රටවල භාවිතා වන විද්‍යාත්මක හා තාක්ෂණික ඥානය ඉතා පහත් මට්ටමකයි තිබෙන්නේ. 1960 දී ඇමෙරිකා එක්සත් ජනපදය සහ සෝවියට් දේශය විද්‍යාත්මක පර්යේෂණ සහ සංවර්ධන කටයුතු සඳහා රටේ අදළ ජාතික ආදායමෙන් පිළිවෙලින් 2.8% සහ 2.3% වැය කොට තිබෙනවා. ඝානාව මෙම කටයුතු සඳහා, 0.2% ක්ද, සකිසථානය 0.1% ක්ද, ශ්‍රී ලංකාව 0.25% ක්ද වැය කොට තිබෙනවා. තුන්වන ලෝකයේ රටවල විද්‍යාව දියුණු කළ යුතු තත්වයක තිබෙන්නේද එම රටවල ආර්ථිකය නොදියුණු තත්වයක තිබෙන හේතුවම නිසයි. එනම්, අධිරාජ්‍යවාදීන්ගේ යටත් විජිත ලෙස ආර්ථික සූරාකෑම වලට තුන්වන ලෝකයේ රටවල් භාජනය වූ නිසයි. නවද, මේ රටවල පොදු මහජනතාව තුල විද්‍යාත්මක අංකල්පය පිළිබඳ තිබෙන අවබෝධය ඉතා අල්පය. ඒ නිසාම සංවර්ධන කටයුතු යළඟා විද්‍යාව උපයෝගී කර ගැනීමට දැඩි උනන්දුවක් ඒ රටවල ජනතාව තුළ නැහැ. මෙය තුන්වන ලෝකයේ රටවල සෑම මට්ටමේ ම පුද්ගලයන් තුළ ඒ කියන්නේ දේශපාලඥයන්, පරිපාලකයන්, අධ්‍යාපනඥයන්, පුහුණු තාක්ෂණිකයන් ආදී විවිධ ජන කොටස් තුළ දිවිය හැකි දෙයක්.

ප්‍රශ්නය:— තුන්වන ලෝකයේ රටවල දේශීය විද්‍යාඥයන්ගෙන් ඒ රටවල විද්‍යාව හා තාක්ෂණික ඥානය ඇතුළු සංවර්ධන කටයුතු වලට සේවයක් වී නැද්ද?

පිළිතුර:— කණගාටුවෙන් වුවද කියන්නට සිදු වන්නේ තුන්වන ලෝකයේ රටවල දේශීය විද්‍යාඥයන්ගෙන් ඒ රටවල විද්‍යාව ඇතුළු තාක්ෂණික ඥානයට එතරම් සේවයක් සිදුවී නැති බවයි. ඇත්ත වශයෙන් ම, මෙම විද්‍යාඥයන් බොහෝ දෙනෙක් අධිරාජ්‍යවාදී ගැත්තන් බවට පත්වී සිටිනවා, මේ විද්‍යාඥයන් අධිරාජ්‍යවාදී දැඟලුම් හා ආකල්ප අන්ධානුකරණයෙන් අනුමෝදනය කළ ජනතාවගෙන් වෙන් වූ වරප්‍රසාද ලත් කොටසක්. ඔවුන්ගෙන් බොහෝ දෙනෙක් නව යටත් විජිතවාදී රාමුව පවත්වා ගෙන යන ඉත්තන් බවට පත්වී සිටිනවා. ඒ නිසාම බොහෝ විට ඔවුන් ඇතිවිය යුතු සමාජ හා දේශපාලන ප්‍රවාහය වලක්වන බාධක බවට පත්වෙලා සිටිනවා.

ප්‍රශ්නය:— මෙයින් ඔබ අදහස් කරන්නේ තුන්වන ලෝකයේ රටවල ජාතික අවශ්‍යතා පිළිබඳ අවබෝධයක් ඇති දේශීය විද්‍යාඥයන් බිහි විය යුතු බව ද?

පිළිතුර:— ඒ ගැන කිසිම සැකයක් නෑ. විදේශීය රටකින් පැමිණෙන විශේෂඥයෙකුට දේශීය අවශ්‍යතා ගැන එක්වරම අවබෝධයක් ලබාගන්නට නොහැකි වනවා සේම බටහිර තරඟයට හසුවූ දේශීය විද්‍යාඥයන්ට ද දේශීය අවශ්‍යතා වටහා ගන්නට අපහසුයි. යම් රටකට උචිතම තාක්ෂණික ඥානය නම් දේශීය අවශ්‍යතා වලට අනුකූලව බිහිවූ ඥානයයි. එවැන්නක් බිහි කළ හැක්කේ දේශීය අවශ්‍යතා ගැන අවබෝධයක් ඇති විද්‍යාඥයන්ට පමණයි.

ප්‍රශ්නය:— එසේ නම් ශ්‍රී ලංකාව වැනි දියුණුවෙමින් පවතින තුන්වෙනි ලෝකයේ රටවල් අනුගමනය කළ යුතු විද්‍යා ප්‍රතිපත්තිය කුමක්ද?

පිළිතුර:— එය බැරෑරුම් ප්‍රශ්නයක්. අවසාන විග්‍රහයේදී විද්‍යාව මිනිස් සංහතියට අයත් පොදු වස්තුවක් විය යුතු වූවත් වර්තමාන ලෝකයේ පොහොසත් හා දුප්පත් රටවල් අතර ඇති විෂමතා විද්‍යාව කෙරෙහි ද බලපානවා. නොදියුණු රටවල විද්‍යාව නව යටත් විජිත වාදයේ අංගයක් බවට පත්වී තිබෙනවා. එම නිසා තුන්වන ලෝකයේ රටවල් මෙම නව යටත් විජිතවාදී ග්‍රහණයෙන් මිදීම සඳහා සහයෝගීව කටයුතු කළ යුතුයි. එහෙත් නොදියුණු රටවල විද්‍යාඥයින් අතර සහයෝගිතාවය ඇති කිරීමෙන් පමණක් දිළිඳු රටවල සංවර්ධනය පිළිබඳ ප්‍රශ්නය විසඳෙන්නේ නැහැ. සෑම සංවර්ධනය වන රටකම විද්‍යාඥයන් සිය රටවල මෙන්ම තුන්වන ලෝකයේ පවතින සමාජ දේශපාලන බලවේග කෙරෙහි ද සිය අවධානය යොමු කළ යුතුයි. එමගින් ආර්ථික සූරාකෑම නොවැකී යාධාරණ සමාජයක් ගොඩනැඟීමේ ඓතිහාසික කර්තව්‍යයට ඔවුන් සහභාගී විය යුතුයි. එවැනි සමාජයක පමණයි විද්‍යාවේ පූර්ණ වර්ධනය ඇති විය හැක්කේ.

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නොබැඳි රටවලට නව විද්‍යා පෙරමුණු

ආචාර්ය සුසන්ත ගුණතිලක

නෙවන ලෝකයේ නාවීනා කෙරෙන විද්‍යාවන් ඓතිහාසික වශයෙන් ආරම්භ වූයේ බටහිර ලෝකයේයි. ශ්‍රී ලංකාවේ හා නෙවන ලෝකයේ බොහෝ රටවලත් ඒ විද්‍යාත්මක දැනුම හා ආර්ථික නියම පුද්ගල කණ්ඩායමක් බිහිවුණේ හුදෙකලම විසිවන ශත වර්ෂයේදී ය. මෙහි මූල් යුගයේ දී එනම් පසුගිය හිස් හෝ හතළිස් වසර තුළ මේ දැනුම බටහිරෙන් ලබා ගන්නා ලද්දේ ශිෂ්‍යයෙන් ථිදේශික විශ්ව විද්‍යාලයනට සංක්‍රමණයවීම මගිනි.

ශ්‍රී ලංකාවේ ශිෂ්‍යයන් බහුල වශයෙන් ගියේ බ්‍රිතාන්‍ය විශ්ව විද්‍යාලවලටයි. නවත් සමහර රටවල ශිෂ්‍යයෝ ප්‍රංශ, ඇමරිකානු, ජර්මන්ද ආදි විශ්ව විද්‍යාලවලට ගියහ. එසේ ගිය ඔවුහු මේ විද්‍යාවේ විවිධ පැති උකහා ගත්හ.

මේ දේශයන්හි විශ්ව විද්‍යාල පිහිටුවීමෙන් පසු විද්‍යාව ලබා ගැනීමෙහි ක්‍රමයෙහි ගුණාත්මක වෙනසක් සිදුවිය. ඒ වෙනස නම් විද්‍යාවන්හි මූලික න්‍යායයන් සහ ක්‍රම තවමත් බටහිර රට වල ප්‍රභවය වූ නමුත් දැනුම බෙදා දීමේ ක්‍රමය නෙවන ලෝකයේ රටවල විශ්ව විද්‍යාලවලම සිදුවීම ය.

මේ විද්‍යාත්මක දැනුම බෙදා දීමේ ක්‍රමය විකාශනශීලී ක්‍රමයකි. ඒ විද්‍යාව පිළිබඳ දැනුමෙන් විශාල සම්භාරයක් වැඩෙන්නේ බටහිර රටවල ය. අදත් ප්‍රධාන වශයෙන්ම එය එසේම ය. පර්යේෂණ හා විද්‍යාත්මක සංවර්ධන කටයුතුවල සියයට 98 ක්ම කෙරෙන්නේ දියුණු රටවලයයි එක්සත් ජාතීන්ගේ සංවිධානය විසින් ගණන් බලා ඇත.

එවැනි විද්‍යාත්මක පර්යේෂණ නෙවන ලෝකයේ කෙරෙන්නේ 2%කි. එයිනුත් අඩක් එනම් මුළු ලෝකයේම කෙරෙන පර්යේෂණවලින් සියයට 11 ක් නෙවන ලෝකයේ ප්‍රශ්න පිළිබඳවයි. දියුණු රටවල කෙරෙන පර්යේෂණ පසුව නොදියුණු රටවලටත් බෙදා දෙනු ලැබේ. මින් හැඟෙන්නේ විද්‍යාව පිළිබඳ සිතුම් පැතුම්වලින් බහුතර කොටසක් සිදුවන්නේ බටහිර රටවල බවය. නෙවන ලෝකයේ කෙරෙන්නේ ප්‍රශ්න පිළිබඳ සුළු සුළු වෙනස්කම් සලකා බැලීම පමණකි. මේයින් හැඟෙන තවත් කරුණක් නම් බටහිර රටවලත් ඒවාට නතු රටවලත් විද්‍යාව පිළිබඳ සිදුවන ගාස්ත්‍රඥයන්හි දී කාලය පිළිබඳ වෙනසක් වූ බවය. පොත පත බහුල වශයෙන් ලද හැකි එමෙන්ම නිලධාරීන් හා ශිෂ්‍යයන් පාඨ්‍යාල ලෙස භූවමාරු කරගත හැකි ස්ථානවල ඒ කාලය පිළිබඳ වෙනස ඉතාම සුළු ය.

මේ විද්‍යාත්මක දැනුම පිළිබඳ විකාශනයේ ප්‍රතිඵල පිළිබඳ තවත් පැත්තක් නම් ආර්ථික හා දේශපාලන ලෝකයේ තිබෙන විසමතාවාදී ශ්‍රම විභජනයක් ශාස්ත්‍රීය ලෝකයෙන් පවතින බව ය. විද්‍යාව පිළිබඳ ප්‍රධාන ලිපි ලේඛන හා ප්‍රධාන ප්‍රශ්න ප්‍රභවය වන්නේ දියුණු රටවල මහා නගරවලයි. ඒ මහා රාජ්‍යවලට නතු රටවල විද්‍යාලයන් විසින් සලකා බලනු ලබන්නේ සුළු විද්‍යාත්මක ප්‍රශ්න පමණි. මෙයට හේතුව නොදියුණු රටවල අවශ්‍ය දේ ලබා ගත හැකි වන්නේ නිමා සහිතව හෙයිනි. මෙම විද්‍යාත්මක විකාශන ආකෘතිය හේතු කොට ගෙන බුද්ධිය අනුකරණශීලිත්වයක් වශයෙන් හැඳින්විය හැකි තත්වියක් ද ඇතිවේ.

ඒ ප්‍රධාන නගරවල හට ගන්නා දැනුමත් ඒ නගර වලට නතු සීමාවන්හි හට ගන්නා දැනුමත් අතර වෙනසෙහි ප්‍රධාන ලක්ෂණ යක් නම් ප්‍රමාණයෙන් දැනුම සංවර්ධන වේගයේත් ඉතාම ප්‍රබල වෙනයයි. මේ වෙනස ඕනෑම විධියේ මිරිමකින් දැනගත හැකිය. ශාස්ත්‍රීය ලිපි ලේඛන, ශාස්ත්‍රීය ප්‍රකාශන හෝ විද්‍යාව හැදෑරීම කරන පුද්ගලයන්ගේ සංඛ්‍යා ලේඛන මගින් ද මේ වෙනස දැනගත හැකි ය. නොදියුණු රටවල උපාධිධරයන්ගේ සංඛ්‍යාව ඉතා වෙගයෙන් සංවර්ධනය වීම නිසා එහි ලා ඉදිරිවන වෙනස නම් එන්ට එන්ටම අඩුවේ.

මධ්‍යම නාගරයන් සීමාන් අතර දැනුමෙහි හා දැනුම සංවර්ධන වේගයේත් වෙනස නිසා ඇතිවන ප්‍රතිඵලයක් නම් ඒ නතු ප්‍රදේශ යට සැවෙන දැනුම ප්‍රමාණය මධ්‍යම ප්‍රදේශයෙන් හට ගන්නා දැනුමෙන් ඉතා සුළු ප්‍රකාටසක් වීමය. මෙසේ දැනුම සංක්‍රමණය වීම ස්වාභාවික වශයෙන්ම අසම්පූර්ණ ය. එයේ සම්පූර්ණ විය හැක්කේ ඒ මධ්‍යම ප්‍රදේශයේ ලැබෙන ලිපි ලේඛන, ප්‍රකාශන හා විද්‍යාඥයනුත් සහමුලින්ම ඒ නතුවන ප්‍රදේශයන්හිම ලැබෙනතාක් පමණි.

දකුණු ආසියානු රටවල තිබෙන විධියේ විදේශ ධන ප්‍රශ්නයක් දැනි වූ කල්හි මීට පෙර පැවැති අසම්පූර්ණ පොත් පත් හනු දෙනු තව තවත් අසම්පූර්ණවේ. මෑතක දී ශ්‍රී ලංකාවේ ද එවැනි ගනු දෙනුවක් සහමුලින්ම නොමැති තැනේ විය. එපමණක් නොවේ. එම විදේශ ධන හේතුව නිසාම ඒ ප්‍රධාන දේශවල තිබෙන විධියේ විද්‍යාත්මක උපකරණ නොදියුණු රටවලට ලබා ගත නොහැකි වේ.

විද්‍යාත්මක දැනුම් විකාශනයේ හා බෙදා දීමේ එක්තරා වටිනා අංශයක් නම් මේ නතුවන රටවල ක්‍රියාවේ යෙදෙන දියුණු රට රටවලින් හා විශේෂඥයන්ගේ සංඛ්‍යාවයි. බොහෝ විට මෙහි දිත් නැවත පෙනෙන්නේ යටත් විජිත වාදී යුගයේ ශ්‍රම විභජන යයි. මක්නිසාදයන් ඒ බැහැරින් එන විශේෂඥයා හෝ විද්‍යාඥයා සිය අදහස් ඒ නොදියුණු රටවලට බලයෙන් ආරෝපනය කරන්නට ප්‍රයත්න දරන හෙයිනි. ඒ අතර ඔවුහු යම්කිසි ප්‍රශ්නයක ප්‍රාදේශික අංශය නොසලසේ නම් ඒ ප්‍රශ්නයේ ප්‍රායෝගික අංශය නොතකා හරින්නට ද ප්‍රයත්න දරති.

ඒ දියුණු මධ්‍යස්ථානවල සිට ඇත පෙදෙස්වලට ප්‍රකාශන විද්වතුන් හා විද්‍යාඥයින්ගේ ගමන් බිමින් ආදියෙන් කරන දැනුම් බෙදා දීම හැරුණු විට මේ දැනුම් බෙදදිය හැකි තවත් මාර්ග ඇත. එනම් ඒ ඇත පෙදෙස්වලින් දා නතුත් ප්‍රධාන මධ්‍යස්ථානවලට යාමෙනි. විදේශ ධන ක්‍රියය නිසා එවැනි ප්‍රධාන මධ්‍යස්ථාන වලට යන ශිෂ්‍යයන්ගේ සංඛ්‍යාව අඩු වී ඇත. එසේ වුවද සම්මේලන සම්මන්ත්‍රණවලට යන විද්‍යාඥයන්ගේ සංඛ්‍යාව දියුණු වන්නට පටන් ගෙන ඇත. එහෙත් ඒ ගමන් බිමින් දැනුම් සංවිධානය වීම පිළිබඳ සීමා වෙගය හා සරිලන්නේ නැත. එසෙන් එවැනි විදේශ සංචාරවල දී සවා දැනුම් ලබා දීම සම්පූර්ණ නැත. මක්නිසාදයන් ආපසු එන විද්වතා විසින් බෙදා දෙනු ලබන්නේ ලබා ගත් දැනුමෙන් ඉතාම සුළු කොටසක් හෙයිනි.

මෙසේ මේ ඇත ප්‍රදේශවල තිබෙන දැනුම් සෑම විටම විකාසී, සීමිත වූත්, යල් පැන ගියාවූත්, මධ්‍යම ප්‍රදේශයට නතු වූත් දැනුමක් වනු ඇත. මෙහි දී නොපමාව පැන නගින ප්‍රශ්නයක් වෙයි. එනම් ව්‍යුහය පිළිබඳ සීමා හේතු කොට ගෙන ඒ මධ්‍යම ප්‍රදේශයේ දැනුම් ඇත ප්‍රදේශවලින් ඒ ආකාරයෙන්ම ලබා ගත නොහැකි නම් ඇත ප්‍රදේශ වල ගැඹුරු දැනුමක් ප්‍රභවය කළ හැකි නොවන්නේ මක්නිසාද යන්නා ය.

යුරෝපය, බැහැරට විහිදීමේ ව්‍යාපාරය ආරම්භයේ දී පැවති විධියේ වෙනසක් ආර්ථික හා දේශපාලන කටයුතු අතින් නෙවෙන ලෝකයේ ද දැනට හටගෙන ඇත. විද්‍යාවේ සංවර්ධනයට ඉව හල් වන යාමාණික රථාවත් ලෝකය පිළිබඳ දර්ශනයන් විද්‍යාවේ ශීඝ්‍ර දියුණුවන් සඳහා අත්‍යවශ්‍ය ය. එනිසා අපේ රට වැනි කුඩා රටවල් විසින් මේ අලුත් අනිත බව පිළිබඳ අදහස් වලින් බෙහෙවින් ප්‍රතිඵල ලද යුතු වේ. එසේ ලබාගෙන ඒ හැඟීම් දේශපාලන කටයුතුවල සිට විද්‍යාත්මක කටයුතු වෙත ගෙන යා යුතුවේ.

නව අතීත විද්‍යාත්මක පෙරමුණු නැතිම සඳහා ප්‍රධාන වශ යෙන්ම අවශ්‍ය වන්නේ බටහිර ලෝකයේ පවා විද්‍යාවේ තත්වය වෙනස් වන බව තේරුම් ගැනීම ය. බටහිර රටවල වෙනස්වීම් විස්තර කරනු ලබන්නේ අර්බුදයක් වශයෙනි. මේ අර්බුදය හේතු කොට ගෙන විද්‍යාව යොමුවන දිසාව පිළිබඳව පැවති ස්ථිර හැඟීම වෙනස්ව ඇත්තේ ය. ප්‍රධාන මධ්‍යස්ථානවල පවා විද්‍යාත්මක කටයුතු පිළිබඳ ප්‍රබල ආලෝලනයක් ඇති වී ගෙන ඒයි. මේ නිසා නෙවෙන ලෝකයේ අප විසින් කළ හැකි වන්නේ ඒ වෙනස් වන බලවේගවලට ප්‍රති ක්‍රියා දක්වීමයි.

එනම් ඒ වෙනස්වීම්වලට අනුව අපත් හැඩ ගැසීමය. නොඑසේ නම් අපට කළ හැක්කේ ඊට වඩා අර්ථවත් මහක් අනු ගමනය කරමින් විද්‍යාවේ තත්වය පිළිබඳ ඒකාන්තිකභාවය බිඳ වැටී තිබෙන බව පිළිගෙන බටහිර රටවල ඇති වී තිබෙන ඒ වෙනස භොඳ දෙයක් ලෙසට පිළි ගැනීමයි. ඒ මධ්‍යම ප්‍රදේශ යන්හි ග්‍රහණය ලිහිල් වීම නිර්මාණශීලීව විමසමින් අපගේ පර්යේෂණ පෙරමුණු නිර්මාණශීලීව ලකුණු කොට ගන්නට ප්‍රයත්න දැරීම අපට කළ හැකිවේ.

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විද්‍යාවෙන් දැක්වෙන සමාජ සංවර්ධනයේ සීමා

මහාචාර්ය චන්ද්‍ර ධර්මවර්ධන
පැරිස් විශ්ව විද්‍යාලය, ඔර්සේ මණ්ඩපය, ප්‍රංශය

වාමාංගික, දක්ෂිණාංගික, උගත්, නූගත් කවුරුත් අසන ප්‍රශ්න යක් නම් මේ රට කෙසේ දියුණුව කරා යොමු කළ හැකිද යන්නයි. ලාංකීකයන් කිහිප දෙනෙක් හමු වූ විට ප්‍රධාන වශයෙන් ඔවුන් කතා කරන්නේ අඩුත් පොත පත, අඩුත් සංගීත සංදර්ශන හෝ සංස්කෘතික හෝ ශාස්ත්‍රීය පුවත් ගැන නොවැබඳුම්ල, රක්ෂා ගිහ කම්, කිසිම දෙයක් කර ගැනීමට නොහැකි වන තැනට පැමිණ ඇති නීති රීති, අනවශ්‍ය දේශපාලන ඇඟිලි ගැසීම්, සැම ආයතනයකම යාමේ දක්නට ලැබෙන චිනය පිරිහීම් ආදිය ගැනය.

අධ්‍යාපන ක්ෂේත්‍රය දෙස බැලූ විට එදා මෙන් අද ගුරු වෘත්තියේ ගර්වයක් නැත. ගුරු කම උතුම්වූවෙන් කෙරෙන්නේ නැත. සිසුන් තුළ විනයක් නැත. විනයක් ඇති කිරීමට තුඩු නොවන දේශපාලන බලපෑම් ඇත. ඒ අමතරව අඩුත් අඩුත් අධ්‍යාපන නිර්දේශ ඉවක් බවක් නැතිවම ගුරු සිසු දෙපක්ෂය මත පටවයි. අපේ විශ්ව විද්‍යාල වල ඇති තත්වය ජායැල් වල ඇති තත්වයට වඩා දුක් ජනකය. ගොළුබෙලි වේගයෙන් වැඩ කරන පාලන තන්ත්‍රයකුත් එක පොත, උපකරණ සහ ගොඩනැගිලි මදිකම නිසා පිරිහී ගිය අධ්‍යයන පද්ධතියකුත් අපේ සරසවි වල දක්නට ඇත. උපාධියෙන් වැඩක් නැති බව දුන දුනත් උපාධිය ගැනීමට පමණක් සරසවියට ඇතුල් වී සිටින, බොහෝ දුරට පවු අදහස් සහ පුහු මාන්නයෙන් පෙලෙන සිසුන් අපේ සරසවි වල අනන්ත අප්‍රමාණව සිටී. ඉගැනීම ට බැරි නිසාත්, ලොකුකම පෙන්නීමට ගිජු නිසාත් '' කැම්පස් පොලිටික්ස් '' වලට බට ශිෂ්‍ය නායකයෝ මේ ව්‍යාජය තව දුරටත් ගෙනියමින් ඔවුන්ගේ මෘග බලයෙන් මණ්ඩප තුළ අවිචාර සමයක් නංවා ඇත. සරසවි වල අනාගතය හෝ ශිෂ්‍යයන්ගේ අවශ්‍යතා නොව, ඔවුනොවුන්ගේ පවු දේශපාලන සංධාන වල අරමුණු පිය වීමට ඔවුහු කටයුතු කරති.

මෙනෙක් දුක් වූ සමාජීය ප්‍රශ්න ලංකාවට පමණක් විශේෂ වූවක් නොවේ. ඉන්දියාව පාකිස්තානය සහ අප්‍රිකානු රටවල් ආදීන් ඇතුළු, ලෝකයේ සැම දුගී රටකම මෙම ප්‍රශ්නය දක්නට ලැබේ. වේගයෙන් වැඩි වන ජනගහනයටත් සමගම පාසල් වලින්, සරසවි සහ වෙනත් ආයතන වලින් පිට වන තරුණ තරුණියන්ට රක්ෂා නොමැත. පුහු මාන්නය සහ '' තත්වය '' පිළිබඳ බොල් ඇදැහීම් අහක දමා වැඩක් කිරීමට ඉදිරිපත් වන තරුණයාට ද, මුදල් හදල්, ඉඩම් කඩම් ආදිය මූලික නිෂ්පාදන අවශ්‍යතාවන් පිරි මසා ගැනීමට ක්‍රමයක් නැත. '' යන්තෙන් කොහේද, කරන්නේ කුමක් ද? '' යන ප්‍රශ්නයට හසුවී මිරිකුණු කරුණ පරම්පරාවක් අද ලෝකයේ සැම දුගී රටවලම ඇත. මේ ආර්ථික හා සමාජීය අකර තැබෙන් ගොඩ ඒමට ඒ ඒ රට වල දේශපාලන නායකයන් යම් යම් පිළියම් හෝ ප්‍රතිපත්ති ඉදිරිපත් කොට ඇත. ශියල්ල ජන සතු කොට රජය යටතේ ඒක කේන්ද්‍ර කිරීම මූලික වීසඳුම ලෙස සමහරු ඉදිරිපත් කරන අතර රජයේ නිති වලට යටත්ව ක්‍රියා කරන පුද්ගලික සමාගම් වලින් දුක්ත බහු කේන්ද්‍රීය ආර්ථික රාමුවක් වඩා කාර්යක්ෂම යයි තවත් කොටසක් කියයි.

මෙවැනි ප්‍රශ්නවල දී අපට විද්‍යාවෙන් සහ විද්‍යාත්මක ක්‍රම යෙන් පිහිටක් ලබා ගැනීමට නොහැකි ද? ඒක කේන්ද්‍රීය හෝ බහු කේන්ද්‍රීය හෝ වෙනත් ආර්ථික රාමුවක් දුන් විට එය තුළින් ලද හැකි සංවර්ධනය කුමක් ද, එහි සීමා මොනවාද යන කරුණු වලට විද්‍යාවෙන් කුමන පැහැදිලි කිරීමක් ලබා ගත හැකි ද?

නවීන විද්‍යාත්මක මූහුණුවරක් යටතේ ගොඩ නැඟුනු ගණිත මය අර්ථ ශාස්ත්‍රයට මෙවැනි ප්‍රශ්න ගෝචර වන්නේ ය. මේ අතින් ''ක්ලබ් ඔෆ් රෝම්'' නැමැති පර්යේෂකයන් කණ්ඩායම මැනක දී ඉතා ප්‍රසිද්ධියක් ලබා ඇත. ගණිත විද්‍යාව හා පරිගනක යන්ත්‍ර (කොම්පියුටර්) අලලා දියුනු වී ඇති විශ්ලේෂ ක්‍රමයන්ගේ ආධාරයෙන් සමාජමය සහ ආර්ථිකමය ප්‍රශ්නයන් විමසීම මොවුන් විසින් කෙරේ. නානා රටවල ලෝක ප්‍රකට විද්‍යාඥයන්, අර්ථ සහ ගණිත ශාස්ත්‍රඥයන් රැසක් සම්බන්ධ වී කෙරෙන මෙම පර්යේෂණයට විශ්ව විද්‍යාල කිහිපයක්ම සම්බන්ධ වී ඇත.

''ක්ලබ් ඔෆ් රෝම්'' කණ්ඩායමේ මූලික ක්‍රමය කුමක් ද? ඒඒ රටවල ආර්ථිකයන් වෙන් වෙන්ව ගැනීමට නොහැකි තරමට එකට ඇඳී ඇති බව ඔවුන් සලකති. එක් රටක අමු ද්‍රව්‍ය තව රටක කර්මාන්ත සඳහා මූලද්‍රව්‍ය වන අතර ලෝකයේ ඇති ඉන්ධන, ලෝහ වර්ග ආදී සම්පත් ද, පෘථිවි තලයේ මනුෂ්‍ය වාසයට ගත හැකි ඉඩ ප්‍රමාණය ද සීමිත ය. වගාවට ගත හැකි ඉඩ ප්‍රමාණය ද සීමිත ය. රට රටවල ඇති ස්වාභාවික සම්පත් , ජනගහනය ආදී කරුණු සහ ඒවායේ අඩුවැඩිවීම් වල වේගයන් දත්තයන් ලෙස ගෙන ලෝකයේ අනාගත තත්වය කුමක් වේදැයි පරිගණක ආශ්‍රිත ගණිතමය ක්‍රමවේදයින් තීරණය කළ හැකි ය. මෙම පරීක්ෂණ වලින් පැහැදිලි වූ ප්‍රධානම කරුණ නම් ඉතා වේගයෙන් වැඩි වන ජනගහනය නිසාම මනුෂ්‍ය සංහතිය ඉතාම අමාරු තත්වයකට

වැටෙන බව ය. වේගයෙන් වැඩෙන ලෝක ජනගහනයට ගෙවල් දොරවල් සැපයීම සඳහා ඉඩකඩ මිඩංගු කළ යුතු ය. ඉන් පසු ඉතිරි වන වගා කළ යුතු භූමි වලින් වැඩි ජනකායකට ආහාර සැපයීම සඳහා වැඩි අස්වැන්නක් ලද යුතු ය. නවීන ක්‍රම සහ අළුත් පොහොර වර්ග යොදා පමණක් මේය කළ හැකි යැයි ඇස්තු කළ හැකි ය. එහෙත්, ඒ සමඟම ඇතිවන පරිසර දූෂණය නියා පෘථිවි තලය මනුෂ්‍ය වාසයට නුසුදුසු වන බව පරිගණක යන්ත්‍රයේ විශ්ලේෂණයෙන් පැහැදිලිව ම ඔප්පුවේ. අධික දස්වැන්නක් ලබා ගැනීම සඳහා පොලොවට යොදන පොහොර වර්ග, කෘමි නාශක ද්‍රව්‍ය, දිලිර නාශක ද්‍රව්‍ය ආදිය නිසා පමණක් නොව, විශාල ජන ගහනයකට අවශ්‍ය ගෙවල් දොරවල්, යාන වාහන, ඖෂධ හා ඉන්ධන සැපයීමේ දී පෘථිවි මතුපිට ඇති ලෝහ ආදි සම්පත් ද ක්ෂය වීමෙන් මනුෂ්‍ය සංහතියේ පැවැත්මට පහරක් වැදේ. ''ක්ලබ් ඔෆ් රෝම්'' කණ්ඩායමේ පරීක්ෂණවලින් පෙනී ගියේ දැනට ඇති තරම් වේගයෙන් ජනගහනය වැඩිවීම සහ සම්පත් ක්ෂය කිරීම දිගටම පැවැතුන හොත් ක්‍රි. වර්ෂ 2500 වීමට පෙර මිනිස් සංහතිය ද (පෙර කළ යම් යම් හේතූන් නිසා ඩිනසෝර් ආදී සතුන් වඳ වූ ලෙසම) පොලෝ තලයෙන් තුරන් වී යන බව ය. 1970 දී කරන ලද මූල් පරීක්ෂණ නැවැත 1974 දී වඩාත් නිවැරදි දත්තයන් යොදා කරනු ලදුව පළමු නිගමනයන් ම සනාථ කෙරිනි. මේ නිගමනයන් 'සමාජවාදී' 'ධනවාදී' හෝ වෙන අනෙක් සෑම ආර්ථික රාමුවකටම එකසේ බලපානු ඇත. මේ නිගමන වඩාම බලපාන්නේ ලංකාව, ඉන්දියාව, චීනය, ඊශ්‍රී දුප්පත් රටවලටමය. පෘථිවි තලයෙන් 2.5% කට සීමා වූ ඉන්දියාවේ ලෝක ජනගහනයෙන් 15% වසයි. මේ ජනගහනය කෙතරම් වේගයෙන් වැඩෙත්ද යත් අවුරුදු පහා මුළු ලංකාවේ ම ජනගහනයට වඩා අධික ප්‍රමාණයක් අළුතෙන් එහි උපදී. ඔවුන්ට ආහාර, අධ්‍යාපනය, ඖෂධ, නිවාස සහ අන්තිමේදී රක්ෂා ද, සැපයිය යුතු ය. ලංකාවේ තත්ත්වය ද අපේ රටේ තරම ගලකන විට එසේම භයානක ය. දිනකට දරු උපත් 1200 ක් පටන් ඇති වන හෙයින් ඔවුන් තරුණ වියට පැමිණි විට දිනකට රක්ෂා දහසක් පමණ අළුතෙන් සැපයිය යුතුය, දිනකට වාහස්ථාන 500 ක් පමණ තැනිය යුතු ය. කිසිම ආර්ථික රාමුවකට මෙවැනි බරක් ඉසිලීමට නොහැකි ය. මේ උපදින අය මිනිස් ශ්‍රමය ලෙස යොදවා ගැනීමට ම අවශ්‍ය ආහාර ආදිය නිෂ්පාදනය කළ හැකි යැයි මෙහි දී ඉදිරිපත් කිරීම බොලඳය. මිනිස් ශ්‍රමයේ උපරිම නිෂ්පාදන ප්‍රමාණය දත්තය ලෙස ගෙන අපේ ජනගහනයෙන් ලද හැකි උපරිම නිෂ්පාදනය සහ එම නිෂ්පාදනයේ වර්ධනය ඉතා පහසුවෙන් ගණන් බැලිය හැකි ය. ඒ තබා ඉවහෙස නොදනෙන යන්ත්‍රයකට පවා ලෝක සම්පත් ක්ෂය නොකොට, පරිසර දූෂණයක් ඇති නොකොට මෙසේ වැඩෙන ජනගහනයකට ආහාර සැපයීමට නොහැකි වන බව යක් සූදක් සේ දක්විය හැකි ය. *ඇත්ත වශයෙන්ම ජනගහනයේ මේ වේගවත් වැඩීම දැනට ම අපට පෙනේ. (පාරවල් පුරවා තට්ටු දෙකේ බස් ඇති වුත් බස්වල ජනයා පිරී ඇත. සෑම තැනම පාසල් ඇති මුත් එකකවත් ඉඩක් නැත. දැනට අවුරුදු පහකට පෙර සුපිරි පොල්වතු දැන් ජනාකීර්ණ කටු ගෙවල්වලට හැරී ඇත.)

ලංකාවට වඩා අන්ත තත්වයට වැටී ඇති ඉන්දියාව සෑම පවුලකම දරු එළ 3 කට නොවැඩි ගණනකට සීමා කිරීමට නීති පනවා ඇත. රතු චීනය, ජපානය, බ්‍රසිලියව රුසියාව වැනි රාජ්‍යයන් ද වැදගත් පවුල් සංවිධාන ක්‍රම ක්‍රියාත්මක කොට ඇත. අපරදිග රටවල අධ්‍යාපනය හා ජීවන තත්වය දියුණු හෙයිනුත්, පවුල් සංවිධාන ක්‍රම කලක සිටම ප්‍රචලිත හෙයිනුත්, ජනගහනය ස්ථිර මට්ටමක නැවතී පවතී. අන්ත වශයෙන්ම ප්‍රශ්නය වැනි රටවල ජනගහනය ඉතාම අල්ප වශයෙන් අඩුවේ ගෙන යයි. ලංකාවේ ද පවුල් සංවිධානය සහ උපත් පාලනය ගැන දැන් දැන් රජය ක්‍රියා කරගෙන යන නමුත් පසුගිය දශකයේ උපත් දරුවන් වැඩෙත්ම ඔවුන්ට ද ඉඳුම් හිටුම් හා රක්ෂා සැපයීමේ බර ආර්ථිකය මත ඉසිලිය නොහැකි වේගයකින් වැටෙන හෙයින් ඉදිරි දශකය තුළ රටේ ආර්ථික තත්වය දුර්වල වන බව ඉදුරාම කිව හැකි ය. එය ගහනයේ වැඩීම ගැන දැන් ගන්නා නිවැරදි පියවරවල් නවත් සෘජුව ගත යුතු ය. එවිට ඇත අනාගත යේදිවත් ශ්‍රී ලංකාවට ආර්ථික වශයෙන් හිස එසවිය හැකිවනු ඇත.

(ගිම්හන් කතා යකුය – copyright reserved by the Author)

* ක්ෂුද්‍ර ජීව විද්‍යාව උගත් අය බැක්ටීරිය කොලනියක වැඩීම සහ අන්තිමේදී මුලෝත්පාඨනය විමි ගැන මෙහිදී මතක් කළ යුතුය.

வளர்ந்து வரும் தேசங்களில் விஞ்ஞானமும் தொழில் நுட்பமும்

P. M. சிதம்பரப்பிள்ளை

இரவு 3 மணி, அடுத்த வீட்டுக்காரர் அவசரமாக நம் கதவைத் தட்டினர்கள். அங்கு அம்மாவுக்கு மூச்சு எடுக்கக் கஷ்டமாயிருப்பதாகவும் தலைவலியும் உடம்பில் தழும்புகளும் உண்டாயிருப்பதாயும், உடனே வைத்திய ரிடம் கொண்டு செல்ல வேண்டும் என்றும் அழைத்தார் கள். வைத்தியர் ஆராய்ந்தவிடத்து, இரு நாட்களுக்கு முன் உணவாக உட்கொள்ளப்பட்ட மரவள்ளிக் கிழங்கி னால் உண்டான நச்சுத்தன்மை என்று கருதினார். தகுந்த மருந்து கொடுத்து குணமாக்கிவிட்டார்.

வளர்ந்துவரும் நாடுகளில் விஞ்ஞானமும் தொழில் நுட்பமும் ஆற்றவேண்டிய பணிகள் யாவை என்று எண்ணுமிடத்து இந்தச் சம்பவம் நினைவுக்கு வந்தது. மரவெள்ளியினால் சில வேளைகளில் நச்சுத்தன்மை உடலில் ஏற்படக் கூடும் என்பர். ஆனால் மரவள்ளி அதிகமாக உட்கொள்ளப்படும் ஓர் உணவுப் பதார்த்தம். உணவாகத் தயாரிக்கும் வகையில் நச்சுத் தன்மையைத் தவிர்க்கலாம் என்று தம் ஆராய்ச்சி மூலம் அறிந்துள்ளனர் விஞ்ஞானி கள். இது நம் விஷயத்திற்கு தகுந்த உதாரணமா?

விஞ்ஞானம், தொழில் நுட்பம் என்றவுடன் சந்திர னுக்கும் செவ்வாய்க் கிரகத்திற்கும் மனிதம் சென்றே, உபகரணங்களை அனுப்பியோ ஆராய்ச்சி செய்தால்தான் உண்டு என்று கருதுவதற்கில்லை. குகையினுள் சில வடிக்க ஓவியன் சிறிய எண்ணெய் விளக்கைப் பாவித்தால், வெளி யேயிருந்து கண்ணுடியோ அத் தன்மைகொண்ட கற்க ளோ பாவித்து சூரிய வெளிச்சத்தை பகல் வேளையில் குகையினுள் அனுப்பி உதவுவது தொழில் நுட்ப மில்லையா? காற்றின் வலிமையைப் பாவித்து காற்றுடி மூலம் பம்புகளை இயக்கி கிணற்றிலிருந்து நீரை எடுப்பது தொழில் நுட்பமில்லையா?

மண் எண்ணெய் அடுப்பு பாவிப்பவர்கள் மஞ்சளாக எரியவிட்டு புகை அதிகம் கலயங்களில் படியச் செய்வது மட்டுமல்லாமல், எண்ணெயையும் வீணே விரயமாக்குவ தற்குப் பதிலாக, அடுப்பு சரியாக இருக்கிறதா, காற்று உள் செல்லும் துவாரங்கள் நல்ல நிலையில் இருக்கின் றனவா, அடுப்பு நீலமாக எரிவதற்கு எண்ணெய் அளவு சரியாக வருகின்றதா என்றெல்லாம் பார்த்துக்கொண்

டால், விஞ்ஞானத்தையே பாவிக்கிறார்கள். நீலமாக எரி அடுப்பில் கூடுதலாக வெப்பம் உண்டு என்றும், எண்ணெயின் முழுச் சக்தியும் அப்போ பாவிக்கப்படுகின்றது என்றும், அவர்கள் விஞ்ஞான ரீதியில் அறிவது மட்டுமல்லாது முன் மஞ்சளாக எரியும் பொழுது வீணுகச் சென்ற எண்ணெயே புகைப்படலமாகி சுத்தமாக்கும் வேலையை மிகைப்படுத்தியது என்றும் அறிவர்.

சமையலறையில் விஞ்ஞானமும் தொழில் நுட்பமும் செய்யக் கூடியவை கணக்கில் அடங்கா! மேலை நாடுகளில் நடப்பவைகளை வளர்ந்துவரும் தேசங்கள் இது விஷயத்திலும் உடனடியாகப் பின்பற்ற முடியாது. எனினும் சில உதாரணங்களைப் பார்த்தோம். எரிபொருள்களைப்பற்றி எண்ணும் பொழுது மரத் தூள் அடுப்பையும் உண்டாக்கி விட்டார்கள் நம் தொழில் நுட்ப வல்லுனர்கள் என்பது ஞாபகத்திற்கு வருகிறதல்லவா?

தும்பு, நார், மட்டை, மரத்தூள் முதலியவற்றைப் பாவித்து தடிப்பான அட்டைகளையும் பலவகை வகைகளையும் இப்போ தயாரிக்க வழிகள் கண்டுகொள்ளப்பட்ட. போதிலும், இன்னும் எவ்வளவோ தும்புகளும் மட்டைகளும் சில இடங்களில் குவிந்து கிடந்து மண்ணோடு மண்ணுகின்றன.

நம் நாட்டின் சில பகுதிகளில் நல்ல நீர் குறைவு இப்போ சில மாதங்களாக மழைக் குறைவால் நாடெங்குமே நல்ல நீருக்குத் தட்டுப்பாடுதான். ஆனால் மகாவலித் திசைதிருப்பு வேலைகளைப்போல் பெரும் திட்டங்களைச் செய்வதுதான் தொழில் நுட்பமா? அன்றுடம் நாம் பாவிக்கும் நீர் வீட்டிலோ, வேலை செய்யும் இடத்திலோ, வயலிலோ... எங்கிருந்து வருகிறது... அதற்காக எத்தனை வேலைகளும் செலவுகளும் நடந்துள்ளன, நடக்கின்றன என்று அறிந்து வைத்திருப்பது விஞ்ஞானத்தில் சேராதா? இந்த நீரை விரயமாக்காமல் அளவோடு பாவிப்பது தொழில் நுட்பமில்லையா?

சில மேலை நாடுகளில் கழிவு நீர், அதாவது அசுத்தமான நீர், இரசாயனரீதியாக நல்ல நிலைக்கு மாற்றப்பட்டு வீட்டுத் தேவைகளுக்குக் கூடப் பாவிப்பது விஞ்ஞானமென்றால், நாம் நம் தேவைக்குத் தக்கபடி வயல்களிலோ வீடுகளிலோ பாவித்து நல்ல நீரை மிச்சப்படுத்துவதும் விஞ்ஞானமே. நல்ல நீர் மிகக் குறைவாக உள்ள சில நாடுகளில் கடல் நீரை மின்சாரம், வெப்பம் முதலியன பாவித்து நல்ல நீராக மாற்றி எடுப்பது தொழில் நுட்பமென்றால், நமக்கு அதிகமாகக் கிடைத்தும் கடலுக்கு ஓடவிடுகிறோமே...., அந்த மழை நீரை குளங்களில் மட்டுமல்ல — வட பகுதி, அம்பாந்தோட்டைப் பகுதிகளில் வீட்டுக் கூரையிலிருந்து நேரே தொட்டியொன்றிற்குள் சேர்த்துக் கொள்வதும் தொழில் நுட்பமே! அதுமட்டுமல்ல. நம் தோட்டத்திலோ, வளவிலே நல்ல வரம்புகள் கட்டி, மழை நீரை தேங்க வைத்து நிலத்தினுள் செல்ல விடுவதும் விஞ்ஞானந்தான். இதனால் நம் கிணறுகளில் நல்ல நீர் அதிகமாக கிடைப்பதுடன், மரம் செடி கொடிகளுக்கும் நல்ல பலன் உண்டு.

சில தேசங்களில் உள் நாட்டு மீன் வளம் பெருகியிருக்கிறது. பெருக்குகிறார்கள் அதிகமதிகமாக. வீடுகளில் கூட சிறு தொட்டிகளில் தம் உணவுக்கு தேவையான மீன் முதலியவற்றை வளர்க்கிறார்கள் நாம் கோழி வளர்ப்பதைப் போல. இங்கும் நம் குளங்களிலும், பெரும் நீர்த் தேக்கங்களிலும் நாம் மீன் வளத்தைப் பெருக்கலாம் அல்லவா?

அரிசி அவிந்து சோறுவதற்கு எவ்வளவு நேரம் தேவை என்று எல்லோருக்கும் தெரியும். ஆனால் சில தேசங்களில் பல காலமாக "மினிட் றைஸ்" (நிமிடச் சோறு) தயாரித்து விற்கிறார்கள். அதை வெந்நீரில் 2, 3 நிமிடங்களுக்கு வைத்து வடித்துவிட்டால் சோறுகிவிடும். இங்கு பலர் ஒரேயடியாக அது ருசியாயிருக்காது என்று கூறிவிடுவர். ஆனால் அந்த நாடுகளில் இலகுவில் சோறு கிடையாததால், நம்மவருக்கே அது தேவாமிர்தம். இங்கேயோ, எல்லோரும் பாவிக்காவிட்டாலும் பட்டணங்களில் மிகவும் உதவியாயிருக்கும்... அதுவும் அவசரமாக விருந்தினர் வந்தபோது.

அரிசியைப் பற்றிப் பேசும்போது எல்லோரும் விரும்புவது கல் இலலாத சோறு அரிக்கன் சட்டியைவிட கல் மண் முதலியவற்றை அப்புறப்படுத்த சுலபமானதோர் வழியை யாராவது தர மாட்டார்களா? ஒரு முறை நம் வீட்டில், தாயார் ஊருக்குச் சென்றிருந்தபடியால், பிள்ளைகள் அவசரத்தில் சோறு காய்ச்சிவிட்டார்கள். நிறைந்த கல். சாப்பிட முடியவில்லை. வெந்நீர் கொண்டுவரச்சொல்லி, எல்லாச் சோற்றையும் அதற்குள் போட்டு, அரிக்கன் சட்டியின் உதவியார் வெகு விரைவாக கற்களை அப்புறப்படுத்திவிட்டேன். ஏன் விரைவாக என்றால், அவிந்த சோறு அரிசியிலும் பார்க்க எவ்வளவோ சுலபமாக நீரில் கல்லைவிட்டு மிதந்து பிரிந்துவிடும்... இதை எல்லோரும் பயன் படுத்த வேண்டியதென்றில்லை, உதாரணத்திற்காக கூறியுள்ளேன்! விஞ்ஞான அறிவைக்கொண்டு நாம் பலருக்கும் உதவக்கூடிய முறைகளையோ கருவிகளையோ கண்டு பிடிக்க வேண்டுமென்பதே குறிக்கோள்.

இப்போ நம் நாட்டின் பல பகுதிகளில் ஆறுகளிலும் குளங்களிலும் "சல்வீனியா" என்னும் தாவரம் படர்ந்து வளர்ந்து பல கஷ்டங்களை உண்டாக்குகிறது. இதனால் குளங்களுக்கும் விவசாயத்திற்கும் நஷ்டம் ஏற்படுகிறது. இதை அப்புறப்படுத்துவது மிகச் சிரமமான விஷயம், இதற்கு ஒரு வழி காண முடியுமா? ஒரு வேளை இதிலிருந்து ஏதாவது கால் நடை உணவுப் பதார்த்தமோ, பீடி சிகரட் போல் அல்லது நுளம்புத் தொல்லைக்கு ஏற்றதாக புகைக்கக் கூடிய பதார்த்தமோ, அல்லது வேறு ஏதாவது தேவைக்கு உகந்த வழி ஒன்று கண்டு பிடிக்கப்பட்டுவிட்டால், சல்வீனியாவின் தொல்லை ஒழிவது மட்டுமல்ல, அதற்கு கிராக்கியும் ஏற்பட்டுவிடும்.

இப்படியே இன்னும் பல உதாரணங்களை எடுத்துக் கூறிக்கொண்டே போகலாம். ஆனால் முன்னர் கூறியது போல நமது குறிக்கோள் ஒன்றே. அதாவது வளர்ந்து வரும் நாடுகளில் விஞ்ஞானம் தொழில் நுட்பமென்றால் அதிகமான மக்களுக்குப் பயன்படக் கூடியதாக, எந்தெந்த விதமாய் இயற்கைப் பொருள்களையும் சக்திகளையும் நாம் மாற்றியமைத்துக் கொடுக்க முடியுமோ, அதுவே உகந்தது... அதுவே தேவை. இதற்காக, பெரும் விஞ்ஞான ஆராய்ச்சிகளில் நம்மில் சிலர் ஈடுபடக் கூடாது என்றில்லை. உலக அரங்கில் நாம் தலை நிமிர்ந்து நிற்க, அதுவும் தேவையே! ஆகையால் வளரும் தேசங்களில் நம் விஞ்ஞானிகள் மட்டுமல்ல, எல்லோருமே ஆராய்ச்சியும் பரந்த நோக்கமும் கொண்டு தத்தம் காரியங்களில் ஈடுபட வேண்டும். மாணவருக்கும் இதே நோக்கத்தைப் போதிக்க வேண்டும். அப்போ சுபீட்சம் கிட்டும்.

VIDU1-2-18a

research in progress

Department of Zoology, Colombo Campus, University of Sri Lanka

Research in the department is centred round the fields of Marine Biology, General Ecology and Entomology. Professor K. D. Arudpragasam is studying the physical and chemical features of the Panadura estuary in relation to the prawn and fish fauna taken in fishing traps. The study includes analysis of the composition and seasonal variation in catch, growth and reproduction of important species and the appearance of the early stages of various species of fish and prawn. The study is supported by a grant from the University.

The ecology of mangrove patches in the Negombo lagoon is being investigated by Dr. S. Wignarajah, with particular reference to the fauna and flora, the soil and the productivity of the area.

Mr. S. W. Kotagama is studying the ecology of a bird colony in the Dehiwala area with observations on breeding behaviour, nests, clutch size and survival.

Pests of stored food are being studied by Dr. (Mrs.) Sabaratnam. This work is supported by a grant from the National Science Council. Dr. Sabaratnam is studying the biology of pests of rice, paddy and two types of green gram as well as pest attacking maldive fish. Physical methods of control are being tested and in addition, the possibility of using repellants is also being studied.

Intercropping trials

Perennial crops such as bannana, passion fruit, cocoa and coffee can be interplanted with immature rubber. Two intercropping trials are now in progress at Yatawatta State Plantation, Matale, where bannana and cocoa are interplanted with rubber.

Two other trials, interplanting rubber with passion fruit in the wet zone and with coffee in the intermediate zone are also being carried out this year. Preliminary arrangements were made for investigating the possibility of cotton cultivation between rows of rubber in the dry zone.

Work done in the Institute laboratories so far has revealed that *Hevea* callus could successfully be grown in artificial culture. This work will be continued in order to induce plantlet formation from this callus tissue.

Testing of Rhizobial strains in pot experiments was carried out and a survey of indigenous strains of *Rhizobia*, their density and distribution in rubber lands is being carried out this year. Testing of imported effective strains under local conditions on legume covers and pulses will be started shortly.

Plant Breeding

Work will continue on the development of new varieties of rubber by breeding, introduction and propagation in order to cater to the needs of the industry. Experiments will be laid out to study the interaction between genotype and environment.

Plant Pathology

In order to refine and effect further economies of disease control or rubber, the biology and epidemiology of leaf diseases caused by *Oidium heveae*, *Gloeosporium alborubrum* and *Phytophthora* spp. are being investigated. Also, a new fungicidal system to control Bark Rot is being studied.

Trials on clonal screening for leaf and panel diseases are in progress. Histological and biochemical aspects of disease resistance are underway.

Investigations are in progress to evaluate a biological system of control of White Root disease.

Soil Chemistry

Fertilizer requirements for new clones: RRIC 100, 103 etc. will be assessed. Economics of fertilizer use and responses of mature rubber to fertilizer will be studied. Usage of "Eppawela Apatite" for phosphate requirements of rubber plantations will be studied in detail. The rubber industry will be using fertilizer for all the mature rubber areas on a discriminatory basis. Soil and foliar surveys will be the basis of these recommendation and will result in savings on fertilizer costs. About 11 long-term field trials were started which are of fundamental importance in assessing the nutrient requirement of *Hevea* in Sri Lanka.

Economic research surveys for studying the economic of GPCs and GCCs will be carried out.

Rubber Chemistry

A new preservative system namely sodium hydroxide, 0.07%, formuldehyde, 0.02% and tetra methyl thiuram disulphide, 0.02% was found to keep field latex fluid for more than two days; this latex was suitable for the manufacture of RSS and the use of this process should assist in increasing the latex supply to GPCs as latex supply can be extended to longer distances and transported at leisure.

The departmental staff gave active assistance in conducting classes in polymer science and in rubber technology at both post-graduate and under-graduate level at the Vidyodaya and Katubedde Campuses of the University of Sri Lanka. A total of 99 and 69 one hour lectures, respectively, were given in 1975 by our officers.

Royalties are being paid to the Institute on the use of formaldehyde stabilised latex as an adhesive and several firms have informed us of their interest in commercially using our patents on cyclised rubber manufacture. The Highways Department has reported satisfactorily on the road marking point based on cyclised rubber supplied to them and have indicated an interest to commercially manufacture it.

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news

NSC activities

Seminar on Sun-drying Methodology.

A seminar on 'Sun-drying Methodology' was held at the Agricultural Training and Research Institute, Colombo, on 21st May 1976 with the co-operation of the Australian High Commission in Sri Lanka. Mr. Donald McBean, Principal Food Scientist of the Commonwealth Scientific and Industrial Research Organisation Australia participated as guest speaker. The Chairman of the seminar was Professor A. C. J. Weerakoon. His Excellency, Mr. A. H. Brothwick, Australian High Commissioner, gave the inaugural address.

Mr. McBean spoke on "The Basic Principles of Drying Processes and particular features of Sun-drying Methodology". An overview of problems of sun-drying in Sri Lanka was given by Mr. L. A. C. Alles. Problems of drying paddy, tea, coconut, rubber and fish were the subjects of the other lectures.

About 50 scientists attached to the University campuses and other research institutions took part in the seminar

Practical proposals for improving drying methodology in Sri Lanka were discussed. The lack of personnel trained in chemical technology was stressed by many scientists present The following recommendations were made by the scientists present to the National Science Council:—

(i) To provide sufficient research grants for work in this area.
(ii) To arrange training scholarships
(iii) To provide travelling fellowships.

Mr. Donald McBean addressed members of the National Science Council Secretariat on 20th May 1976 on the Organisational Aspects of Science in Australia and in particular within the CSIRO.

● **Asian and Pacific Coconut Community—Cocotech Meeting May 1976.**

India, Malaysia, Papua New Guinea, Sri Lanka and the Solomon Islands were among the countries that took part in the Cocotech Meeting held between 17—22 May 1976 in the Cameroon Highlands, Malaysia. The Asian Pacific Coconut Community is the apical authority under which operates 3 sub-panels:-

(1) Production and Research
(2) Processing,
(3) Marketing.

Dr. U. Pethiyagoda, Director of the Coconut Research Institute was on the Production and Research Sub-Panel, **Mr. H. W. S. de Silva**, Chairman, Coconut Processing Board was the delegate on the sub-panel on Processing and **Dr. S. Tilakaratne,** Chairman, Marketing Board was on the Marketing sub-panel.

Some of the interesting points that emerged from the discussions were:-

(i) In all countries, intercropping is a traditional practice, although formal experimentation and properly documented yield and profitability figures are lacking. Grass, manioc, yams, bananas, pineapple and fruit trees are the main crops grown.

(ii) Cocoa interplanted with coconut has proved to be the most outstanding combination, notably in Malaysia, Papua New Guinea, the Solomon Islands, India and Western Samoa. Discussion at the workshop centred largely on the special features of this combination.

(iii) The most impressive development of cocoa as an intercrop is witnessed in Malaysia.

(iv) Countries which have extensively developed cocoa as an intercrop have done so at the expense of pastures—natural or cultivated. In such countries as Malaysia, Papua New Guinea and Western Samoa, there was said to be no special need to develop cattle under coconut. The situation is different in Sri Lanka.

It was unanimously decided to recommend to the APCC Secretariat, that action be taken to assist member countries by:-

(*a*) Collection and collation of information pertaining to intercropping. Member countries were to co-operate by providing relevant information when called for.

(*b*) Co-ordination of research. It was felt that certain types of experiments could usefully be repeated at several sites within the region or otherwise co-ordinated.

(*c*) Facilitation of exchange of planting materials deemed to be particularly well suited to intercropping with coconut; current difficulties in procuring appropriate cocoa seed material was mentioned.

(*d*) Arranging for suitable training of extension staff employing such facilities as are available within the region

(*e*) Providing market information on the up-to-date prices of fertilizers and agrochemicals on a periodic and continuing basis.

(*f*) Providing market information on price trends for intercrops.

Of special significance to Sri Lanka were two recommendations:-

(*a*) In compiling a bibliography on coconut intercropping, the experience Sri Lanka has in this type of work was recognized, and any prospects for financial assistance or for provision of the necessary materials, were to be considered for this work.

(*b*) The need for irrigation equipment to support intercropping with short term crops in Sri Lanka was emphasized. It was resolved that if any opportunities for international assistance are available to the APCC, Sri Lanka's need in this respect to be accorded priority.

● **Symposium held to Commemorate 150 years of Tea in Indonesia—June 1976.**

Dr. R. L. Wickremasinghe, Acting Director of the Tea Research Institute, Talawakelle, participated in a Symposium held to commemorate 150 years of Tea in Indonesia. The symposium was held at Bandung, where a number of foreign and local scientists presented papers on various aspects of the tea trade, tea processing, tea agronomy and production, and tea economics. The symposium was followed by the inaugural opening of the new Research Institute for Tea and Cinchona, at Gambung elevation about 1500 m. and situated about 40 km. from, Bandung. In addition to the impressive research laboratories, the Institute also has a modern tea factory, equipped with machinery, most of which has been imported from Sri Lanka.

Dr. Wickremasinghe was also able to visit several black tea factories, one green tea factory and one of the substations of the Research Institute. It transpired that the most popular clone in Indonesia is our own TRI 2024, followed by TRI 2025 and TRI 777. The climax of the commerative celebrations was the opening of another massive tea factory at Raneabali by the President of Indonesia. The general impression made on Dr. Wickremasinghe as a result of his visit was that the tea industry in Indonesia is in a state of rapid progress.

● **APO Symposium on Environment—June 1976**

A top Management Symposium on Environment was organised by the Asian Productivity Organization (APO) in Tokyo from 26th May to 2nd June 1976. There were 18 participants from 15 Asian Countries, including Sri Lanka, Bangladesh and Papua New Guinea.

Professor P. P. G. L. Siriwardena, Vice Chancellor, University of Sri Lanka, was elected Chairman of the Symposium. The objective of the symposium was to increase both public awareness and appreciation of the various environmental problems resulting from man's activities and to help in the promotional efforts of member countries in preserving and enhancing the environment through participation in the International Symposium on Environment and the World Environmental Exhibition.

At the end of the symposium, Prof. Siriwardene reviewed the deliberations as follows:-

— Pollution control may not be of immediate benefit to some of the developing countries in view of the high cost of pollution control and the best cure is prevention;
— the cost of pollution control itself should be considered in the light of other factors including social benefit and social behaviour;
— each country will have to work out systems suited for its own local conditions rather than adopting foreign systems;
— there should be pollution control within industry with organisations offering testing and advisory services to small industries;
— education and training in environmental studies, pollution control, environmental engineering and environmental management, should be introduced at all levels and should be multi-disciplinary;
— government support to environmental education and training and policy both at the central and local governments concerning pollution control should be formulated with legislation aiming at what can be effectively enforced;
— local habits, culture, ethnic factors etc. should be taken into account and there is need to build up public awareness;

— consideration should be given to health inspection and national safety laws to promote occupational health and safety;
— resource management, industrial estate, and zoning are useful to make pollution control easier;
— environmental planning should be linked with social and economic planning and public participation in project planning should be encouraged;
— transfer of appropriate technology in pollution control is important.

The participants visited the pollution-free industrial estate for small industries and the World Environment Exhibition.

● **Scientific and Technological Co-operation among Non-aligned Countries—Special International Sessions—June 1976**

The Sri Lanka Association for the Advancement of Science (SLAAS) sponsored an International Seminar on Scientific and Technological Co-operation among the Non-aligned countries held at the Hotel Oberoi, Colombo between 30th June and 5th July 1976. The Chairman was Mr. Justin Samarasekera, President of the SLAAS.

Delegates from 19 non-aligned countries including Zambia, India, Egypt, Malaysia and Korea took part in the seminar. The inaugural address was made by the Honourable Minister for Industrial and Scientific Affairs, Mr. T. B. Subasinghe.

The main objectives of the conference were:-

— to pose the common problems in fields of science and technology that the non-aligned countries have to face.
— to discuss strategies the non-aligned countries are developing to tackle such problems,
— to set up mutually beneficial channels of communications for sharing of scientific and technological research and experience, exchange of information and materials,
— Interchange of scientific and technical personnel between non-aligned countries,
— the establishment of institutions and the formulation of strategies for co-ordination.

The recommendations made at the conclusion of the seminar included:-

— the establishment of central institutions of member countries to develop common strategies,
— the utilisation of the existing centres of research in member countries,
— the establishment of training centres etc. which will necessitate the building up of an infrastructure both within the countries and on an international scale,
— a book exchange pool on a barter basis, and
— an exchange of studies of nutritional problems of the countries.

Mr. T. B. Subasinghe, Minister of Industries and Scientific Affairs endorsed the draft report of the resolutions made at the seminar and said that he proposed presenting it to the fifth summit conference of the Non-aligned nations in August.

SCIENTISTS IN THE NEWS

Professor P. P. G. L. Siriwardene was on an educational tour in the United States on the International Visitors's Programme and visited several universities and other institutes of technical and industrial interests including the Oakridge Atomic Energy Establishment. This was a thirty-day programme arranged by the Department of States.

Dr. R. O. B. Wijesekera, Head, Natural Products Section, CISIR has left for Bangkok on an UN ESCAP Consultancy Mission on Essential Oils, for a period of 3 months. During this time he will be visiting Pakistan, Afghanistan, Nepal, Indonesia and Thailand.

Forthcoming Meetings

● **29th November — 10th December 1976**
9th Biennial Meeting of the Commonwealth Science Council (CSC)
Venue: Bandaranaike Memorial International Conference Hall

The 9th biennial meeting of the Commonwealth Science Council hosted by the Sri Lanka Government will be held in Colombo from the 29th November to 10th December 1976. This meeting will be organized by the National Science Council of Sri Lanka. The Secretary-General of the Council, Dr. G. C. N. Jayasuriya is the current Chairman of the Commonwealth Science Council.

Formerly known as the Commonwealth Scientific Committee, the CSC had its origin in the Commonwealth Scientific Official Conference of 1946. The fullest possible collaboration between the government civil scientific organizations of Commonwealth countries is promoted by the CSC. Comprised of representatives appointed by Commonwealth Governments, the CSC encourages scientific co-operation through its biennial meetings—the eighth in July 1976 in Zam-

bia—the visits of its Secretary to member countries, through the scientific information service it provides, through the training workshops and seminars it arranges and through the collaborative projects it helps to promote.

The Scientific Adviser to the Commonwealth Secretary-General serves as Secretary to the CSC. The present holder of this office is Mr. D. G. Thomas, an agricultural botanist from Australia's Scientific and Industrial Research Organization.

The broad objectives of the Commonwealth Science Council at present are 'To ensure the fullest possible collaboration between members of the Commonwealth in increasing the capabilities of individual nations to use science and technology, for their economic, social and environment development'.

To achieve these objectives, the Council fosters the most effective use of the scientific and technical resources of member countries by promoting the exchange of information and personnel, and sponsoring studies of their scientific and technological activities in pursuit of economic and social development. The Council develops and maintains, as may be appropriate to these objectives, contacts with and among professional organizations and institutions of science and technology in member countries. The CSC performs a supervisory role in relation to certain scientific organizations which operate under its aegis. These are the Commonwealth Geological Liason Office and the Permanent Committee of the Commonwealth Collection of Micro-organisms. The CSC has a continuing arrangement for the circulation to member countries of publications, and lists of publications of Commonwealth Scientific Organizations. Finance for CSC common services, for the office of the Secretary and for the Commonwealth Geological Liason Office is provided by contributions from member countries on an agreed scale.

The head quarters of the CSC are in London,. At present it is located at Africa House, Kingsway, London WC 2B 6 BD.

- **15th December — 17th December 1976**
  International Rubber Conference
  Venue: Bandaranaike Memorial International Conference Hall, Colombo

The year 1976 is significant for natural rubber because the first rubber (*Hevea brasiliensis*) seedling was introduced to Ceylon by Sir Henry Wickhem in 1876, and this year marks the centenary of that event. Arrangements are being made by the Rubber Research Institute of Sri Lanka to celebrate this centenary by holding an International Rubber Conference at the Bandaranaike Memorial International Conference Hall.

Over 50 research papers will be read at this conference by our scientists and several eminent scientists from abroad. A special commemoration stamp will be issued by the Government, to mark the centenary.

- **6th to 12th February 1977**
  Third Asian Symposium on Medicinal Plants and Spices—ASYMPS-3
  Venue: Sri Lanka Foundation Institute, Colombo

This International Seminar is being organized with the joint collaboration of the National Science Council, UNESCO and the Sri Lanka Foundation Institute. The seminar will be followed by a Workshop and an Exhibition. The Workshop will be held in the University laboratories at Peradeniya and the Symposium is to be held at the Sri Lanka Foundation Institute in Colombo. An exhibition of Medicinal Plants and Spices will be organized at the Bandaranaike Memorial Ayurvedic Research Institute, Nawinna.

The purpose of the Symposium is to give an over-all picture of the research carried out in Asia on Medicinal Plants and spices from the botanical, phytochemical and pharmacological points of view.

A limited number of research workers are invited after application to participate in a training course on methods for phyto-chemical, microbiological and pharmacological screening of plant material. This training course—which will be led by Prof. Finn Sandberg, University of Uppsala, Sweden—will take place immediately before the Symposium, from 31 January to 5 February 1977.