Structural Framework for Implementation of Science and Technology Policy

Dr. Anwar Hossain

In the second in a series of a two-part write-up the author — a noted scientist of the country — recommends an administrative framework in which the National Science and Technology Policy can be implemented.

IN my last article I have dealt with the raison d'etre for a Science and Technology Policy for the country. The present article will deal with the recommended administrative framework in which the excellent National Science and Technology Policy, that already exists, can be implemented. The scheme is shown in a diagramatic form in Figure-1. It has been carefully prepared in order to introduce minimum changes from the existing set-up of the Government.

The present scheme envisages the revival of the position of Science Adviser to the Head of Government, with the rank of a Cabinet Minister, in order to give the much-needed political recognition of the importance of Science and Technology and the necessity to introduce science in the corridors of power and policy-making.

The incumbent should be a renowned scientist experienced in administration. He will also hold the position of Vice-Chairman, National Council for Science and Technology (NCST) and Chairman of its Executive Committee. NCST will have close liaison with the National Economic Council (NEC) and the Planning Commission should constantly feed ECNCST with the requirement of technology and skill for implementation of the National Economic Plan. The ECNCST will, in turn, prepare a Technology Plan in conformity with the National Five-Year and perspective plans so that necessary technological infrastructure can be built up and the country achieves technological self-reliance. The ECNSCT will arrange effective linkage with the Scientific Research Institutions of the country and the Scientific Departments of the Universities through Committees and Study Groups.

A very important function of ECNCST will be to channel funds allocated for research, which should be progressively increased to at least 1% of GNP, in two streams. The routine expenditure of the Science & Technology Division, an administrative arm of the Government, will be made in accordance with normal Government financial rules. As bureaucratic procedure cannot be avoided, the present type of allocation and expenditure may be followed. The main funding for research and development work and other activities, as shown in the Figure, will, however, be channelled through a newly-created Autonomous Body, to be named Science Foundation (already under active consideration of the Government), which will distribute funds to individuals, groups, bodies, both in the public and private sectors, who can justify such expenditure to relevant Committees of NCST.

The Foundation will be created with a generous grant by the Government and could collect further sum from all productive sectors, as envisaged in the Science Policy. All grants-in-aid from developed countries, International Bodies (e.g. UNDP & World Bank), Multinational Bodies, Foreign Endowments (e.g. Ford Foundation) in the field of Science & Technology will be given to the Science Foundation. It will have a Governing Body to be headed by the Science Adviser and an Executive Director, who will be a seasoned scientist/engineer. In addition to supporting research, the Foundation will fill up the existing gap of funding the extension work, feasibility studies and necessary seed/venture capital required between research and industrial/agricultural production and services. In the long run, the Foundation will be a self financing body out of its income from the fee and royalty, which could be charged to the productive sectors where technology has been transferred.

It may be mentioned that the National Research Development Corporation of India has licensed over 2000 techniques to industries resulting in the present annual turnover of the order of 5000 million rupees (i.e. 1000 crore Taka) and their annual income is 50 crore Taka only from the 5% royalty that they charge to the industries out of their sale proceeds.

The Science and Technology Division can look after the three main research organizations of the country viz the Atomic Energy Commission, BCSIR and SPARRSO (which should be transferred from the Ministry of Defence to S &T Division) and, of course, the Science & Technology Information Service. The scientific organizations under the S &T Division will perform specific tasks given to them by the Government, through NCST, required to undertake scientific and technological research in such development projects that cuts across more than one specific sector, for which individual Ministries have their own scientific laboratories. As for example, Electronics Research can be the responsibility of the Atomic Energy Commission.

The BCSIR can develop chemicals and pharmaceuticals from natural resources and SPARRSO can provide geographical and environmental information for all development projects, including the dynamic ones needed for disaster preparedness and post-disaster works. The laboratories and individual scientists & scientific groups in the S &T Division, the Universities, research institutions of any other Ministry and even the private sector can receive grant or easy loan from the Science Foundation so that scientific research is not affected due to budgetary restrictions of the Government.

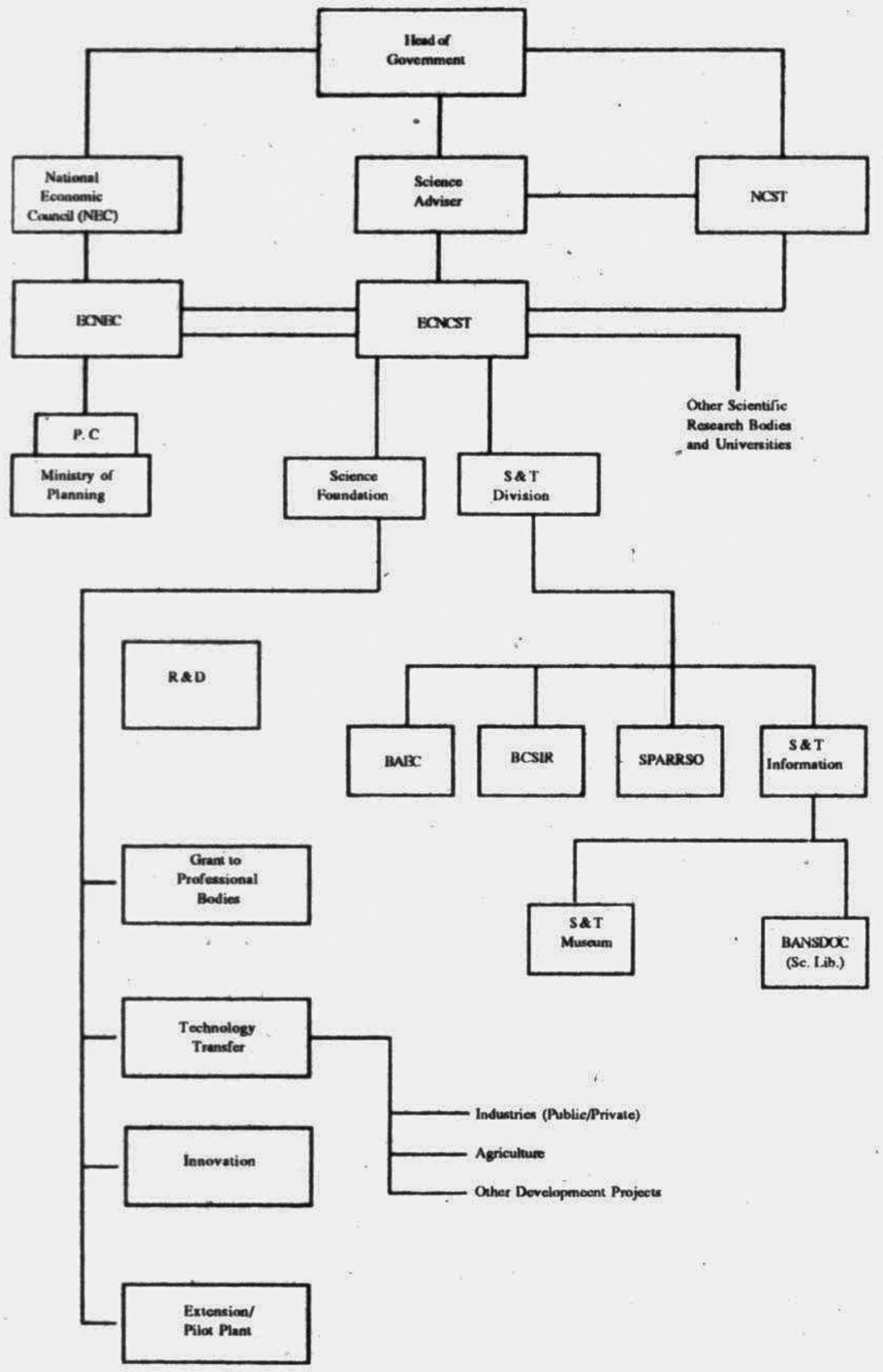
A deserving entrepreneur, who wants to utilise the results of research for productive purposes with raw materials available in the country, could get adequate financial assistance from the Foundation for various studies until production, when he can repay the loan and pay royalty to the scientific organisation which has provided the process/technology.

The Science Foundation will provide necessary grants to professional scientific bodies and could finance a limited number of foreign training and expenses for attending seminars/conferences abroad, if found useful. The most important function of the Foundation would be to transfer technology required by industry/agriculture or any other development project with the specific purpose of enabling the organization to absorb the technology. The transfer should therefore have an element of training i.e. development of skill-both professional and vocational.

An important function of the S &T Division will be dissemination of information on Science & Technology and popularise science to policy makers, planners and public in general. For this, encouragement should be given to write and publish scientific books and journals, enthuse the young generation through science fairs, Science Museum and other means. There is another shortcoming in our society, which must be made up, again starting with the young generation. This is the fear of technology and lack of interest in practical work. I would strongly suggest that small workshops should be established all over the country, not only to meet the local needs, but to train the young generation in practical trades. More sophisticated workshops can be set up in selected larger towns all over the country.

It is important to note that creative work can flourish only in a free atmosphere. The scientific laboratories must thus be free from bureaucratic control and adequate remuneration and facilities should be provided to the scientists to undertake goal-oriented research so that they do not feel tempted to compare their lot with persons in other professions, especially those having administrative power. Scientists should develop a sense of pride in their work and achievements and should not suffer from any sense of inferiority complex that leads to jealousy and lack of self-confidence. It is in such an environment that scientists can successfully implement task assigned to them.

The National Council for Science and Technology will be the custodian for the development of Science and Technology in the country and could set up new institutions for the purpose, if necessary. The idea is to implement the National Science Policy in the light of the socio-economic objectives of the country and necessary transfer of technology to achieve self-reliance. In this process, basic science will also be developed in the research institutions and Bangladeshi scientists will be able to contribute significantly towards the scientific knowledge of the world.



Mobile Phones Taking Root in Europe

by Robert Bailey

LONDON - On the street here, the user of a mobile telephone no longer warrants a glance such has been the spread of their use in the last five years. First established in Scandinavia in the early 1980s, mobile networks in Europe are steadily taking root.

A considerable boost to their growing acceptance will come in July, when the new standard agreed by 22 operators in 19 countries come into being. The GSM standards, which take their name from the Groups Speciale Mobile committee establishing them, will mean subscribers to GSM networks will be able to use their phones across Europe for the first time.

Britain's two cellular operators, Vodafone and Cellnet, as well as France's Radiocom 2000 and Germany's Deutsche Bundespost Telekom and Mannessmann networks are all due to launch GSM networks next year in response to expanding markets.

There are now more than three million cellular phone users in Europe and about 5.6 million users in the United States. It is estimated that the number of mobile subscribers on both sides of the Atlantic as well as in Japan could easily quadruple in the next 10 years as new concepts and systems become available.

Mobile telecommnications have evolved from being primarily a tool for business or perhaps a status symbol to being a mass market product used in daily life.

Within two years, new technologies based on the GSM digital standard will mean that Europe will have personal communications networks (PCN), which by the end of the decade, if not before, could mean low-cost mobile products becoming a reality for everybody.

The chairman of the US Millicom Company, J. Shelby Bryan, has forecast that within 10 years the large-scale application of PCN systems could mean that 25 percent of Americans will use wireless communications, making mobile use much less expensive than conventional cellular systems and possibly even competing in price with fixed-wire systems.

As with today's mobile systems, PCN works on a cell basis. When a hand-held or car-mounted mobile phone is in use, the radio signal emitted connects via base stations with the normal exchange network. The signal carried through different areas, or cells, as the mobile user moves location.

PCN differs, however, in that it is designed to operate in a higher frequency band and cells are much smaller, perhaps less than a one-mile (1.6 kilometer) radius instead of 1.5 to 2 miles. The shorter range means that radio frequencies can be used much more often.

For the customer, this offers a system that, as the numbers of subscribers grow, will be much less expensive to use than today's cellular systems. The shorter distance that radio signals will have to travel to base stations will also mean that telephones will be less obtrusive since a need for less power will lessen the requirement for batteries.

Mercury in Britain has outlined a phone concept for a fold-up compact instrument weighing nine ounces (270grams) and measuring five inches (12.8 centimeters) long when closed.

Researchers at Japan's Nippon Telegraph and Telephone are trying to develop a prototype weighing just 4.2 ounces. It would run for a month on a rechargeable battery and cost less than $200. NTT thinks there could be more than 20 million users in Japan for such mobile systems in the next decade.

In the United States, experimental PCN systems are due to be tested in Houston and Orlando, Florida.

In Europe, the initial pace for the new technology is being made in Britain, where three licenses have been awarded.

Mirotel, which groups British Aerospace, Pacific Telesis and Millicom of the United States, Matra Communications of France and Sony of Japan, aims to provide a PCN service to 60 percent of Britain when it starts operations in1992. Mercury Personal communications, linking the United States' Motorola and Spain's Telefonica, aims at 60 percent coverage within two years of star-up. Unitel, involving STC and Thorn-EMI of Britain, US West and Deutsche Bundespost Telekom, is projecting a 33 percent coverage.

There are obviously very big stakes to be played for and, despite the hype, resistance to the new generation of mobile systems can be expected from established operators seeking to protect their market shares.

Nevertheless, the introduction of pan-European standards and new digital technologies suggest that the tide of change, in terms of how people use telecommunications, will be overwhelming.

Greens Challenge Antarctic Studies

By Prakash Chandra

NEW DELHI : More than 100 scientists have once again flown to Antarctica for India's tenth expedition.

Now questions are being asked whether a country facing a foreign exchange crisis triggered by the Gulf crisis should venture out so far in the cold.

The trips to Dakshin Gangotri — the Indian Research Station in Antarctica — have cost New Delhi and estimated 460 million rupees (US$36.8 million).

Officials have justified the expense by saying "this budget is peanuts when you think of the vast geological potential in Antarctica. Eventually, when the mining of minerals begins there will be heavy dividends."

But environmentalists here have protested. "We must preserve the natural laboratory that is Antarctica now threatened by pollution, tourism and the demand for oil and minerals," they say.

Recently at a conference in Chile, the member nations of the Antarctica Treaty agreed on a legal system to protect the frozen and fragile environment. There were sharp differences, however, on whether the exploitation of the rich resources, including oil, should be banned permanently or temporarily.

New Delhi takes a line that mining on Antarctica is a worthwhile economic activity if others also do it in the coming years. The current expeditions are designed to generate the fund of geological knowledge for this purpose.

Should India venture out so far in the cold?

India has been given international recognition for its scientific accomplishment. It has been given the consultative status under the Antarctica Treaty and the membership of the International Scientific Committee on Antaretica Research.

"Our view is that the fragile area of Antarctica must be fully protected form human depredation, while an international consensus is reached on mining. We would like to continue the international moratorium on all mining activity till the Third World countries also develop appropriate technology for mining," a senior official with the Indian expedition told Depthnews.

India has expressed the fear that if mining is allowed now Western countries will have a clear edge over the poor because they have the money as well as the technology.

Officials recall that an international agreement, called the Convention on the Regulation of Antarctica Mineral Resources Activities (CRAMRA), was reached in 1988 to permit exploitation of oil and mineral resources in Antarctica. The pact collapsed when Australia and France — responding to strong pressure from environmentalists — announced they would no longer support it.

Enthusiastically supported by Greenpeace — the international environmentalist group — Australia and France backed by Italy, Finland, Holland, Greece and Belgium are seeking an immediate and permanent ban of all mineral activities in Antarctica.

But the United States, Chile and Uruguay prefer a long and renewable moratorium. Other countries, including Britain, New Zealand, South Africa, Japan, Germany, Argentina, Norway, China and the Soviet Union, support this view.

The 11th conference of the Antaretica Treaty in Chile set up two separate groups to discuss specific protection steps and whether measures to protect the continent's environment should take the form of a simple protocol complementing the existing treaty or a separate convention should be signed.

The assault on the Antarctic environment by man has forced Greenpeace and the Antarctic and Southern Ocean Coalition to call for declaring the continent a work park and a wilderness preserve.

There have been a number of accidents in Antarctica forcing environmentalists to raise a war cry over unbridled human activity for research or exploitation.

In January 1989, an Argentine naval ship sank near the island of a peninsula spilling 950,000 litres of oil. Weeks later, a Peruvian research vessel crashed against rocks, producing an oil slick more than half-a-mile long.

The huge rubbish dump at the US McMurdo station has shocked scientists a.l environmentalists alike who wish to see Antarctica as an unspoiled natural laboratory.

The Americans think exploitation of Antarctica's mineral and oil resources is inevitable.

The US and the Soviet Union make no territorial claim nor do they recognise the claims of other countries. Territorial claims have been frozen since the Antarctica Treaty of 1959, but if the present international agreements regarding Antarctica break down, the dispute might resume. Several times in recent years, Chile and Argentina have been on the brink of war over issues involving Antarctica.

"The survival of the human race depends on the survival of Antarctica. An oil spill in Antarctica waters can damage the food chain for decades. It is essential that Antarctica be declared a wilderness reserve protected by all nations," environmentalists say Depthnews Science.

A New Tree of Life Takes Root

BIOLOGIST are about to overhaul the way in which they classify species, radically redrawing the evolutionary tree of life. their new classification is based on the genetic make-up of species rather than their physical characteristics.

Carl Woese of the University of Illinois and his colleagues have pioneered a description of the molecular differences which define the basic divisions of life. This description has allowed them to draw the new tree of life for the first time.

An accurate tree of life is one of the Holy Grails of biology. It is supposed to record the evolutionary history of all species, but has itself undergone repeated mutations since a version was first proposed by the German biologist Ernst Haeckel in 1886. The new Tree could put an end to endless taxonomic arguments.

In the new classification, traditional kingdoms such as Animalia and Plantae lose their leading role and are seen merely as branches of three new "domains" _ named Eucarya, Archaea and Bacteria-between which all species are divided. Many species will be reclassified in new kingdoms. The brown algae, for example, currently called plants, will be given their own eucaryan kingdom.

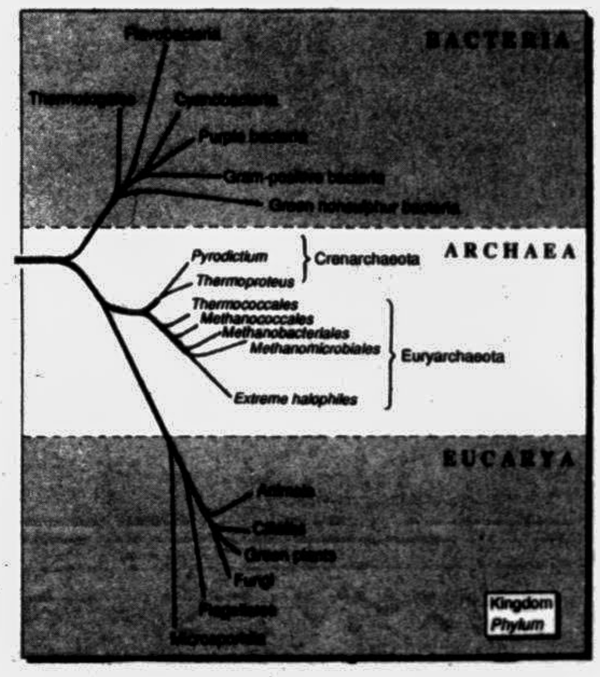
What biologists had previously considered the deepest division, between eukaryotic organisms, whose cells have a special type of nucleus, and prokaryotic ones, whose cells do not, is also superseded in the new system.

The arrangement classifies species according to characteristic sequences of RNA in the ribosomes of a cell, sequences which are specified by an organism's genes, rather than relying on the structure and method of growth of organisms. "It's a much more natural system," says Woese.

The new Tree is likely to establish itself quickly in schools and colleges because it provides a simple arrangement of species and has great explanatory power. For researchers, the structure of the Tree is already providing valuable insight into the fundamental mechanisms of life.

The classification put forward by Woese is based on the idea that the extent of similarity in sequences of ribosomal RNA is a measure of how closely related organisms are. The more similar the ribosomal RNA, the closer the two species are related.

Over the past 20 years, biologists have built up a detailed picture of the sequence of nucleotides found in ribosomal RNA. Gradually, a picture has emerged of which parts of the



sequence are characteristic of which classes of organisms.

For example, there is a hairpin loop on all ribosomal RNA, lying between what are known as positions 500 and 545, which has a bulge sticking out from the main structure. Species in the bacteria domain have six nucleotides in the bulge, while species in Archaea or Eucarya have seven. This telling difference holds for virtually all organisms. By using several similar tests, Woese has succeeded in creating definitions which, for the first time, can classify every organism in one of the three domains. The method can be extended to classify kingdoms and smaller units, even individual species.

"At the molecular level we have superb, readable, documents of evolutionary history," says Woese. "They are very easy for us to understand."

The big surprise — even though the new Tree is in its infancy, with many branches and even kingdoms still to be sorted out — is that the primary division is between the bacteria and the rest. Although the archaea, previously called archaebacteria, have prokaryotic cells like bacteria, Woese's molecular analysis shows they are more closely related to the eucarya, previously termed eukaryotes, even though these have a different type of cell organisation. The branching at the stem of the tree, which shows Eucarya and Archaea springing from the same bough, reflects their specific, though distant relationship.

Almost as striking is the loss of status of the animal and plant kingdoms. Rather than being two of five, these will now share kingdom status with up to a dozen groups.

Haeckel's first tree had three kingdoms : animals, plants and a rag bag of microorganisms termed Protista. Fungi and bacteria later took the total to five. This split and the later prokaryote-eukaryote distinction were based on large-scale phenotypes not molecular genotypes.

Although Woese's ideas are widely accepted in the biological community, his tree is criticised from two sides. James Lake at the University of California in Los Angeles has an alternative method of molecular classification which, he claims, shows that archaebacteria should be split between two basic units of eukaryotes and prokaryotes. Lynn Margulis of Boston University in Massachusetts argues that the basis for classification should be phenotypic and not molecular.

Margulis does not think any molecular classification can work because animal cells, for example, contain three genomes. There is inherited DNA in the nucleus, the mitochondria and the chloroplasts. The DNA in the mitochondria and chloroplasts is bacterial in origin, the result of a symbiosis between two primitive cells. Margulis argues that basing the classification only on the genome in the nucleus is illogical and that once the other genomes are taken into account there is no feasible molecular basis for classification.

She also says the idea of a truly Darwinian tree of life which only divides branches is outdated. In reality, some of the branches have merged. "It is more of a bush," she says.

Woese discounts these arguments. "In a trivial sense Margulis is right," he says. "But to the first or second approximation she is not. The amount of genetic material outside the nucleus is far less than 1 per cent and has little bearing on a cell's pedigree."

The debate will continue but at last Woese has put his classification system before the biologists for discussion. — WB