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The Third World Academy of Sciences

newsletter

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First Meeting of Third World Network of Scientific Organizations in October

The first meeting of the Third World Network of Scientific Organizations will be held in Trieste from 4-6 October 1988. It will be attended by about 60 members of the Network, including 15 Ministers of Science and Technology from Third World countries.

The participants will review the global problems of science and technology with particular reference to conditions obtaining in the Third World. The subjects that will come up for discussion during the three-day deliberations will include: Role of science and technology in the economic development of the South, Planning and utilization of science and technology, Government involvement in science and technology, Global/Frontier problems in science and technology, Natural and man-made hazards etc. The proposed objectives and programmes of the Network will also be discussed during the meeting.

The Third World Network of Scientific Organizations, which made its debut in 1987, is an association of science academies, research councils and ministers of science, technology and higher education belonging to the Third World. Its prime objective is to promote science and technology in developing countries.

It will be recalled that in 1986, the Third World Academy of Sciences (TWAS) invited several national science academies and research councils in developing countries, with which TWAS had already established close links, to sign an agreement envisaging the strengthening of cooperative links between TWAS and these scientific bodies. An invitation was extended to some thirty science academies and research councils in the South, of whom twenty-three responded positively.

Encouraged by the response, the President of the Third World Academy of Sciences, Professor Abdus Salam, proposed at the opening of the TWAS Second General Conference in Beijing, China, in September 1987, that the TWAS initiative should be extended in scope and that a "Network" linking science academies, research councils and other leading scientific organizations in the South be formed with the full participation of Ministers of Science and Technology and Higher Education, so as to enhance communication and collaboration among them and to promote the cause of science in the South. The South could then collectively make substantial input in frontier science programmes (such as biological studies of the human genome, space research and nuclear fusion), which may have a significant impact on development in the Third World.

Professor Salam's proposal was strongly supported by the representative of the Italian government at the Conference who also pledged financial support for the "Network". Soon after, the Third World Network of Scientific Organizations was formed.

Seventy-seven scientific organizations from 60 developing countries have already become members of the Network, while three expatriate organizations have accepted to become associate members.

TWAS Awards for 1987

The Third World Academy of Sciences is pleased to announce the names of recipients of the TWAS 1987 Awards. The Award winners are:

Prof. Cesar Lattes (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil) for his fundamental contributions to High Energy Physics and in particular for the discovery of natural and artificial mesons;

Prof. Chuangtian Chen (Fujian Institute of Research on the Structure of Matter, Fuzhou, Fujian, China) for his outstanding contributions to the development of new nonlinear optical materials, the formulation of a quantum chemical theory that guides the search for such materials and the discovery of beta barium borate and lithium triborate;

Dr. Adolfo Martinez-Palomo (Centro de Investigacion y De Estudios Avanzados Del IPN, Mexico D.F. Mexico) for his fundamental contributions to the knowledge of the cell biology of cancer cells and parasites;

Prof. Mudumbai Seshachalu Narasimhan (Tata Institute of Fundamental Research, Bombay, India) for his fundamental contributions to Mathematics in the areas of algebraic geometry, differential geometry, representation theory of semi-simple groups and partial differential equations.

The essay competition was open to authors from the South as well as the North. The Prize, which is being given for the first time, was awarded to Prof. David A. King (Johann Wolfgang Goethe Universität, Frankfurt, Germany) for his essay entitled "Shams Al-Din Al-Khalili and the Culmination of the Islamic Science of Astronomical Timekeeping", and in particular for bringing to light the highly impressive astronomical tables compiled in Damascus in the Fourteenth Century and used there until the Nineteenth Century for timekeeping.

The Awards Scheme has been instituted by the Academy to accord recognition to outstanding scientific accomplishments of Third World scientists. Each award consists of a prize amounting to US$10,000, as well as a medal on which major contributions of the award winner are inscribed.

Catalyzing Science Development: A Programme for TWAS

As we well know, there are many phenomena in nature that are in one way or another latent and can be precipitated to occur by an appropriately chosen small action which expends very little energy. An often-quoted example is rain-making, when the supersaturated clouds can be made to release their load of moisture resulting in a wide-spread rainfall. The precipitating action is the initial seeding of a relatively few centres of condensation.

A quite similar phenomenon is catalysis in chemistry, where the addition of a small amount of chemical of the right sort precipitates a given chemical reaction in a large amount of material.

There are analogous situations also in science development, that is, in the building of science in the Third World countries. My present note describes such situations and suggests why the Third World Academy of Sciences (TWAS) is in a particularly advantageous position to interact in such situations and act as a catalyzer for desired changes.

These situations involve latent resources in the world-wide scientific community which match unsatisfied needs in the scientific communities of the Third World countries, and where the two do not meet simply because of the absence of a small, bridging activity that would connect the two and release the flow of such resources to the Third World countries.

A very good example for such a situation, one in which the bridge has in fact been built and the flow is well underway, is the supply of back volumes of scientific journals to libraries in the Third World countries. Such back issues of scientific journals are abundantly available from scientists world-wide who have died or who are retiring, or who simply ran out of office space for storing their own subscription of such journals which, however, are available in a library 5 minutes distant from their offices.

These unwanted back journals used to be discarded, at a time when libraries in the developing countries were unable to acquire, through the conventional channels of journal editors and book handlers, the very same back issues. What was wanted to catalyze the flow of journals was a coordinator who would provide addresses of libraries in need to sources of these journals in the world-wide scientific community.

The result of the recognition of this situation was the programme that has been operated by the International Centre for Theoretical Physics (ICTP) for a decade or so, providing such a coordination. At the expenditure of $3,000-4,000 a year (paying for the shipping of the journals when no other source of funds for this is available), many tons of journals have reached the libraries in the developing countries. The total commercial value of these journals is 50 or 100 times the expenditure for this coordinating programme.

Needed for organizing such action are a sufficient knowledge of the real needs of the pursuit of science in the Third World, and a flexible, light, and enterprising approach to the task of organization.

It is my claim that TWAS is singularly well equipped for this kind of role as an organizer of such catalytic programmes. Its membership contains an enormous pool of scientific prestige as well as knowledge about how science is pursued. Indeed, TWAS is directly linked to the scientists in the Third World who actually pursue science. TWAS also has an appropriately small and flexible organizational structure so that experimenting with such catalytic projects would be quite easy.

So, how could one implement this project? The first step should be an appeal to all TWAS members for ideas for such catalytic projects. Each member should be asked to provide three such projects, each described briefly on one page, including the following information: (a) What is needed in question? (b) Why is this unfulfilled at the present? (c) What is the corresponding latent source? (d) What is the programme that could join the two? (e) What are the financial resources needed for the programme?

Concerning the last question, suggestions should be limited to situations where the bridging programme would require less than $10,000 a year, and in fact emphasis should be placed on suggestions where the cost is much below that, or in fact does not involve new finances at all.

Just to provide a few further illustrations of such programmes, let me list four.

1. Supplying new journals to libraries in the developing countries by acquiring permission from journal editors for a satellite edition of scientific journals made available only to libraries in the Third World;

2. Supplying editors of journals published in the Third World with a list of potential referees from within the world-wide scientific community in the various scientific disciplines who could be used to referee papers submitted to those journals (and could also be used to referee research proposals submitted to the Third World country's own science management organs);

3. Operating a visitor's registry which would exchange information between scientists from the world-

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Workshop on Increasing Flow of Scientific Literature to Third World Institutions

A two-day workshop on devising ways and means of increasing the flow of scientific literature to Third World institutions will be held at Trieste from 31 October to 1 November 1988 under the auspices of the Academy.

Representatives of some 20 scientific associations currently involved in book and journal donation schemes will attend the Workshop. These would include TWAS, ICTP, AGID, American Chemical Society, ICSU Press, Society of Economic Paleontologists and Mineralogists, American Geophysical Union and the International Union of Microbiological Societies. The Workshop will also be attended by representatives from UNESCO, UN Centre for Technology, IDRC, IUPAP and other potential support agencies.

The prime objective of the Workshop would be to review existing services and to design cooperative strategies and procedures to augment the dissemination of scientific publications to developing countries. Few, if any, co-operative links seem to exist among donor organizations and there are no regular opportunities to share experiences and strategies. The Workshop could help in forging closer links and, hopefully, lead to an improved climate for the dissemination of scientific information to the developing world.

The long-standing Donation Programme of the International Centre for Theoretical Physics (ICTP), now run jointly with the TWAS, currently recycles some 50,000 books and journals annually to about 500 institutions in 90 countries. A growing number of Northern scientific societies and associations are also contributing their bit by providing free copies of publications to Third World institutions, or by recycling to the latter material surplus to the needs of their own members and other donors.

The Workshop will review the existing programmes and pinpoint common approaches and problems such as (i) identifying the best recipient, (ii) attracting donors, e.g. via tax breaks, (iii) selecting material for shipment, and (iv) handling the shipping. The Workshop will also discuss possible joint services and their funding and design, and appropriate follow-up actions.

Conference on Role of Women in the Development of Science and Technology in the Third World

A Conference on the Role of Women in the Development of Science and Technology in the Third World will be held at the TWAS Headquarters, Trieste, Italy, from 3 to 7 October 1988.

The Conference is a sequel to the suggestions put forth at the Second General Conference of the TWAS (Beijing, September 1987) for a greater participation of women scientists in the Third World developmental activity and R&D enterprise. It is being organized by the Academy in co-operation with the Canadian International Development Agency (CIDA).

The Conference will (i) identify and bring to light the most important achievements of women in different fields of science and technology, and in the area of science policy; (2) present case studies of the status and role of women in science and technology in various countries, identify the obstacles faced, and propose solutions to overcome these; (3) formulate recommendations addressed to governments, the scientific community, funding agencies and international organizations concerning an improved and increased role for women in the development of science and technology.

It is expected that the Conference participants will propose specific follow-up activities and mechanisms, all aimed at improving the role of women in science and technology in the Third World and, if possible, elsewhere. The proposals will focus on: (1) the possibility of initiating an inventory to identify and describe the work of women scientists and technologists, creating a detailed data base of these, and regularly up-dating, publishing and widely disseminating this information in the form of directories; (2) various possible mechanisms to enhance the role of women in science and technology world-wide, with special emphasis on the Third World. These mechanisms may include the establishment of and/or the better utilization of associations of women scientists and technologists in the Third World; (3) concrete South-South and South-North collaborative projects in which women scientists would play an equal role to men scientists.

The Third World Academy of Sciences intends to publish and widely disseminate the proceedings of the Conference. Participants invited to attend the Conference are, for the most part, eminent women scientists, technologists and science decision-makers from the Third World as well as representatives of international organizations concerned with science and technology.

After the Fireworks

If you count some rather large fireworks, China has had a good 700 years of experience at launching rockets. It has not, as yet, won much recognition for its achievements in the sky, but that may soon change. On August 5th, Chinese scientists fired a satellite-bearing *Long March 2* rocket from the north-western province of Gansu; eight days later they brought the satellite safely back down in Sichuan province. The satellite, which was plonked into a relatively low orbit, was carrying nearly two tons of experimental equipment for the Chinese Academy of Sciences. It also had two payloads (for research into low gravity and the formation of crystals) from West Germany — China's second satisfied customer in the West.

The first was France. Last year a *Long March* rocket carried some instruments for Matra, a leading French aerospace and defence contractor. In theory, China should have even more clients: there is a queue of frustrated customers after the *Challenger* shuttle disaster in January 1986 and a subsequent aborted launch from French Guiana of a payload contracted to Europe's Arianespace. China offers the world's lowest launching prices. And it has successfully sent more than 20 of its own satellites into orbit since 1970, thanks to the rockets that have grown out of its missile programme.

Yet the Chinese order book is far from full: Matra is planning to use the *Long March* again; a consortium of Britain's Cable & Wireless, Hongkong's Hutchinson Whampoa and the China International Trust and Investment Corporation is planning to use a *Long March 3* rocket next year to launch a telecommunications satellite; and a *Long March* rocket may launch a Swedish satellite in 1991. That is not much, given the long and hungry queue for space.

What, then, is wrong? One reason, despite China's achievements, is a pervasive lack of confidence on China's technology among telecommunications companies and scientific laboratories. This is reasonable enough, given China's overall backwardness. Another is that China's rocketry is up to 15 years behind America's and Western Europe's. Satellites require delicate positioning in space: better to launch them expensively than to launch and fail — which is why Arianespace has built up a backlog of over $2 billion worth of business, and why private-sector American launchers have a backlog of around $ 700m. A third reason is that in the incestuous world of aerospace, western customers are loath to desert western suppliers.

If China has not quite grasped the opportunity presented by the stuttering of America's shuttle and Europe's *Ariane* rocket, at least it is reaching out. Although its inferior satellites are unlikely to appeal even to Third World customers, it sees reasonable prospects for its launching vehicles. After the *Challenger* explosion, China's Great Wall Industrial Corporation began to undercut American and European launch and insurance prices by 15%. It also offered to put western satellites ahead of its own in the launching queue.

China hopes to defray the cost of its space programme — perhaps $1.5 billion a year — by getting a share of the 700 commercial-satellite launches that could take place by the end of the century. The problem is that if China's space scientists are anything like America's, both the ambitions and the costs of the programme are likely going to go into orbit themselves. The most sensible programme would be one that concentrates on replacing and improving China's satellites. That way China might get a telephone system that works and, with the help of earth-observation satellites, find out more about its own natural resources. A less sensible programme would be to plan a manned shuttle and a space station, just like America. That is precisely the dream outlined last November by the Ministry of Astronautics Industry.

Courtesy: *The Economist,* 20 August 1988

Some Thoughts on Science in the Third World

Many people fail to appreciate that transfer of technology is not a black box which can be transferred to any country irrespective of the indigenous base. Still worse has been the slogan of Appropriate Technology (A.P.). The lack of precise definition of A.P. has led to several chain reactions in other fields. One specific fallout has been goal-oriented research. The so-called goal-oriented research is also having its restrictive influence on higher education, and especially the Ph.D. programme.

The first task we have to take is to re-orient the diehard decision-makers that transplantation of technology is not an easy task. It will not take root if the ground is not made suitable for its survival. The suitable ground is an indigenous base of science in the country, for which a part of the educational expenditure must be spent for Ph.D. training and higher research.

In a traditional benefit-cost analysis, the output for value-oriented product cannot be quantified and turned into monetized units, but the achievements are easily felt by the people in the field. The traditional concept of evaluating a project engaged in *uplifting the thought process* must be judged on a different premise than the traditional economist's financially quantifiable near term cost-benefit analysis.

Dr. S. Zaman Mozumder
Associate, ICTP

Southern Africa: Ministers Adopt Technology Report

Ministers responsible for women's affairs in the Southern Africa Coordination Conference (SADCC) have adopted a comprehensive experts report on appropriate technology for women in the Africa sub-region.

The report is based on country papers presented during the experts meeting which preceded a two-day ministerial meeting from the nine SADCC member countries — Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe.

The meeting was organized jointly by Tanzania's Ministry of Community Development, Culture, Youth and Sports and the United Nations Development Programme (UNDP), to exchange experience on improved technologies, recommend suitable ones for women and develop project proposals for submission to the SADCC Council of Ministers.

According to the report, there is great need to disseminate information on the implements manufactured in the SADCC countries that can ease the burden on women.

If disseminated timely, such information will reduce duplication of manufacturing implements that can be obtained from another SADCC country and allow the other countries to concentrate on manufacturing items not available in the region.

The report calls for the promotion of local assembling of tractor-drawn equipment, provision of spare parts, and training of women to maintain and repair the equipment.

It also calls for strengthening local institutions, like the Arusha-based Centre for Agricultural Mechanisation and Rural Technology (CARMATEC), particularly by increasing the number of women involved in the stages of technology design.

National science technology councils should also take rural women's concerns into consideration and design councils including women should be established.

International Seminar on the Influence of Nutrition and Early Stimulation in the Third World

An "International Seminar on the Influence of Nutrition and Early Stimulation for the Education of Children in the Third World" was held at the Wenner-Gren Centre in Stockholm, Sweden, from 6 to 9 April 1988. Among the 39 participants was Prof. Marcel Roche, who was included as observer for the Third World Academy of Sciences. His report:

The meeting was characterized by a high level of scientific and educational quality. The existence of widespread malnutrition in the children of the Third World was once more acknowledged. This is a glaring fact, which must once again be stated loudly and clearly. On the other hand, if experiments on rats (chiefly) are clear with regard to the positive effects of nutrition and early stimulation, human observations are more equivocal. Favourable results almost always emerge from studies whose evaluation is impressionistic, and less favourable results take place when the study is "scientific" and, specially, properly controlled.

In animals (rats), the studies reported on by J.L. Smart (Manchester) are specially significant and relevant. This author has shown, in rats submitted to undernutrition during the suckling period, that early stimulation enhanced forebrain growth in weight, length and, in some studies, width. There was some evidence of increase in cortical thickness in the visual cortex, as well as modification of oligodentrocytes to neurons and of synapses to neurons, synaptic disc diameter and aspects of dendritic branching. It appeared that undernourished rats are as capable of responding positively to environmental enrichment as are well-fed rats. However, it should be emphasized that early stimulation does not enable previously undernourished animals to catch up in brain growth, like the well-fed early stimulated animals; it merely shifts them to the lower end of the normal (well-fed) range.

In the human, the situation is much more complex, since undernutrition and early stimulation are part of a "galaxy" (this was the word constantly used throughout the symposium) of physiological and social variables caused by poverty. In truth, the need is to eliminate poverty rather than to implement palliative measures that do not solve the basic problem of unjust distribution of wealth. Among the variables which were not considered in the symposium is the continued emotional and intellectual understimulation which occurs throughout life in underprivileged sectors of society.

A number of studies show, however, that poor conditions of nutrition and lack of stimulation in early infancy affect such items as school enrolment, dropout rate and general achievement throughout life and that, therefore, remedial measures, such as early supplementary feeding and stimula-

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Parkinson's Disease Linked to Scavenger Mechanism

Experiments carried out by Turkish researchers indicate that the degeneration of brain cells caused by Parkinson's disease occurs because a mechanism that mops up the reactive compounds of oxygen in the body fails.

In making this discovery the researchers have found a way of testing whether the treatment for the disease — a drug called L-dopa — actually speeds up the degeneration of brain cells.

Parkinson's patients suffer from the progressive destruction of the substantia nigra — brain cells that secrete the neurotransmitter, dopamine. The brain needs dopamine from the substantia nigra to initiate and control certain types of movement. As these cells die, the supply of dopamine dries up and patients start to lose control of their body.

No one knows what causes Parkinson's disease, but there are a number of theories. By finding out how the brain cells are destroyed, researchers can begin to select between the different hypotheses and work towards better treatment of the disease.

Neuroscientists already have evidence that reactive compounds of oxygen destroy cells in the substantia nigra. These compounds form free radicals that kill cells by disrupting the lipid molecules in the cell membrane.

Normally, a variety of antioxidant scavenging systems protect the cells by mopping up the reactive oxygen compounds. Some researchers believe that in patients with Parkinson's disease, the substantia nigra deteriorates when the antioxidant scavenging system stops working.

There have been several reports of defective antioxidant mechanisms in the brain. Autopsies have shown that patients with the disease have reduced levels of antioxidative chemicals — catalase, peroxidase, glutathione (GSH) and glutathione peroxidase — in their substantia nigra.

Researchers have been dubious of this hypothesis because to date they have not been able to detect a deficiency of these enzymes in other parts of the body. It seems unlikely that the deficiency of scavenger compounds is restricted to a group of dopamine-secreting cells in the substantia nigra.

Suha Yalcin and colleagues from Marmara University and Istanbul University, both in Turkey, have examined levels of antioxidant compounds in red blood cells and found that loss of these compounds is not restricted to the brain. They compared red cells from patients with the disease with red cells from healthy individuals of the same age and found that those with Parkinson's disease had lower levels of GSH and GSH peroxidase. This suggests that the scavenger mechanisms in the substantia nigra might break down as a result of a genetic or generalised deficiency in antioxidant compounds. Researchers are not sure why the substantia nigra is singled out for attack if the deficiency is widespread?

Thomas Perry, David Godin and Shirley Hansen from the Department of Pharmacology in the University of British Columbia, Canada, have suggested that it might be the dopamine in substantia nigra cells which makes them vulnerable. The black pigmentation of the substantia nigra, which gives it its name, increases between childhood and early adult life. This pigment, melanin, may be formed by oxidation of dopamine. In Parkinson's disease, nerve cells could be dying because reactive chemicals produced by the oxidation of dopamine are not being mopped up by the scavenging system.

At present, treatment of Parkinson's disease is aimed at curing the symptoms by replacing the dopamine which the substantia nigra is no longer producing.

Patients are given a drug, L-dopa, to make up the deficit of naturally produced dopamine. Although L-dopa eliminates the muscle tremors and stiffness which characterise Parkinson's disease, nerve cells continue to degenerate relentlessly and the symptoms become progressively more difficult to control. Because L-dopa is metabolised in the same way as dopamine, doctors think that replacement therapy with L-dopa could in fact be accelerating cell death.

Doctors are now beginning to favour the use of antioxidants in an attempt to aid the patient's failing scavenging system. Clinical trials of two drugs, Deprenyl and tocopherol, have started in the United States and Canada, but so far there is too little information to determine what effect, if any, the drug will have. The group in Turkey plans to use its red blood cell tests to find out whether L-dopa is causing cell membranes to break down, and to assess the benefits of antioxidant treatment.

• Alison Cook (Courtesy: *New Scientist,* 26 May 1988)

Venom against Cancer

Egyptian researchers at Ain Shams University near Cairo are exploring the use of spitting cobra venom as a treatment for cancer. According to *Asiaweek*, an extract from the venom — called fraction three — has the ability to "rip apart the membranes of cancer cells and attack their reproductive structures."

Results from a laboratory experiment on 120 mice injected with cancer cells show that all those that did not receive fraction three treatment died within 24 days; those that were given a double dose of the treatment survived nearly twice as long. Autopsies revealed that the venom-treated cells "appeared to have been exploded."

World Development Forum, 15 June 1988

Remote Sensing in Egyptology

Simply defined, remote sensing implies the study of an object or a process, investigating something without having to touch it. This broad definition includes such diverse methods as interpreting an image of Landsat taken from 920 kilometers above the Earth, probing the ground beneath the surface with radar waves, or studying a painting with ultra-violet light.

During the past two years, I have applied these advanced space-age techniques to two archeological projects in Egypt: (1) study of the wall paintings of the tomb of Queen Nefertari in Luxor; and (2) nondestructive investigation of the second boat pit of Pharaoh Khufu (Cheops) in Giza.

The first project involved the study of the wall painting in the tomb of Nefertari and was part of joint research between the Egyptian Antiquities Organization (EAO) and the Getty Conservation Institute (GCI). The tomb belongs to the favourite wife of Pharaoh Ramses the Great, who ruled Egypt for 67 years (1292-1225 BC). When it was unearthed in 1904 by an Italian expedition headed by E. Schiaparelli, it had been robbed of all contents. More importantly, it was robbed of some of its magnificent wall paintings by salt crystallization behind the plaster layer on which the ancient Egyptian artisans had applied their painting. Fear of further damage caused the tomb to be closed to all visitors during the past 50 years.

The objective of the study was to establish the origin of the water that caused the mobilization of salt and its recrystallization in order to recommend a treatment to conserve the paintings. I applied remote sensing methods and techniques to: (1) map the region in the immediate vicinity of the tomb for the establishment of a hydrologic model of the area; (2) establish whether the deterioration was a one time event or a continuous process; and (3) study the state of various segments of the tomb's walls to locate areas needing emergency treatment.

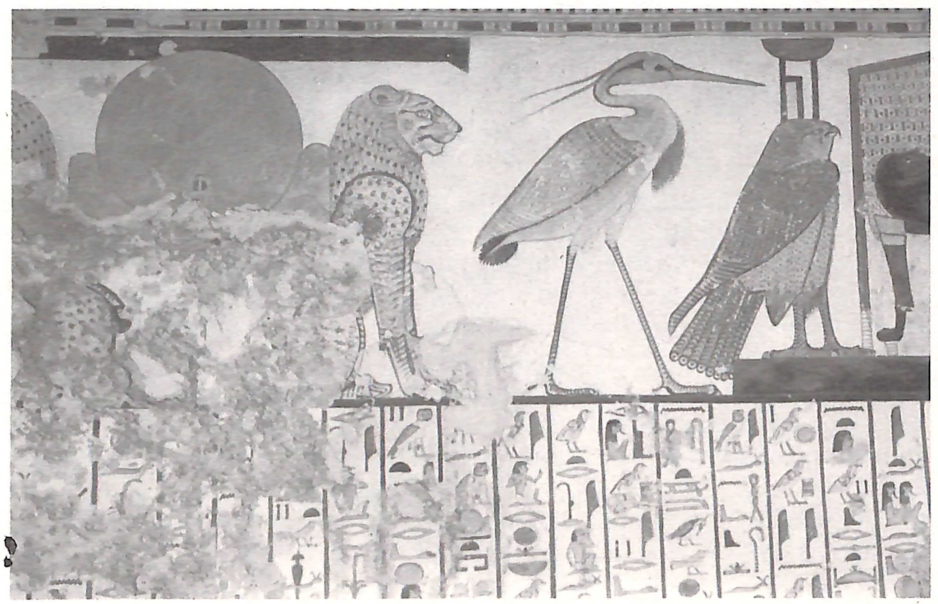
To establish the drainage pattern in the Valley of the Queens, where the tomb exists, I ordered a Thematic Mapper image obtained by Landsat spacecraft. The image showed the fracture pattern in the region and emphasized that a one-mile long escarpment separated the Valley from the main plateau to the west. This setting allowed the study of the hydrology of the Valley of the Queens as a separate unit.

The basic topographic features of the area were shown in a French map made in 1926. Additional details were mapped by Swiss Air Photo from aerial photographs. Furthermore, profiles of dry valleys and hill slopes were obtained through the help of Earthwatch volunteers under the direction of surveyors from Cameron and Associates. All such data were integrated in the computer-generated hydrologic model of the area.

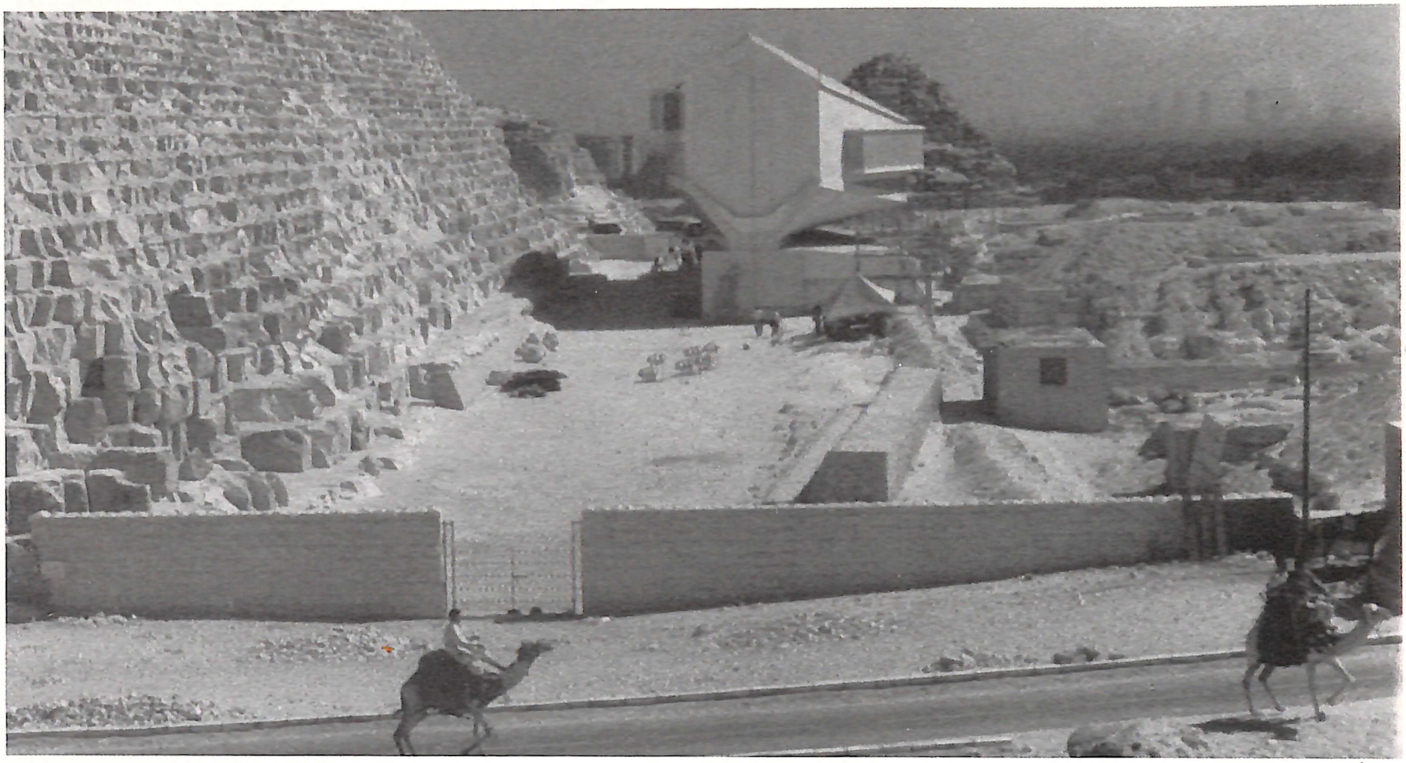
To establish the relationship of the deterioration of the wall paintings over time, we used software that was designed to study Landsat images. Photographs of the same wall taken at different times were compared. This indicated that the recent deterioration is mostly physical rather than chemical; already separated pieces fell down with advanced age. Based on this information, it is unlikely that the chemical deterioration continues to this day.

The study of the state of various parts of the wall was done with multispectral photography. Instruments were used to obtain photographs in the visible, near infra-red, and ultraviolet light. These image data indicated which parts of the wall have deteriorated, but without visible signs on the outside wall. Pockets of air or salt not visible to the human eye were detected and helped in applying emergency conservation.

The second project involved the



Wall painting of the tomb of Nefertari showing a variety of animals and birds with religious text underneath. To the left is an area that had deteriorated due to salt crystallization behind the plaster layer.



The Great Pyramid of Giza (left), with the site of non-destructive investigation of the second boat pit (under tent) near the museum that houses the first boat, which was discovered in 1954.

non-destructive investigation of a boat pit of Pharaoh Khufu. The pit in question was located in 1954, aligned with another one, 18 meters south of the Great Pyramid of Giza. The two pits were revealed by the removal of a heap of rock rubble and wind-blown sand, and were found to be separated by the axis of the pyramid.

The eastern of the two pits was excavated from under a cap of 41 limestone blocks. Gypsum mortar sealed the crevices between the cap blocks. This suggested that the cavity was hermetically sealed. Another suggestion of the tight seal was that when opened it emitted the smell of cedar wood of the disassembled boat inside.

The wood was excavated and the assembled vessel was placed on exhibit at the Boat Museum, which was built at the site of discovery. The boat had shrunk about 0.5m since it was put on display in 1982. It was feared that such deterioration may have been caused by the changing environmental conditions inside the museum. Since the second (western) pit was thought to also contain a boat, much like the first, it was hoped that the investigation of its environmental surroundings would lead to a better understanding of how best to preserve the ancient wood. This idea was the driving force behind the project. In addition, it was believed that sampling of the air inside the potentially hermetically sealed pit may reveal important data on the atmosphere of the Earth the way it was 4,600 years ago.

A research plan was developed through an agreement between the EAO and the National Geographic Society (NGS) providing for undertaking the following steps: (1) geophysical surveying of the site, (2) drilling a 9-cm hole using dry rotary drill motion through the limestone cap rock; the drilling and other operations were sealed by an air lock to separate the air inside from that outside; (3) sampling the air in the cavity at different levels, (4) measuring pressure, temperature and relative humidity inside the chamber, (5) photographing the interior with a video camera using a fiber optic "cold" light and a 35 mm still camera, and (6) sealing the drilled hole with a similar material as that used by the ancient Egyptian builders.

On completion of the research plan, testing of the various steps commenced. The drill and airlock as well as the photographic systems were all tested at a warehouse belonging to the NGS in Washington, D.C. Successful completion of all tests paved the way for the planning of site investigation during the month of October 1987. First, a scaffold was built on top of the selected site and a tent was set up to protect the imaging equipment. Then a block was selected and prepared for drilling with minimal distur-

bance to the overlying wall. The block was found to be 1.60 cm thick, and there appeared to be no change in pressure as the drill bit went through. This indicated that there may have been communication between the atmosphere inside and outside the chamber. Seventy litres of air were collected from 18 cm, 94 cm, and 145 cm below the ceiling for analysis by specialists of the National Oceanic and Atmospheric Administration (NOAA) at Boulder, Colorado.

Regarding environmental measurements, the pressure inside the chamber was identical to that outside. The temperature measured 27°C (81°F). The relative humidity was 85 percent. It is interesting to note that the humidity measured in the first cavity a few days after opening it was also high — 88 percent.

Photography of the interior revealed a disassembled boat. Much like the case of the one that was opened in 1954, the second pit contained stacks of wood with pieces of the cabin arranged on top. The second boat appeared to be smaller than the first, with four small pointed oars on top. Bronze hooks were revealed, which appeared similar to those that hinged the cabin doors in the first boat.

As soon as air samples reached NOAA's laboratories, atmospheric scientists and physicists began to monitor the contents of the canisters and analyze their components. Results of freons analyses came first. F11 measured 300 part per trillions (ppt) and F12 about 540 ppt. These values were higher than, but close enough to, those of ambient air, measured near Cairo.

An unusually high value was that of the content of CO_2 inside the chamber in dry air, which was done by freezing out water. CO_2 measured 720 part per million (ppm), double the amount in the ambient atmosphere. It was expected that CO_2 might have been produced by degassing from the organics inside the pit or even driven off the limestone walls of the chamber. However, because of communication between the air inside and outside, this value should not have remained high.

A further test was to date the CO_2. Such a test required the Tandem Accelerator at the University of Arizona, which gave the age of 2,000 years. This indicated a mixture between ancient air and a modern counterpart.

Three attempts were made to capture from the air organic particles for Egyptian specialists to identify any micro-organisms. Antiseptic bottles containing a water and alcohol mixture were brought to the site and air from the cavity was allowed to flow through them. Three groups of scientists took samples for analysis at Al-Azhar University, the Suez Canal University, and the Egyptian Atomic Energy Establishment. These samples were completely free of microbial contaminants. This may have been so because the air was pumped from nearly one meter above the contents of the chamber, whereas bacteria or other organisms may have settled to the bottom of the pit or the upper surface of the wood.

The success of these two projects convincingly established the applicability of advanced remote sensing technology to the study of the cultural heritage of one of the most ancient civilizations. The methods and techniques used will have applications worldwide. • Farouk El-Baz

Latin America: Science and Technology to further Agriculture

Public and private investment in science and technology is crucial to the development of agriculture in the Latin American region, according to experts who met here recently at a Seminar.

The Seminar "Policies and Mobilisation of Resources for Technological Innovation in the Region" was organised by the Inter-American Institute for Agricultural Cooperation (IICA), and the Institute for Economic Development of the World Bank.

Eduardo Trigo, of the Generation and Technology Transfer Department of IICA, said the discussions — particularly those referring to the coordination of the public and private sectors — could lead to increased funds to develop agriculture in the region.

In different working groups, participants analysed the institutional and financial repercussions associated with technological advancement, as well as the possibility of regional cooperation.

Technological advances should be part of a vision which "is flexible enough to incorporate macroeconomic and other relevant policies", conference participants said as they called on governments to take a more active role on the issue together with multilateral bodies.

Trigo noted that Latin American countries spend less than 0.5% of their Gross National Product (GNP) on agriculture, "even though 1% would be desirable, given that industrialized nations spend almost 2%."

New and Emerging Sciences and Technologies Needed

Dr. I.H. Usmani, Ex-Chairman of the Pakistan Atomic Energy Commission and former Senior Energy Adviser to the United Nations, recently spoke before a distinguished group of British parliamentarians in the House of Commons, in his present capacity as the Secretary General of the BCCI-sponsored International Foundation for the Promotion of New and Emerging Sciences and Technologies (NEST).

Dr. Usmani stated that whatever had been achieved by the advanced countries of the East and West was due to a total commitment on the part of policy planners, decision makers and the people of these countries, to the cause of science, particularly its application in the form of technology. A country which acquires technology, automatically acquires the "Master Key" that opens all doors to resources. Technology can and does generate not only new products, but finds substitutes for the existing ones, thus enlarging the overall resource base and therefore contributing to the increase in the GNP of the country concerned. A unique feature of a science-based technological effort is that it is perhaps the only human activity which transcends all national frontiers. *Its products flourish best when subjected to the free forces of the Market Economy.*

Dr. Usmani supported this thesis by quoting the examples of two island countries: England in the West and Japan, thousands of miles away, in the Far East. While England pioneered the "Industrial Revolution" of the 18th and 19th Centuries, Japan is one of the acknowledged leaders of the "Technological Revolution" of the 20th Century.

The "Beggary Gap"

Dr. Usmani expressed grave concern at the "Business-as-usual" approach that was being adopted by planners of developing countries for socio-economic development, because the "Business-as-usual" approach depended entirely on: (a) acquisition of conventional technologies and (b) *"Cost consciousness" rather than on "Future consciousness".* According to this approach the GNP of the developing countries would grow arithmetically at a linear rate while their populations were growing geometrically at an exponential rate. The difference between the two rates of growth gave rise to what Dr. Usmani termed as the "Beggary Gap". Presently the developing countries tried to fill this gap by obtaining loans, grants, and even charity gifts, by way of aid, from the richer countries. The adoption of this approach created more problems than it solved.

Dr. Usmani cited the cases of Argentina, Brazil and Mexico, the developing countries which had borrowed heavily in the past to fill the "Beggary Gap" but were unable to re-pay the debts which ran into billions of dollars! This ugly situation would not have occurred had these countries invested in New and Emerging Sciences and Technologies (NEST) rather than conventional technologies. *They produced goods at prices higher than those produced by the advanced countries using the same technologies.* Therefore, the only way open to the developing countries was to close the "Beggary Gap" by taking a "quantum jump" through the promotion of New and Emerging Sciences and Technologies (NEST).

Myth of Appropriate Technologies

Some friendly and motivated individuals and institutions have propagated that what the poor developing countries needed was the simple "Appropriate technologies" and not "High technologies". Dr. Usmani, quoting from his own experience, first as Chairman of the Pakistan Atomic Energy Commission and later as the Senior Energy Adviser to the United Nations (throughout the so-called oil crisis of the '70s and early '80s) ridiculed the idea of reserving the primitive technologies in the garb of "Appropriate technologies" for the developing countries to adopt, because in his opinion all technologies were appropriate. The nuclear power reactor that he established was as appropriate in a power-starved bullock country like Pakistan as solar photovoltaic (PV) cells proved to be appropriate for "Rural Electrification" in remote and small villages of the same country. According to him, if "Small is beautiful", then "Big was not necessarily bad"!

Six Favourable Circumstances

Dr. Usmani then dilated upon the six favourable circumstances that existed today for the developing countries to make an assault on poverty — the unconquered frontier. They were:

1) The existence of an international pool of knowledge and wisdom, including the results of scientific and technological researches already done (on problems similar to those presently faced by the developing countries), to which contributions had been made by the Chinese, the Hindus, the ancient Egyptians, the Greeks, the Romans, the Jews, the Christians and the Muslims. This pool of international knowledge was growing at such a fantastic rate that New and Emerging Sciences and Technologies (NEST) continue to pour into it for adaptation by any country.

2) The developing countries had enough of a hard core of talented scientists and technologies who could be trained in any disciplines of NEST, however complex they may be. The developing countries had produced even Nobel Prize winners like Profes-

sor Salam of Pakistan in such sophisticated subjects as Nuclear Physics and Professor Milstein of Argentina in medical applications of Biotechnology.

3) Practically all the developing countries, though poor, could easily spare about 0.5% (half a percent) of their GNP out of their own resources, for financing adaptive research and establishing a network of Extension and Demonstration centres for NEST with a view to proving their viability and monitoring the performance of NEST. This small investment could be regarded by the planners of developing countries as a kind of an "Insurance premium" against adversity and for avoiding the creation of the "Beggary Gap" in the future.

4) By far and large, the attitude of the Governments of technologically advanced countries and of the "Multinationals" was co-operative, friendly and favourable to the transfer of NEST involved, subject to the terms and conditions to be negotiated to mutual satisfaction and advantage.

5) There were philanthropists like Nuffield, Ford and Rockefeller and humane bankers like McNamara of the World Bank and Agha Hasan Abedi and Swaleh Naqvi of BCCI who have the vision and generosity to establish non-profit-making Foundations for the promotion of scientific and technological activities in the developing countries.

6) It was gratifying to find that there were also Heads of State of developing countries like President Kaunda of Zambia and President Zia-ul-Haq of Pakistan who enthusiastically supported the concept of NEST for development.

In his capacity as the first Secretary General of NEST, Dr. Usmani gave broad outlines of the structure and working of the Foundation as summarized below:

i) The Foundation was not a bank but a non-profit-making company with its Headquarters legally registered in Cayman Islands.

ii) The Foundation is a unique institution in the sense that it deals only and exclusively with projects which involve NEST.

iii) For the present, the activities of the Foundation are limited to four developing countries: two in Africa - Zambia and Zimbabwe - and two in Asia - Bangladesh and Pakistan.

iv) As Pakistan was a medium-sized country with a population of 100 million and climate and geographical terrain (high mountains, green valleys, arid areas and sea coast) typical of developing countries, it has been selected as a model country for demonstration of projects involving NEST.

v) The Foundation has established one Branch in London to keep abreast of the rapidly developing NEST in advanced countries, and the other in Karachi to supervise the demonstration and implementation of projects involving NEST.

vi) The Foundation is concentrating on identifying projects in two of the most important sectors of the Economy of developing countries, namely: (a) Energy and (b) Agriculture: Food and Water.

vii) Due to paucity of funds, the Foundation has so far played only a catalytic role by financing: (a) the preparation of survey and feasibility reports for the projects involving NEST, by top class consultants; (b) the visits of experts to and from the developing countries; and (c) the collaboration with the Private sector and the Public sector Agencies, including the Government Ministries on selected projects.

viii) The Foundation intends to enlarge its promotional activities by: (a) co-financing selected projects involving NEST on a case by case basis in the Private and the Public sectors as well as the "Mixed sector"; (b) awarding Research Contracts and Fellowships on subjects related to the solution of problems with which the developing countries are faced; (c) participating in the organization of scientific conferences, meetings and seminars on specific subjects concerning NEST.

NEST Projects

Dr. Usmani explained that the Foundation had several projects (involving NEST) under study, but those for which feasibility reports have been prepared and which are ready for implementation are the following:

Pakistan — Sector A: Energy

i) Establishment of a mini "Solar Dam" or a central Solar PV powered station of 10 MW capacity (largest of its kind in the world) at Mastung in Baluchistan (Pakistan) feeding power in bulk to the national grid.

ii) Establishment of a factory assembling modules of PV cells in Lasbela (near Karachi) having an annual capacity of 1MW/year on a single shift basis.

iii) Installation of a small newly designed hydro power turbine which is capable of generating power from the flow rather than fall of water (H.F.T.) for demonstration in the Bong Canal taking off from the water reservoir at the Mangla Dam Site, in Pakistan.

iv) Marketing of solar PV power systems to demonstrate: (a) Lighting of homes, streets and parks, etc; (b) Pumping of water for drinking and irrigation; (c) "Rural Electrification" of small and isolated villages on a decentralized village to village basis, providing water for drinking and lighting ("Pani-Bigli" programme) for homes, huts, shops, rural dispensaries and community centres, including power for fans, educational TV sets and medical refrigerators, etc.

v) Demonstration of electric vehicles on the roads of Karachi incorporating PV charged batteries, in collaboration with the Pakistan Automobile corporation.

[Note: While designing, operation, installation and testing (DOIT) of the PV systems involved will be done by the Foundation, the payment for the

above rural electrification will have to be recovered from the Rural co-operatives, or the Provincial or Central Governments in easy installments, if need be, on approval by the Foundation].

Sector B: Agriculture: Food & Water

i) Establishment of a soymilk plant of 2000 litres/hr capacity in Karachi with a view to providing an incentive for the cultivation of soybeans and an additional outlet to the farmers for selling their soybeans not only to oil mills but to soymilk and soya-based Animal Feed plants.

ii) Rapid multiplication of good breeds of cattle particularly the high milk-yielding buffaloes and cows, at (a) the Baluchistan Government's Livestock Improvement Centre near Quetta (Baluchistan) and (b) the Military Dairy Farm in Rawalpindi, through the Embryo Transfer Technology (ETT).

iii) Marketing of specially designed filtration units which can provide safe (bacteria free) and clean drinking water in rural and urban areas by converting dirty and filthy water.

[Note: In the Agricultural Sector the following projects are under study for implementation in Pakistan: (a) establishment of a Biotechnology Centre specializing (to begin with) in the rapid production of disease-free potato seeds through Tissue Culture Techniques (TCT) in collaboration with the Pakistan Agricultural Research Council (PARC); (b) Evolution of salt-tolerant varieties of wheat, etc., in lands affected by water logging and salinity; (c) Utilization of agricultural polymers in arid areas for retention of moisture with a view to increasing agricultural and horticultural productivity].

Zambia — Sector A: Energy

i) Establishment of a mini-hydro power station of 640 KW capacity in the Zambesi basin at Luakela.

ii) Installation of a Solar PV system for pumping water for irrigation.

Sector B: Agriculture: Food & Water

i) Establishment of a soymilk plant after conducting the Consumer Acceptance Test (CAT) in Lusaka.

ii) Establishment of a centre for Embryo Transfer Technology (ETT) to improve the breeds of good milk and meat-yielding cattle and to multiply such breeds rapidly.

iii) Establishment of a Silk Centre at the national level.

Conclusion

Dr. Usmani concluded by saying that we were living as Dickens would have said in the "Best of times; and the worst of times". Ours was the Age of Wisdom as well as the Age of Ignorance. It was an age of affluence in some countries and of abject poverty in others. He, however, sounded a note of optimism by placing his hope in the Future through NEST and quoted the late President Kennedy of the United States of America who once said: *"People look at things and ask, why? I dream of things and ask why not?".*

International Seminar on the Influence of Nutrition — Continued from page 5

tion, regular visits to home, mother education and proper early schooling may be of benefit.

In conclusion, it was decided that there is a need to define better the developmental dimensions that "interactive stimulation" is expected to enhance, including the social, cognitive, emotional and psycho-motor dimensions. Also, that evaluations should pay greater attention to proper comparison groups and to controls for socio-economic differences among groups. It was suggested that both nutrition and interactive stimulation are part of a broader web of conditions affecting growth, development and behaviour. The priority areas identified by the seminar to improve the physical and mental development of children in developing countries were four:

1. The need for food supplementation of pregnant women in the third trimester of their pregnancy;

2. The need for nutrition and micronutrients, or supplementary feeding, for the motherchild dyad in the first two years of life;

3. Nutrition as an essential component of all early stimulation programmes;

4. The need for community involvement in the recognition of priorities in the field of nutrition.

All available evidence indicates that the effectiveness of school feeding depends on, and can be enhanced by, the actual quality of the schooling itself. Poor schooling is likely to overwhelm any positive effects which the feeding may have, and hence cancel out any benefits that might accrue. Active community support for, and involvement in school feeding programmes are vital if the benefits are to be sustained, attitudes changed, and practices modified.

It was strongly recommended that interagency cooperation (UNESCO, FAO, WFP, UNICEF, WHO and various NGOs) be promoted, since action in favour of the young child must of necessity be interdisciplinary. Two actions in this respect were recommended:

1. That UNESCO, jointly with other agencies concerned, plan and support an appropriate number of interdisciplinary workshops in which such specific issues can be addressed;

2. The creation of an inter-agency ad hoc Committee, under sponsorship of UNESCO, to help stimulate and coordinate actions undertaken by the various agencies involved was suggested.

Umberto Cordani: First IUGS President from the Third World

Professor Umberto G. Cordani has been elected President of the International Union of Geological Sciences as of May 1, 1988. He replaces Prof. Eugen Seibold who had temporarily filled the gap left by the death in July 1987 of President William Hutchison.

Born in Italy in 1938, but a citizen of Brazil since 1960, Prof. Cordani is the first IUGS President from the Third World, a significant change for the Union, which began as a European and North American initiative. He points out that geology is global and cannot be viewed only from the North. Important geological records can be preserved anywhere, and each regional setting is unique and must be studied from within. The tropical regions are obviously important, since they exhibit many distinct geological and geochemical processes at the surface that must be studied if we wish to consider a global earth system. On the other hand the development of science in the Third World cannot be accomplished alone, for the progress from one level of development to another requires international cooperation, as it does for economic and social improvements.

Prof. Cordani points with pride to the very rapid growth of the geological community in Brazil from 1960, when he was among the graduating class of geologists, to the present number of 4000 to 5000. Yet for the 140 million people of Brazil, a few thousand geologists in such a vast land are not really sufficient to meet local needs, and the contrast with the situation in the USA or even more so in the USSR is marked. Moreover, the best scientists are so burdened with other duties that they have difficulty in working effectively.

Prof. Cordani is Director of the Institute of Geosciences at the University of Sao Paulo, perhaps the largest and most productive geoscience research organization in South America. A USP graduate himself, Prof. Cordani is a member of the Brazilian Academy of Sciences, the Academy of Sciences of the State of Sao Paulo, and member of several editorial boards of South American and international journals. He is the author of over 140 scientific books, papers and other publications, especially on geochronology, of which he is a pioneering leader in South America.

Prof. Cordani is well known for his active and wide-ranging participation in the international scientific community. He was Vice-President of IUGS from 1984 and member of the IUGS Advisory Board for Research Development, until his election as President. He has also been a member of the IGCP Scientific Committee (1980-85), the Council of the International Association of Geochemistry and Cosmochemistry (1981-85), and the Bureau of the Inter-Union Commission on the Lithosphere (1981-85). Prof. Cordani also served as leader of IGCP Project 120 ("Magmatic Evolution of the Andes"), on the IUGS Sub-Commission of Geochronology, on the IAVCEI Working Group on Radiogenic Isotopes, and on the former International Geodynamics Project. He has been Visiting Professor at the Université Libre (Brussels), the Universidad de Chile (Santiago), University of Texas (Dallas), the University of Oxford, the University of California (San Diego) and the Università degli Studi di Milano.

In a recent interview with Episodes, Prof. Cordani talked of his hopes for IUGS. He paid tribute to the many scientists around the world involved in one of the main tasks of the Union, the setting up of international standards in geology, especially as regards stratigraphic boundaries and rock nomenclature. This work, he pointed out, can only be carried out in an international forum like IUGS. On the other hand, IUGS also encourages and provides support for projects on new aspects of earth sciences such a mineral deposit modelling, remote sensing, comparative planetology and microtectonics. Likewise, Prof. Cordani believes that both basic and applied research are important, though the former is closer to the main goals of IUGS. He points to the valuable work on applied geology carried out under IUGS affiliates such as the International Association of Engineering Geology, with its activities on urban geology and on landslides.

He sees as one of the main tasks ahead for IUGS to strengthen its national committees around the world and their links with the Union, a special concern also of Bill Hutchison. Another challenge is to find the best way to involve the geological sciences in the new interdisciplinary environmental science, such as embodied in the Global Change programme recently launched by ICSU. These endeavours transcend IUGS and require closer links between geologists, geophysicists, biologists and ecologists, between IUGS, IUGG and other ICSU unions.

Geology is certainly not known enough by the public, and if this is true in general the problem is dramatic in the Third World. Thus, geological education, he feels, should be one obvious priority area for IUGS, for example through its Commission on Geology Teaching and the Association of Geoscientists for International Development. Prof. Cordani welcomes suggestions for specific actions.

At the same time he recognizes the need for caution when adding more projects to the already

Continued on next page

Kuku Receives Ogun Special Award

Professor Aderemi Oluyami Kuku has been honoured as one of the distinguished sons of Ogun State.

Born 47 years ago, Professor Kuku showed early academic brilliance by standing first in his class, not only during elementary school, but throughout the secondary school education at Eko Boys' High School in Lagos where he obtained his West African School Certificate in Grade 1 in 1959. His demonstration of leadership qualities led to his appointment as Senior Prefect (Head Boy) at the School for the year 1959.

Professor Kuku was awarded the B.Sc. (Special) Mathematics with upper second-class honours by the University of London in 1965, and received his Ph.D. from the University of Ibadan in 1971. After his initial appointment as Assistant Lecturer at the University of Ife in 1965, he moved to the University of Ibadan as a Lecturer in 1968, to become a Professor of Mathematics in 1982 and Head, Department of Mathematics, 1983-1986. He is currently the Dean of the Postgraduate School, University of Ibadan, and the Chairman of the Committee of Deans of Postgraduate Schools in Nigerian universities.

Professor Kuku's research contribution has been mainly in the new, but important, field of mathematics called Algebraic k-Theory. The development of this field started a little over twenty years ago, when Professor Kuku commenced his graduate studies, and so he has been one of the pioneers in the field that has had tremendous influence and applications, not only in most branches of pure mathematics, but more recently in some applied areas like Quantum Physics, Econometrics and Dynamical Systems.

He has published a number of interesting papers on Algebraic k-Theory and related mathematics, as well as on topical issues of mathematical education. He has also published two books - one entitled Abstract Algebra, which is suitable for the use of honours mathematics undergraduates and postgraduate students, and the other, entitled Axiomatic Theory of Induced Representation of Finite Groups, is meant for research mathematicians and advanced postgraduate students. After introducing algebraic k-theory to Nigeria, Professor Kuku has succeeded in generating the interest of younger mathematicians in the field and is currently supervising some postgraduate students.

Professor Kuku's standing and recognition internationally could be judged from the fact that he has been invited to give colloquia and seminar lectures in mathematics at several top universities all over the world, e.g. USA - Columbia University, New York; University of Chicago; University of Illinois at Urbana-Champaigne; Northwestern University Evanston; Cornell University, Ithaca; University of Oklahoma; West Germany - Universities of Bielefeld, Münster, Munich, Paderborn; Canada - Queen's University, Kingston, Ontario; University of Edmonton; England - Universities of Warwick and London etc.

Professor Kuku has been the recipient of several honours. He is currently the President of the African Mathematical Union - the supreme organization for mathematics in Africa. He is a member of the European Academy of Arts, Science and Humanities (the only Nigerian member of this prestigious Academy in Europe); member of the International Mathematical Union; Commission on Development and Exchange (the only African member currently on any commission of the IMU, which is the supreme organisation for mathematics in the world); Fellow of the African Academy of Sciences, Vice-Chairman, Scientific Committee of the Organisation of African Unity; Fellow of the Mathematical Association of Committee for the Pan-African Union for Science and Technology (which, when inaugurated, will be the supreme umbrella organisation for all scientific and technological associations in Africa); member of the Council of the Nigerian Mathematical Society, member of the Mathematics Advisory Committee of the International Centre for Theoretical Physics, Trieste, Italy; Honorary Citizen of Huntsville, Alabama, USA.

Professor Kuku was Vice-Chairman of the First Congress of African Scientists held in Brazzaville, Congo, June 1987; Chairman of the UNESCO Committee of African Consultant Scientists, Dakar, Senegal, January 1987; Vice-President, Science Association of Nigeria (SAN) 1983-84, Chairman, Mathematics Section, SAN, 1978-80, Business Manager, 1978-81; member of Council SAN 1976-84; member of the Editorial Advisory Board, *Nigerian Journal of Science* 1977-81; member of Council, Mathematical Association of Nigeria 1985-87.

Umberto Cordani
Continued from previous page

numerous programmes of IUGS. He would like to ensure that the projects already underway receive effective support rather than spreading the Union's limited resources on additional initiatives. Clearly, President Cordani is excited by the challenge of channeling through the work of the Union the enthusiasm of geoscientists around the world.

Courtesy: *Episodes*, June 1988

Bina Awarded Salam Prize

"Who is Bina?"

Many asked the question recently, some with raised eyebrows, after reading a small item in newspapers under the heading "Salam Prize for Bina." It was not the element of disquiet in the raised eyebrows, but a shade of wonder, Bina being not a man but a woman!

We know the young lady, a rather nodding acquaintance forged in many symposia on Chemistry. That Dr. Bina Shaheen Siddiqui had bagged the Salam Prize in Chemistry though tickled our imagination as well but in another context: feminists in Pakistan may now be walking with an added spring in their step.

At least science in Pakistan is no longer a man's domain only, as many may be carrying the misconception. The science laboratories at the University of Karachi and in various research institutions are full of the forms that carry the misnomer "weaker sex," and we might be hearing more about other Binas in the coming years.

What is so special about Bina that brought her the thousand dollar cheque and a certificate of honour from Prof. Abdus Salam? 52 research publications, mostly in foreign journals of high repute like *Tetrahedron, Metrocycles, Phytochemisty, Plant Medica, Z. Naturforsch.*

Dr. Bina works as Assistant Professor at the H.E.J. Institute of Chemistry, University of Karachi, but her image at the University is that of an assistant to Dr. Salimuzzaman Siddiqui, the renowned chemist. She designates herself differently though: "I was a student of Dr. Siddiqui and am still a student of Dr. Siddiqui," came her opening cherished remark as we sat down at the Institute with her after the announcement of the Prize to talk and know more about her.

Dr. Bina did her M.Sc., M.Phil. and Ph.D. (in 1980) from the University of Karachi. Dr. Siddiqui is a colossus but his shadow on persons around is like the invisible infra-red. In its warmth, they grow rapidly rather than being dwarfed. Bina is one.

Glancing through a brochure on H.E.J., we found the number of research publications carrying the name of Dr. Siddiqui as 171. Bina's name is bracketed with him in 33 (in those of 1980 onwards). Many more have been added to the list recently.

She seems to be enamoured with 'neem' *(Azdirachta Indica)* among plants and trees, if mounting researches in chemistry of natural products is any indicator. Eighteen of her research papers are on fresh fruits, leaves, twigs and stem-bark of the 'neem' tree.

From leaf, two compounds have been found to have insecticidal activity and are potent against housefly and mosquitoes. Most of the insecticides we use are toxic and are a health risk. The 'neem' insecticides are safe. These researches are thus significant. No environmental damage would accrue from them.

But other research work on 'neem' fruit have been found effective in the protection of certain crops. They can be used as pesticides in agriculture, thus getting rid of the toxic use presently.

Comparative studies on other fractions from most parts of 'neem' are being carried out in Germany, too. Some have shown antibacterial activity.

'Neem' grows wild and is also cultivated all over Pakistan, India and Burma, and every part of it — flowers, leaves, fruit bark, root-bark and gum — has been of great interest in folklore, in Unani and Ayurvedic systems.

Dr. Siddiqui had started his pioneering research work on 'neem', half a century back, in 1940, and isolated two crystalline compounds, nimbin and nimbinin.

One factor of 'neem', is nimbidin, which is anti-ulcer, anti-inflammatory, also carrying analgesic activity — two-and-a-half times greater than phenyle butazone.

It is now the second active phase in which Dr. Bina and some others are collaborating with Dr. Siddiqui on further separation and isolation of various active ingredients from 'neem.'

Another significant work of the Salam Prize winner is on the plant kaner ('jungali gulab'). The ingredients isolated are mostly cardiac things and terpenoids. Some factors have been sent to Sweden for evaluating their depressant activity (against central nervous system) and can be used as sedatives, the side toxic effects of which are nil.

Lately, single constituents have been isolated from kaner and are to be tested for biological activity and toxicity. They show good promise and have commercial potential.

Another significant area of research in which Dr. Bina is involved, is of a fundamental nature. It is the studies on structure versus activity relationship of different compounds with a view to discovering compounds which are biologically active (that is, of some medical use) but have least or no toxic effects. One example is extension of Von Braun cyanogen 'bromide reaction on alkaloids'.

An interesting research work in progress is on 'mehndi' *(Lowsoinia alba)* fruits (not leaves so widely used by ladies for painting their palms). One of the reported compounds shows anti-tumour activity. In folklore and Unani medicine, 'mehndi' is reported for its anti-bacterial activity.

Dr. Bina looked averse to taking credit for so many researches and putting them in her basket. "It is all

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M.S. Swaminathan

Described as "one of the world's greatest scientists" by Nobel Laureate Norman E. Borlaug, Dr. M.S. Swaminathan is widely recognized as the architect of the Green Revolution in India, which radically improved agricultural yield through the introduction of genetically superior grain varieties. This work alone transformed India from a "begging bowl" to a "breadbasket" almost overnight, nearly doubling the total crop yield from 12 million tons to 23 million tons in four crop seasons. Dr. Swaminathan thus deservedly won the first Annual General Foods World Food Prize worth $200,000 — the monetary equivalent of the Nobel Prize.

Awarded for the first time in 1987, the Prize rewards achievements in any field that impacts our food chain: the food and agricultural sciences, food processing and preservation, nutrition and genetics, transportation and distribution, agricultural and economic policy.

At the Prize award ceremony on 6 October 1987, Dr. Borlaug testified to Dr. Swaminathan's many and multifarious accomplishments thus: "His many and diverse contributions have alleviated hunger and misery, and have contributed greatly toward improving the well-being of millions of people in the Third World... I personally had the good fortune to see the important and diverse roles he played in research, extension, and agricultural policy, which ushered in the Green Revolution in India. During the 1980's, I have seen this tremendous positive impact spread to many other countries... We are confident the trail you have blazed toward increasing production, and improving the quality and availability of food for millions, will be an incentive to attract some of the most talented, creative and best motivated young women and men to careers in the food system. Our words to you tonight can hardly do justice to your many accomplishments ".

Major Force

For over a quarter of a century, Dr. Swaminathan has been a major force in shaping the Indian policies in agriculture on an ecologically and economically sustainable basis. As a geneticist, he worked for the development of strains of wheat, rice and coarse grains that would grow well in the ecological settings of India. As a public servant, he held the responsibilities of leadership of the Indian Council of Agricultural Research (ICAR), Departments of Agriculture and Rural Development of the Ministry of Agriculture and the Planning Commission, and the Science Advisory Committee to the Cabinet of the Indian Government. Since 1982, he has been serving as the Director General of the International Rice Research Institute in The Philippines.

Dr. Swaminathan's contributions have been varied, starting with basic research on the genetics of potato, wheat and rice, and extending to applied genetics and crop improvement, biotechnology, agricultural and science policies and programmes, growth with equity and human nutrition, and health care.

Under his stewardship as Director General of the International Rice Research Institute (IRRI) in Los Banos, the Philippines, 600 researchers from around the world work to increase yields of one of the world's most important food crops. IRRI released the first improved rice varieties in the mid-1960's; today farmers grow improved varieties on 55% of the Third World's ricelands. Their increased production feeds 650 million more people than earlier varieties would have been able to do.

At the world renowned agricultural research institute, Dr. Swaminathan has proved that he is not only a brilliant scientist, but a capable administrator as well. His infectious enthusiasm and love of humanity have inspired and motivated thousands of others to give wholeheartedly to the cause he has chosen for his life's work: humbly serving the rural poor.

Dr. Swaminathan has also effectively championed causes beyond the realm of science. For example, he has recognized the important role of women in agriculture in developing countries. "In the ultimate analysis", he wrote, "the goal of scientific research is to enhance human happiness. This is why IRRI accords importance to equity issues in technology generation and transfer. An important initiative in this field is greater attention to the problems of women farmers as well as women labourers in rice farming areas. Evidence suggests that when women have independent access to income, child nutrition is improved. The poorer the household, the greater is the need to increase total family income by enhancing the earning capacity of women." Dr. Swaminathan followed up his words, *Science* reports, by establishing the Asian Rice Farming Network, which has examined the effects on women of technological change in rice-based farming systems; designed, tested,

and adapted technologies to reduce drudgery and increase women's incomes by creating more opportunities for them to earn money; and identified gaps in input-delivery systems and government policies that hamper women's full participation in developing and adapting technology.

Life Sketch

Dr. Swaminathan was born on 7 August 1925 in Kumbakonam in Tamil Nadu, India. In 1944, he obtained his B.Sc. from Travancore University, and three years later, another B.Sc. of Agriculture went to him from Coimbatore Agricultural College, Madras University. In 1952, Dr. Swaminathan obtained his Ph.D. from the School of Agriculture, University of Cambridge, UK. He was a UNESCO Fellow in Genetics at the Agriculture University at Wageningen, The Netherlands during 1949-50 and a Research Associate in Genetics at the University of Wisconsin, USA during 1952-53.

From 1954 to 1972, Dr. Swaminathan worked as Teacher, Researcher and Research Administrator at the Central Rice Research Institute, Cuttack and at the Indian Agricultural Research Institute, New Delhi. From 1972 to 1979, he served as Director General, Indian Council of Agricultural Research and Education. From 1979 to 1980, he was Secretary to the Government of India, Ministry of Agriculture and Irrigation, and Acting Deputy Chairman of the Planning Commission, Government of India during April-June 1980. Since 1982, Dr. Swaminathan has been serving as the Director General of the International Rice Research Institute.

Dr. Swaminathan holds many honorary positions in international organizations. He has been conferred the honorary degree of D.Sc. from 22 universities including the Technical University of Berlin, West Berlin; University of Wisconsin (USA); etc. He has also been the tutorial professor for 50 graduate students for their studies on Ph.D. theses.

Dr. Swaminathan has been honoured by many world-renowned institutions and science academies. He is Fellow of the Indian National Science Academy; Fellow of the Royal Society of London (FRS); Foreign Associate of the National Academy of Sciences of the United States; Foreign Fellow, National Academy of Science of Italy; Foreign Member, All-Union Academy of Agricultural Sciences, USSR; and was President, XV International Congress of Genetics held at New Delhi during 1983.

More than 10 scientific awards have gone to Dr. Swaminathan for his remarkable achievements in scientific research, including the Mendel Memorial Award of the Czechoslovak Academy of Sciences (1965), Borlaug Award (1979), Albert Einstein World Science Award by the World Cultural Council (1986).

The Third World can be rightly proud of Dr. Swaminathan's achievements and acquisitions.

Catalyzing Science Development
Continued from page 2

wide scientific community who are about to travel in a certain part of the world, and scientific institutions who would be interested in hosting such travellers for a few days;

4. Encouraging and providing incentive for scientists in the Third World to communicate to the world-wide scientific community their specific problems of pursuing science in which the cooperation of of the world-wide scientific community could be very helpful. Such awareness-building can be done through articles in trade journals, through talks given at international conferences, through books, through discussion sessions on this subject arranged with scientific visitors to the Third World, and in many other ways.

There is no limit to what TWAS could do for science in the Third World — or at least the limit is certainly not a financial one. So on to a new role for TWAS, that of an imaginative catalyzer of science development!

• Michael J. Moravcsik

Computer System

A Computer System in Mali is addressing a major need of developing countries: "better coordination of aid projects so they can be made more efficient and effective," reports *The Christian Science Monitor.*

"In one area, there are five different organizations working in agriculture, five different approaches. It means that in one village, the people are paying for seeds while right next door they are getting seeds free. [...] There is no development, it's just a laboratory experiment."

To counteract this duplication, a data base system was coordinated by the New York-based Industry Council for Development (ICD), whose member corporation IBM donated the computer, software and technical assistance to Mali.

Though one of the strongest objections to the project was that computers are not appropriate technology, ICD's executive director states that "appropriate tech does not necessarily mean low-tech. It means finding the level of technology that is appropriate for solving the problem at hand."

ICD has set up a similar computer system in Niger and has plans to establish systems in Senegal and Burkina Faso.

World Development Forum, 15 June 1988

Suggestions and Comments are Welcome

Would you like to express your opinion in the TWAS Newsletter? Do you wish to make a suggestion? Do you have any comment? Please write to us and let us know!

International Cooperation in Photobiology

Under the title *Comité Internationale de la Lumière (CIL),* the first committee to coordinate international cooperation in photobiology was set up in Lausanne in 1928. The name was changed to *Comité Internationale de Photobiologie (CIP)* in 1951 at a subsequent meeting in Paris. In the early years, medical men figured prominently in the activities of the organization. The importance of natural sunlight in human health and disease was obvious, though ill understood, and CIP provided a forum for medical workers to interact with physicists, chemists and biologists from pure and applied branches.

In the the 1940's, studies in photobiology were stimulated by advances particularly in the fields of molecular biology, vision, photosynthesis and photoperiodic responses in animals and plants. Such studies were supported by important advances in our understanding of basic photochemistry and photophysics of energy transfer and excitation phenomena, so fundamental for our comprehension of biological processes stimulated by light. The "frontier" nature of photobiological studies and the necessity for a multidisciplinary approach for them, was emphasized when the aims of the CIP were reformulated in 1964 as "the stimulation of scientific research concerning (a) the physics, chemistry and climatology of non-ionizing radiations (visible, ultraviolet and infrared) in relation to their biological effects, and (b) the effects of the application of these radiations in biology and medicine". As the message spread and more and more countries promoted their national efforts by the formation of national photobiology societies affiliated to the international body, the CIP's name was changed once again in 1976 to the *Association Internationale de Photobiologie (AIP).* The Association (then as CIP) was recognized as the Commission on Photobiology in the division of General Biology of the IUBS in 1955. To promote excellence in photobiology and phototherapy, AIP awards medals and citations through "Niels Finsen Foundation of AIP" in memory of the celebrated pioneer in this field. The awards are made every four years during the Congress sessions.

Photobiology is a frontier science in which tools and techniques of almost every other science, pure and applied, are necessary. The relationship between photophysics, photochemistry and photobiology cannot be over-emphasized. Great advances have been made in the understanding of the complex biological processes by pushing the frontiers of various scientific disciplines so as to meet at a common point. A common forum for the exchange of ideas is essential because there are differences in the language used by a physical scientist and biologist. A photochemist or a photophysicist dealing at the molecular level is concerned with time periods of pico-seconds to few seconds available to the photoexcited molecules. But a photobiologist, looking at the phenomena at the cellular level, speaks in terms of biological times, minutes or hours or days. For vision, the effect is instantaneous.

Biological phenomena are very complex. Highly ordered arrangement of functionalities brings about efficient responses under mild conditions required in living systems. Therefore, to get an insight into biological phenomena, complex systems must be broken up, bit by bit, into simpler systems at the molecular level in order to reconstruct the total system. The reconstruction part is not so easy, although knowledge so gained can be applied for biomimetic systems. Photochemical conversion and storage of solar energy is a very active field of research whose results are expected to produce possible solutions to energy problems. Still, it has not been possible to reproduce the entire photosynthetic route for storage of solar energy as nature does in plant photosynthesis.

Two very important aspects of photobiology which are developing in a parallel fashion are plant photosynthesis and photomedicine. Both have various ramifications and applications, the former in agricultural practices and energy resources, and the latter in alleviation of human sufferings. The AIP organizes Congresses every four years to take stock of the latest researches and to initiate and encourage discussions in the form of round tables and symposia. Until now the practice was to hold these Congresses alternately in USA and Europe. The 1984 Congress was held in Philadelphia and the 10th Congress will be held this year in Israel.

These Congresses usually discuss the state of knowledge in various aspects of photobiology. Usually the sessions are divided into sub-sessions, such as (i) Photophysics and Photochemistry, (ii) Photosynthesis, (iii) Photomedicine, (iv) Chronobiology and Bioluminescence, (v) Photomovement, (vi) DNA damage and repair, (vii) Solar Energy Conversion, and (viii) Environmental Photobiology and Exobiology. Special lectures are arranged such as "Towards molecular understanding of sunlight-induced skin cancer in mouse and man", "Lasers in surgery and medicine", "Primary electron transfer in photosynthetic bacteria", "The visual world of birds and insects: Retinal bases for animal colour vision", and so on. Latest techniques and experimental methodologies are presented in "School" lectures, or lectures by specialists.

In between these Congresses, workshops or small conferences are organized on topical subjects in order to encourage international cooperation. Two important workshops held recently showed great concern for the ozone balance. It is well known that ozone acts as a shield protecting life on this earth. Any depletion of this shield by man-made pollutants will cause increased flux of ultraviolet radiation lying between wavelengths 280 and 315 nm designated as UV-B, with consequent biological effects. This region generates strong photochemical activity in biological molecules such as proteins and nucleic acids and this is the region where ozone has strong absorption. Even a 1% depletion of ozone will cause a 3% increase in transmission of UV-B. The countries near the equator are more likely to be affected.

An international workshop on "Solar radiation damage and the induction of skin cancer" was organized by the Swiss Institute of Experimental Cancer Research under the auspices of AIP. The workshop was held in Lausanne in September 1978 to commemorate the 50 years of the first meeting of AIP (then under the name of CIL), which took place in the same city in 1928. The aim of the Workshop was to evaluate available knowledge in the field by establishing a correlation between increased influx of UV radiation, if any, consequent to stratospheric ozone depletion and data collected from on-going clinical and epidemeological studies under UV-B radiation. Other topics of discussion included sunlight induced melanoma and non-melanoma skin cancer, susceptibility of geographical location and skin type to cancer, solar radiation damage of skin and molecular changes, methods of evaluating and predicting sunlight induced damage, solar dosimetry, etc. The Workshop was attended by 99 pre-registered scientists from 16 countries.

The second workshop entitled "Effects of ultraviolet radiation on plants" was organized for 3 days in 1982 in India in collaboration with the Indian Photobiology Society. Not much is known about how increased influx of UV-B will affect plant ecosystem in general and crop production in particular. It is a global problem and can be studied in depth under international collaborative programmes. The scope and perspective of the Workshop could be judged from the titles of the sessions: (i) Special irradiance in nature, fluctuations in factors affecting atmospheric ozone; (ii) Effects of UV-B at the organelle and molecular level; (iii) UV protection mechanisms and non-destructive effects of UV; (iv) UV-B effects on whole plants and ecosystems including the marine ecosystem; (v) Methodology, action spectra and molecular targets; (vi) Methodology: standardization of methodology for conducting researches on UV-effects, Spectro-radiometry and dosimetry, radiation sources, detection and evaluation of UV-B damage. There were round table discussions on: (1) Relative merits of various destructive, protective and repair mechanisms; (2) Status of UV-B researches in India; (3) Planning for future.

Priorities for future researches in this area were identified as follows: (i) Increased attention to establish the mechanisms of UV-B response in plants; (ii) Detailed studies in the laboratory and under field conditions, of the phenomena of photoprotection and acclimatization; (iii) Practical field screening of plants and food crops vis-a-vis their sensitivity to UV-B radiation; (iv) Exploring the feasibility of breeding new crops for UV resistance as pilot projects.

Participants included atmospheric physicists, photophysicists, photochemists, plant physiologists, marine ecologists, illumination experts and environmentalists. This Workshop established that present day problems could not be localized and also did not encompass the expertise of a single discipline. International cooperation and a multidisciplinary approach alone could produce the desired result.

The aspects of photobiology comprising photomedicine can contribute to many national health problems of developing countries such as skin diseases (e.g. vitiligo, melanoma, fungal ailments), eye cataract, industrial toxicology problems aggravated by light and so on. The therapeutic use of germicidal lamps in medical practices and the effect of UV on viruses and bacteriophages enlarge the field covered by light. Photomedicine includes photochemotherapy of hyperbilirubinemia and neonatal jaundice, photodynamic action of dyes in treatment of herpes simplex lesion, photochemotherapy of psoriasis using psoralen, porphyrin phototherapy of cancer and so on. In recent times, as a result of concerted efforts of scientists from many countries, considerable advances have been made in phototherapy of cancer using porphins. Use of laser lights for retinopathy and other forms of microsurgery has added new dimensions to photobiology.

Advantages of frequent get-togethers and discussions on ongoing results have prompted all the national photobiology societies of Europe to form the European Society for Photobiology (ESP). It came into existence in 1986, and generated great enthusiasm, particularly amongst younger scientists who could participate in the annual meetings more frequently without financial constraints. They have also acquired a journal, called the *Journal of Photochemistry and Photobiology.*

The American Photobiology Society is a very active society with a large membership and holds meetings annually. It publishes an international journal, *Photochemistry and Photobiology,* of a very high standard.

The Indian Photobiology Society is

the only society of its kind in the East and will complete its first five years in 1989. Japan Association for Photobiology is an association of a number of societies with similar interests. Japan is the likely venue for the next AIP Congress in 1992.

Brazil is represented by individual members. Participation of the African subcontinent and other developing countries of Asia, including China, and those of South America, will provide an impetus to the study of photobiology.

Already, the ICSU Committee for Global Change Programme has working groups on subjects which overlap with those of AIP. For example, Biosphere Interaction with Atmospheric Chemistry, Effects of Climate on Ecosystem Changes, Understanding the Role of Marine Ecosystem are topics for AIP to collaborate in.

Similarly, the programmes of the new Biotechnology Committee (COBIOTECH) which involves "improving the productivity of photosynthesis processes" is also an area of concern for the AIP. Representations of AIP on these committees will facilitate greater coordination of various activities of ICSU.

Light, matter and life are three pillars of photobiology. Considering the importance and geographical location of Third World countries, the activities and inputs from their participation will be mutually beneficial to the overall development of the subject and the knowledge so gained could be used for the greater well-being of the people.

AIP can help (i) to identify relevant areas of research necessary for meaningful and workable programmes of development in collaboration with the local expertise, and (ii) to organise training schools and workshops on topics of specific interest to the region, which would help to initiate sustainable programmes.

• K.K. Rohatgi-Mukherjee

Proposal of an International Centre for Resource Management in Greece

Energy and physical resources are necessary for development. These resources are not scarce. What is scarce is technology. Technology is not only machines, it is also knowledge to run these machines. Most of the developing countries waste whatever resources they do have because of a serious lack of scientists, technologists and modern management expertise.

The main cause for underdevelopment in these countries is their weak linkage to modern science and technology. The scientists in the developing countries are isolated. Science cannot survive, let alone flourish, in isolation. The International Centre for Theoretical Physics (ICTP) in Trieste, Italy, was established to end scientific isolation and to put a stop to brain drain.

The ICTP had its origin with one of the world's greatest theoretical physicists, the Nobel Laureate Professor Abdus Salam of Pakistan. He evolved the concept of an international centre of the highest standard where brilliant physicists of all countries could come as a matter of right. The Centre was established in 1964 under the auspices of the International Atomic Energy Agency. The schools, conferences, workshops, seminars and research activities organized by the Centre were earlier concentrated in the field of High Energy, Nuclear and Plasma Physics. The Centre has since diversified its activities to reflect the special interest of UNESCO as its co-sponsor.

ICTP in Trieste made its debut in 1964 with a budget of US$355,000. The building was donated by the Italians. Now its budget is about 13 million US dollars (80% from Italy). About 4,000 scientists visit the Centre every year. Since its establishment nearly 30,000 scientists have visited the Centre, about two-thirds of them from developing countries.

The proposed International Centre for Resource Management (ICRM) in Greece should be modeled on ICTP. The UN organizations are financially hard pressed. The ICRM should be built and run with the financial support of the Development Initiative of the European Communities.

The proposed centre will concentrate on Energy Policy, Communication, Hydrology and Water Resource Management, Soil Science, Climatology, Meteorology, Oceanography and Desertification, the main goal of the Centre being resource management. The scientific council of the ICRM should include leading scientists from all these disciplines.

Greece has a great advantage as a location for the Centre. It is a European country but one very close to Asia and Africa. Besides, Greece has a good relationship with developing countries. There are a number of expatriate scientists who could be immensely beneficial for ICRM programmes in organizing workshops, seminars and supervising research projects.

Trieste is now identified with physics in Italy because of ICTP. The new International Centre for Genetic Engineering and Biotechnology (modeled on ICTP) under the aegis of UNIDO went to Trieste and New Delhi. A new synchrotron facility which will be accessible to scientists from developing countries will be commissioned in 1992. The project will be headed by another Physics Nobel Laureate, Professor Carlo Rubbia, the future Director-General of the European Centre for Nuclear Research (CERN).

Continued on next page

Women in Science

The threat of a serious shortage of scientific personnel looms in the years ahead. Many predictions are, of course, notoriously unreliable. If a shortage is a realistic scenario, however, it is important to find ways to employ underrepresented groups more equitably — for reasons of national interest as well as of equality.

Women are one conspicuously underrepresented group in the higher echelons of academia and industry. Records of their transit through the system may help provide clues to appropriate remedial actions. Some trends in the data are promising. For example, in the 1930s women received 7% of the Ph.D. degrees in mathematics and the physical sciences, 15% of those in the life sciences, and 16% in the social sciences. But by the early 1980s those percentages had all doubled. Recently, however, the figures appear to have leveled off.

Tracing the progress of women through the system shows that the percentages roughly parallel those of men for total percentages in science through high school, college, and entrance into graduate school. The serious differential in participation occurs at the postdoctoral level. For example, 93,000 men and 94,000 women undergraduates were majoring in the biological sciences in 1984; the respective graduate enrollments were 22,000 and 17,000. At the next level, however, women are poorly represented on faculties and on average receive lower salaries than do men in comparable positions. One survey showed that although women had 10% of the doctoral degrees in chemistry, they had only 4% of the faculty jobs. At no stage in the educational process is there an indication that the attrition is caused by lack of academic performance.

Attempts to understand the attrition have so far been unsuccessful, but some theories seem better than others. In the past, certainly, prejudice from the "old boys" was widespread, and it has only been partly eradicated. Moreover, the perception of this historical prejudice can be a subtle deterrent in today's more enlightened, but imperfect, world. The lack of role models can be a source of insecurity, a point made eloquently by Sheila Widnall in her AAAS presidential address. That situation may change as more women take important roles in our society, and particularly in science. But the insecurity may be a decisive factor during the period between graduate school and tenure, an interval of intense competitive pressure. Those who have pedagogical or administrative roles need to be sensitive to the stress of the pressured student or the untenured assistant professor. The support of a steady friend with encouragement to stay the course and an occasional congratulations for work well done can be crucial in developing the self-confidence that is essential for a research investigator.

Words are important, but actions are more so. Important contributions would be programmes to make it easier for women during childbearing years to continue their professional involvements. Several universities have introduced "stop the clock" programmes that allow women who are raising children to have tenure decisions postponed. Other programmes, such as half-time appointments, "extend the clock" on grants, or on-site and subsidized day care are particularly appropriate. Women not only bear the children, they are the prime organizers of their upbringing, and in these years they need a special form of encouragement. Since equality of responsibility is not yet here, not only are the demands on women faculty members greater, but they are more subject to criticism. A man who does less teaching because he serves on editorial boards is excused as normal, whereas a woman who asks to do less teaching to help raise a child is viewed as a burden. Today there is less prejudice at the time of promotion, but obstacles confronted before tenure decisions are sufficient to discourage a significant portion of talented women scientists.

Although the problems for ethnic groups are not the same as those that women face, they have some of the same characteristics. There are relatively few role models, and the need for encouragement of pioneers in potentially hostile territory is real.

As the country expands into an ever-increasing technological base, the need for women and minorities in both academia and industry increases proportionally. It may cost some money, some effort, and some understanding, but the voyage to full equality can be even more exciting and worthwhile than the voyage into space.

• Daniel E. Koshland, Jr. (Courtesy: *Science,* 25 March 1988)

International Centre for Resource Management — Continued from previous page

An international centre in Greece could act as a catalyst for Greek science as well. The ICRM could be ideally located in Crete where a university system already exists. The Centre could serve as an important link between North and South, East and West, for the promotion of science.

• Saiful Islam

Foreign Engineers: Assets or Liabilities?

In the struggle to maintain a favourable economic position in an increasingly competitive world, the nation looks to its engineers to unlock the secrets of technology. Engineers are expected to design better-quality goods using advanced materials and less costly manufacturing processes. It is generally believed that the nation's engineering prowess, properly applied, will allow US-made products to compete successfully in markets around the world.

With such high stakes presumably riding on engineering, it is not surprising that attention also has focused on the size and calibre of the current pool of engineers, as well as on the quality of engineering education.

One of the most obvious characteristics of the US engineeering community is the number of foreign-born engineers, both in industry and in academe. In 1982, naturalized citizens constituted about 14 percent of the engineering work force — up from 5 percent a decade earlier. In schools of engineering, foreign-born engineers make up about 60 percent of the number of doctoral students and more than two-thirds of the postdoctoral appointees. In the years 1983-1985, slightly more than half the cadre of assistant professors under the age of 35 was foreign-born. About 60 percent of those earning Ph.D.s in American universities remain in this country to work, and their skills are making important contributions to industry and education.

While recognizing the urgent need at this time for these highly trained professionals, concerns have been raised that the size of the foreign-born contingent over the long term may be detrimental to the nation's pool of engineers and to the careers of American-born engineers.

In a recent review of the situation, a Research Council committee concurred that the presence of foreign-born engineers is creating "real opportunities," but also "possibly problems."

"The influx of foreign engineers has been greatly beneficial to industry and to the universities," said committee chairman Stanford S. Penner of the department of applied mechanics and engineering sciences at the University of California at San Diego. *"There simply are not enough American-born engineers. Furthermore, American universities could not currently function without foreign-born staff at the levels the committee considered to be necessary and appropriate."*

The study was requested by the National Academy of Engineering (NAE) as part of its efforts to understand trends and identify potential problems in the nation's technological base.

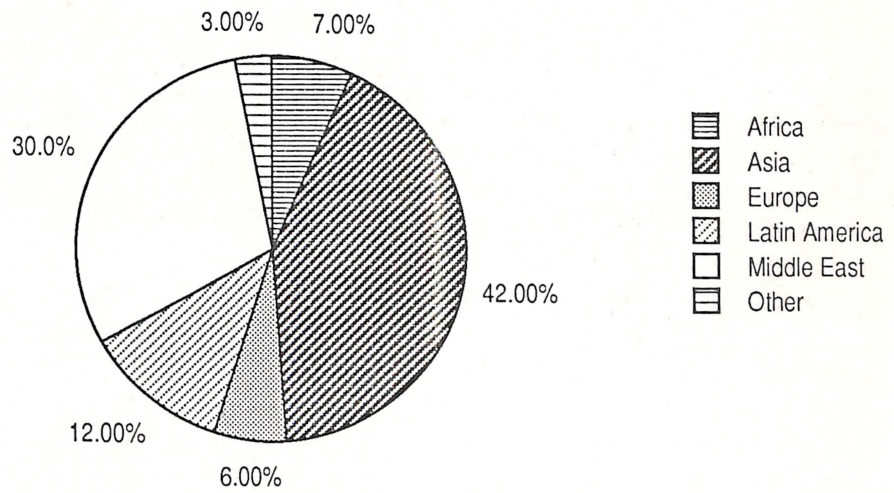
Language and Culture

One frequently heard complaint from undergraduate students — more than 90 percent of them are American-born — is that some foreign teaching assistants do not speak English fluently enough to serve as effective instructors. With decreasing numbers of American engineers in graduate programmes, university engineering departments have been forced to rely on foreign students as teaching assistants during their graduate studies.

Communication problems can be overcome by careful monitoring of language proficiency and teaching effectiveness of teaching assistants, the committee advised. It suggested that the monitoring be done at a higher university level, not by the engineering departments responsible for instruction.

Penner agreed that difficulty in understanding an instructor is a seri-

Foreign Engineering Students, by Area of Origin, 1983-84



Source: Institute for International Education, Profiles, 1983/84, *New York: The Institute, 1985*

ous problem. The university has a "clear and obvious obligation to see that the faculty can speak English clearly," he said. At the same time, he pointed out that language is not the only criterion of a good teacher. "I've known foreign instructors with strong accents who were able to communicate ideas and instruct English-speaking students very effectively, and I've known English-speaking professors who had difficulty getting their ideas across. Language proficiency is an important component of teaching effectiveness, but an intelligible accent does not represent an insurmountable handicap."

More than half the foreign-born engineering students come from regions of the world that are culturally quite different from the United States, namely, the Far East (31 percent), India (6 percent) and the Middle East (20 percent). This has prompted reports on some campuses that teaching assistants from other cultures may discourage women and minorities from considering engineering as a career option.

The committee said it was unable to verify this claim because it received anecdotal evidence both supporting and refuting it. Efforts should be made, the committee recommended, to develop a firmer factual basis to determine the validity of such reports.

The committee said it could find no evidence that foreign-born engineers had limited the access of qualified US-born students to graduate schools, had reduced job opportunities for American-born engineers, or had depressed their salaries. On the contrary, some US universities favour American-born applicants through admission ceilings for foreign students.

Defense Needs

Although foreign engineers are filling important jobs in industries and universities, many of them are not acceptable for defense-related work because of the difficulty individuals with close relatives in foreign countries encounter in acquiring security clearances. This reduces the talent pool, especially among Ph.D. engineers, available for these purposes. The presence of engineers without security clearances on research staffs has also been reported to hinder cooperative efforts among university, industry, and national laboratories, the committee pointed out.

"There are real issues and perceived issues in the widespread use of foreign engineers," Penner noted. "The concern about adequate engineering skills for defense is clearly a real issue. Very few of the 60 percent of the foreign Ph.D.s who stay here are immediately employable for defense work, and many may not be able to participate for many years, if ever, in defense work requiring special-access clearances."

The committee recommended that the Department of Defense continue to examine ways in which it can effectively use the engineering skills available in the immigrant engineering community.

Industry and universities have welcomed foreign engineers to fill needs that cannot be met by the supply of American engineers. In some cases, foreign engineers came to the United States with some training in special fields that were not popular with Americans — optical sciences, for example. With recent advaces in non-linear optics and laser technology, these fields have become economically important, and specialists in optical sciences are in demand.

US firms depend heavily on foreign engineers in their R&D divisions, the committee reported. Almost one out of three doctorate engineers employed in industry is foreign-born, and that number is increasing. The committee cited a survey in which 20 research directors for high-technology firms confirmed that foreign engineers are essential to their company's operations.

"It is clear," the committee noted, "that these foreign-born engineers enrich our culture and make substantial contributions to the US economic well-being and competitiveness." Without them, the committee said, "universities and industries would experience difficulty in staffing current education, research, development, and technological programmes."

An added benefit to society, the committee pointed out, is that most of the education of foreign-born Ph.D. engineers has been borne by their country of origin. This makes it considerably cheaper for the American taxpayer than is the education of American engineers throughout their entire education.

"It's a terrific economic bargain for us," Penner agreed.

Disinterested Americans

One reason foreign students dominate graduate engineering programmes is that US firms pay relatively high salaries to new engineers with B.S. degrees. Stipends for graduate engineering students, on the other hand, often are inadequate for minimal living expenses.

Most foreign-born students, on the other hand, receive their baccalaureate training in their own countries and come to the United States specifically for graduate education. While the number of foreign-born graduate engineering students has risen steadily in recent years, the number of American-born Ph.D. candidates fell sharply. Even though enrollments of native American engineers have increased in the past few years, only about 45 percent of Ph.D. candidates in engineering are currently US citizens, including 4% who are naturalized citizens.

The committee concluded that the responsibility for the decline in American-born graduate engineering students lies with "faulty policies and serious deficiencies in the US educational and value systems." Among

federal policies is a reduction in the number of graduate fellowships available only to US citizens. As these have been replaced with research and teaching assistantships open to all, large numbers of foreign students have been successful in the competition for awards, the committee concluded.

To encourage American engineers to enter doctoral programmes, the committee recommended that fellowships paying adequate stipends, though not necessarily comparable to starting wages in industry, be established for US citizens.

"We need to pay them a living wage," Penner explained. "They cannot live on the current stipends, especially if they are married and have a family or attend school in a high-cost area."

This is a short-term solution. To assure an adequate pool of citizen engineers in the long term, the committee called for general upgrading of science and mathematics education throughout the curriculum. This should have the effect of guiding more students — including more women and minorities — into engineering as a career with a larger portion of them remaining to complete a doctorate. An increase in the number of women and minorities in engineering will become even more important in the future as the size of the US-born student population decreases.

Engineering Emphasis

American engineering ability has made the United States the world's technological leader. Much of this success has been attributed to the "hands-on" approach to engineeering problems. However, engineering schools abroad tend to emphasize engineering science and theoretical studies rather than the practical solution to problems.

Foreign engineers coming from this type of background may eventu-

Continued on next page

Should Scientists Budget Science?

National Academy of Sciences president Frank Press took an unusually bold plunge into dangerous waters last month by calling for a new approach to funding science. Instead of forcing Congress to choose from among a bewildering array of costly projects, Press told NAS members, scientists themselves should decide what's best.

Press even offered his own list of priorities, well aware that he was shattering an unwritten rule for science leaders: thou shalt not favour one discipline over another. But the current plight of science in this country, he said, convinced him that he had to act quickly and decisively.

"I thought something had to be said, not just to stop the yelling but to be concrete," Press said.

But the yelling had only just begun: "It means exactly nothing," replied one Senate staffer when asked for his reaction. "I hope we can forget his words and move on." Observed one veteran House staffer, " He's taken a very narrow view of science, one that's in keeping with the academy's attitude but not necessarily the public's."

Press believes that last autumn's stock market crash and the intractable federal deficit have made science funding a zero-sum game. Scientists must lobby for the most important projects, he argues, to ensure that Congress uses scientific rather than political criteria to make the best of those limited dollars. But many important figures, while applauding Press's willingness to speak out, have refused to endorse his approach. What's more their opposition could undermine the academy's cherished view of itself as guardian of the scientific enterprise.

"Nobody asks farmers whether they want price supports for wheat rather than for cotton," says Alvin Trivelpiece, executive director of the American Association for the Advancement of Science. "Why should scientists be treated any differently and be required to choose among several worthy projects? I think the issue for scientists should be the quality of the research."

Trivelpiece, a former Department of Energy official, is one of the original supporters of the proposed superconducting supercollider, which comes out among the also-rans in Press's ranking. The SSC falls in a category of "big-science" projects that Press says may need to be delayed until adequate funds are available. The space station and efforts to make the US economy more competitive join a cluster of projects constituting an even lower priority category that Press labels "political value judgements."

Healthy Enterprise

"The items he puts in categories one and two depend in large part in what's in category three, in particular the need for enhancing US competitiveness," says Harvard's Lewis Branscomb, a former chief scientist at IBM.

"I didn't hear the speech; instead I was busy lecturing to my students [at the Kennedy School of Government] on how we must rebuild our industrial capability to preserve a healthy scientific enterprise."

H. Guyford Stever, former NSF director and outgoing foreign secretary of the National Academy of Engineering, offers up the same criticism. "I'd put competitiveness at the top, and I'd put the need to upgrade our infrastructure — facilities and equipment — in the same category as our human capital. It's the only way to recover our strength in advanced technology."

One member of the House Science, Space and Technology Committee notes that Press's emphasis on "small science" and training goes well with the academy's traditional role as spokesman for the individual, academic investigator. At the same time, the staffer criticized Press's lack of concern for the institutional support needed to perform small science and the contributions that international partners could make in reducing the cost of various "big science" projects.

Criticism of Press's approach is not confined to the physical sciences. A leading spokesman for biomedical community is worried that the concept of setting priorities would in effect put a self-imposed limit on federal spending for research.

"It's a question of strategy," explains John C. Sherman, executive vice president of the American Association of Medical Colleges. Why should we assume that there's a fixed pot of dollars? I prefer the idea that support for science is not fixed, at least not until we get to a level that represents a reasonable proportion of our GNP."

In his April 26 speech to the 125th annual meeting of the academy, Press said he hoped his criteria, in addition to being "the least divisive", were "politically realistic and responsive to congressional requests for advice." In fact, the Senate Budget Committee has asked the NAS to suggest how Congress can best analyze what has grown into a $62 billion programme of R&D spending carried out by more than a dozen federal agencies. But conducting a study isn't the same thing as winning support for a particular view of how to slice the federal research pie.

Many Capitol Hill observers feel that Press, in his speech, exceeded the academy's mandate to provide technical advice.

"It may be good rhetoric," says one Senate staffer who follows space issues, "but it's worthless advice. All of these items are political, including ensuring an adequate supply of scientists." Adds a staff member of the Senate Budget Committee, "The chairman [Sen. Lawton Chiles (D-Fla.)] isn't very happy about Dr. Press's ranking of the space station. I think you have to assume that politics will rub up against this."

Robert Rosenzweig, president of the Association of American Universities, believes that Press's call for a permanent mechanism to set priorities in science is even more important than which programmes get funded this year. But he warns that scientists and Congress can't be the only participants in such a system.

"None of this will amount to anything unless the [next] president is active in the process," he says. "The academy's advice will be helpful, but it can't compensate for the lack of a strong executive presence in the setting of priorities for science."

Leadership Role

Despite the disagreements, most observers praised Press for tackling the issue. "I'm amazed by his boldness, and his willingness to take a leadership role," says Robert Park of the American Physical Society. "Even if we don't all agree, at least now we have something to argue about."

Not Trivelpiece, though. He warns that such a debate is likely to generate more heat than light: "I don't think that scientists are congenitally suited to make such choices." A better approach, he says, is for scientists to rally behind the administration's proposed $3.5 billion increase in the 1989 budget for various science, space and energy programmes. "If Congress wants to say that housing or veterans' medical benefits are more important, they can do it," he says. "But scientists shouldn't be put in that position."

• Jeffrey Mervis (Courtesy: *The Scientist,* 30 May 1988)

Bina Awarded Salam Prize
Continued from page 15

team work," she insisted. That is a truism, no doubt in modern scientific research where most of the results are out of group work and not an individual effort. Nevertheless, the individual counts. Many researches to the credit of an individual scientist, when seen in an integrated shape, turn as hallmark of the talent in the scientist, a measure of the researcher.

What does she do in her leisure hours, after working in the laboratory for long hours?

Household work and gardening are on the top of the list. But she also sits before the mini-screen for about two hours to watch TV drama and news. Literature also interests her and she often reads up to midnight and beyond.

A surprising aspect of her career is that she has not been abroad and all her acumen in research is indigenous. Why?

She was a bit amused at the question-mark in our mind. "I had opportunities but didn't avail them because I was diffident to travel and living alone in foreign lands. But now I propose to shun the shyness and might go abroad," came the answer.

She agreed with us that such an exposure would provide an impetus to her research effort and a wider horizon.

• Azim Kidwai (Courtesy: *Dawn*)

Foreign Engineers
Continued from previous page

ally change the character of US engineering education. The committee suggested further studies to determine how changes of this type are likely to affect long-term changes in the training of engineers, new directions in engineering curricula, and US competitiveness in international markets.

• Pepper Leeper (Courtesy: *NRC News Report,* February 1988)

Rising Indirect Costs Threaten Research

From Yale to Stanford, Universities are troubled

Indirect costs aren't glamorous. They won't solve the mystery of dinosaur extinction or find the charm in quarks. But whisper those two simple words in the ear of virtually any president or provost of a major research university, and you may see a strong person blanch. The reason: Indirect costs are rising, contributing to an existing shortfall of cash that threatens the very foundations of research.

No one at a university — especially not scientists toiling in their labs — can escape these costs, which cover everything from maintenance and operations to depreciation and administration. The issue of who pays has torn apart researchers and their university administrators. It has led to strife among faculties, pitting scientists who cover their share against those who do not. It may skew the actual types of science that are done and put some universities at a competitive disadvantage in the battle for grants. The morass of indirect costs, Stanford president Donald Kennedy sighs, has taken more of his time than any other federal issue.

"Indirect costs are like taxes," says Rick Biedenweg, vice president for information resources at Stanford, who has just completed a two-year study on the subject. "Nobody wants to pay them."

But when the bills are not fully paid, dire things happen. Testifying in Senate hearings last month, for example, Yale president Benno Schmidt described three cases in which deteriorating equipment or leaky roofs destroyed important experiments or forced costly delays in research. Finding the money to cover maintenance and operaton of research facilities, said Schmidt, "is a matter of tremendous concern not only to me but broadly among the presidents of institutions like Yale."

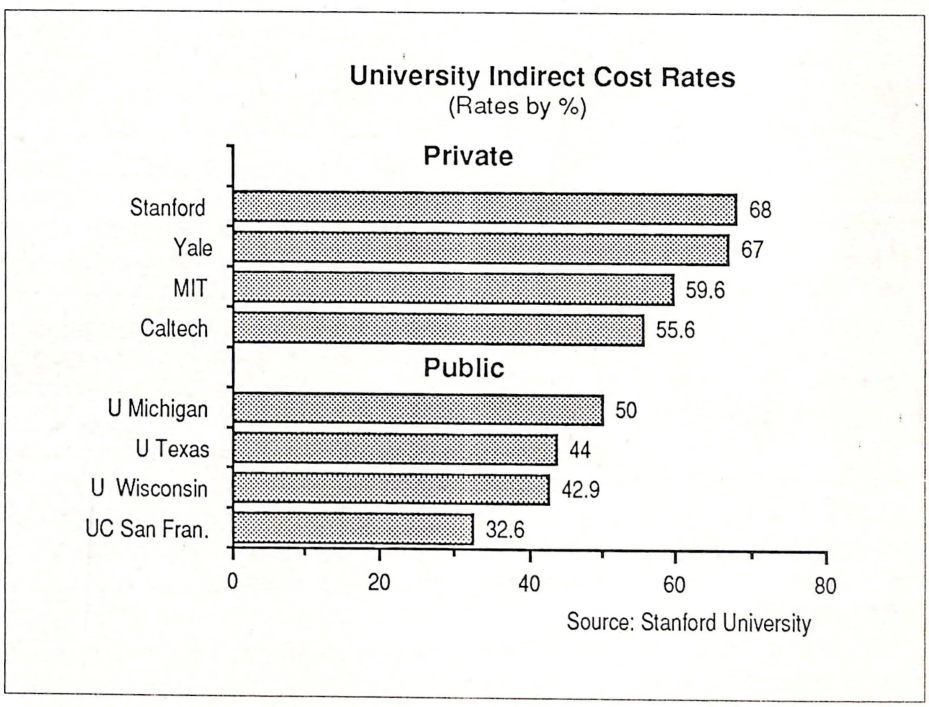
The problem of meeting these indirect costs is quietly growing. Historically, the federal government subsidized construction of many college buildings in the 1950s and early 1960s. But between 1965 and 1984, federal funding for building laboratories, faculty offices, and other research and development facilities at colleges and universities dropped from more than $350 million to approximately $50 million per year. As this support declined, the burden shifted to universities, which naturally tried to make up the shortfall by charging everyone from federal agencies to foundations for depreciation on research facilities as part of the individual research grants.

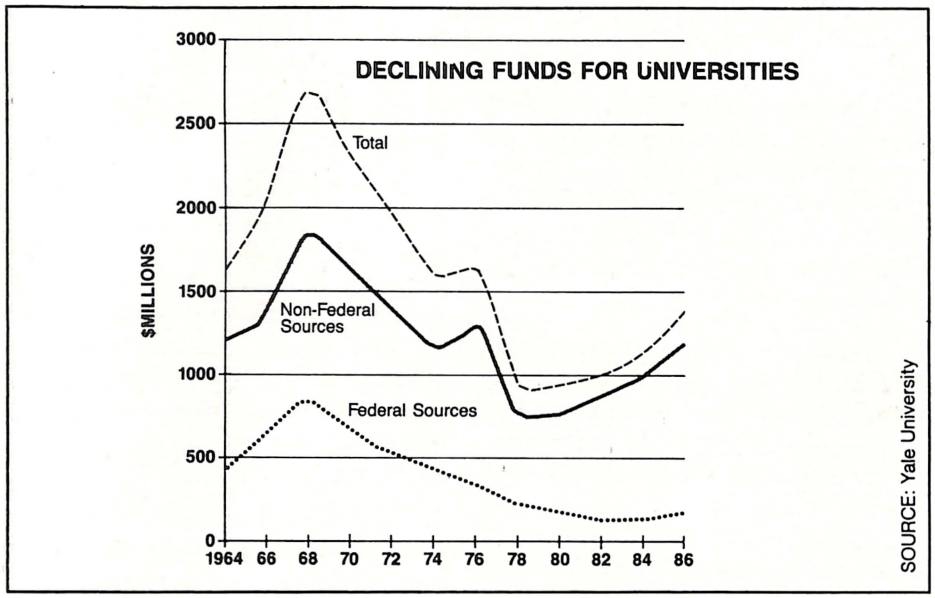
The amounts of money are not trivial. Depending on the university, indirect costs range from $32,000 to $99,000 for every $100,000 requested in direct funds for research.

Nevertheless, getting funding agencies to ante up has been partly successful. At Stanford, for example, "indirect cost recovery" contributes no less than 35% of the unrestricted general funds in the university's annual operating budget of more than $320 million.

But universities say that this still falls short of their expenses. "Insufficient recovery of indirect costs means that someone else, not the funding agency, is subsidizing the conduct of research," says Robert Rosenzweig, president of the Association of American Universities.

Federal agencies simply don't have the kind of money it takes. "Over the course of time, the NSF and other





agencies have not received the kind of budgetary increases they needed to keep up with the quality of research or the cost of doing research," points out Stanford chemistry professor John Brauman, a member of a faculty task force studying Biedenweg's report.

Yet miserly federal budgets aren't entirely to blame; in many cases, universities intentionally don't ask for everything they need. Stiff competition for federal funds provides a strong incentive to underestimate actual overhead when applying for grants. The pressure to under-report is especially strong at private universities. They must compete for grants with state universities, which typically charge lower rates for indirect costs (see chart) because of government subsidies.

Furthermore, says Vanderbilt University provost Charles Kiesler, the system really hits universities as opposed to private research, which enjoys full indirect cost reimbursement. The inequity is especially unjustified, says MIT provost John Deutch, since universities usually conduct research far more economically than national laboratories or industry.

To make the whole situation worse, indirect research costs are rising. According to the Stanford study conducted by Biedenweg, the indirect cost rate (indirect expenses measured against such direct costs as salaries) has jumped 10 to 15 points at most major research universities over the last 10 years — representing as much as $10 million to $15 million in additional costs. At Stanford, the climb has been even more dramatic, 27 points — a 58% increase — since 1973. Another 13-point climb is expected over the next five years because of the construction of a new $250 million, 41-acre facility for science and engineering research. Stanford faculty fear that this may put them right out of the ball park when it comes to competing for research dollars with colleagues from universities with lower rates.

For most universities the biggest chunk of the increase comes from expenses associated with laboratories and other facilities. According to Biedenweg's study, for example, Stanford experienced a total real growth of 68% in operating, maintenance, and depreciation costs between 1978 and 1985. Rising energy costs and an aggressive building and renovation programme (which dramatically increased depreciation) were the main culprits.

The bottom line, of course, is that the same amount of money buys less actual research than it ever did before. And the result at Stanford, and at many research universities caught in the bind, is a push-pull struggle between administration and faculty. His administration's relentless desire for growth is a mistake, argues Stanford physicist Sebastian Doniach, because it just drives up indirect costs. "The university is shooting itself in the foot by not recognizing the facts," he says.

If the trend continues, adds another researcher, who requested anonymity, "we're going to have this marvelous place and everybody's going to be discouraged and drawn away." For faculty, he explains, the rising indirect cost rate creates "a zero-sum game." Grant awards for his research have remained constant, he says, so that less and less money goes to actual work. "And that means you have to go out and get more awards, and we're decreasingly successful the more of those we have to get," he says.

Such conflicts between faculty and administration are inevitable. "The institutions quite rightly are trying to recover costs of research and the faculty members quite rightly are trying to do research," says Brauman.

The issue of who pays has divided researchers and administrators, caused strife among faculties, and pitted scientist against scientist.

A related problem is that the burden falls unequally across the sciences. Basic research in chemistry, biology, and the social sciences, typically funded by small government grants, is especially feeling the squeeze, says Stanford economics professor Roger Noll, another member of the faculty task force. But "big science" — physics, defense research, and computer science — can

Publishers read the Future with Compact Discs

The technology that recreates an orchestra in the living room could also open up a reference library on a computer screen. CD ROM, compact discs that can be read but not altered, are emerging as an alternative to paper now that the computer industry has set software standards.

Although Philips and Sony set a standard for CD ROM, the wording was left vague so that publishers could develop their own software for finding text on the disc. One group of manufacturers called the High Sierra Group found their way out of the chaos by setting their own standards.

The result is that any CD ROM which sticks to the format laid down by the group can be played on any IBM-compatible personal computer when it is connected to any CD ROM drive. This keeps down hardware costs to around £3500.

The British Library pioneered work on CD ROM and has been working with Blackwell Scientific Publications, based in Oxford, on a two-year experiment called Adonis. *Articles from more than 200 biomedical journals are published on CD ROM each week.* Libraries will print out articles from the disc on request. *By 1990, 50,000 technical articles should be available from discs.*

J. Whitaker, publisher of *Books in Print,* is using CD ROM to make life easier for bookshop staff and librarians. Virtually all British bookshops already subscribe to Whitaker's microfiche listing of 500,000 titles available in Britain, from 13,000 publishers. Now, shops and libraries can receive *Bookbank*, a monthly CD ROM, which contains the full listing for a subscription of £980 a year.

In its simplest form, the search works by keyword or author. More complicated systems need skilled operators, often librarians, to search out combinations of keywords and spellings.

Bookbank uses less than half the 650 megabytes available on a single side of a 12-centimetre disc. Whitaker hopes to use the remaining space to list the million books currently out of print.

Nimbus, the British record company now owned by Robert Maxwell, has modified the CD ROM technology, so record shops can return to the old practice of letting customers listen to music before they buy it.

Nimbus stores a mix of text and music on a CD ROM. The text is a listing of all the 86 music CDs in the Nimbus record catalogue, with the text of magazine reviews and a full-colour representation of the disc sleeve artwork. The music is a short sample from each record in the catalogue. The CD ROM drive feeds text to the computer for display on its screen and music to a pair of headphones or loudspeakers. The screen is touch-sensitive so that users can browse and listen without needing to use a keyboard.

Courtesy: *The New Scientist,* 5 May 1988

Continued from previous page

usually find plenty of funding, while its expensive facilities and equipment jack up the indirect costs for everyone's research in the university community.

"Society has decided that high-tech research is important," says Doniach. "So the university is effectively taking money from the people who have either constant dollars or decreasing dollars and using it to pay for the high-tech stuff. We're objecting to the little guys who are feeding the big guys."

The mathematician who uses just paper, pencil, and a small office, for example, must charge NSF the same overhead, as a percentage of his grant, as does the high-energy physicist, whose sophisticated and expensive facilities cost a fortune to run. "The people who feel most done-in by the system are those who do not place very high demands on their university," says Noll.

Solutions to these problems are elusive. A number of scientists have proposed that universities simply give up trying to recover all of their indirect costs. One effect may be to force efficiency onto these oft-times wasteful institutions. "Burgeoning administrative empires" should be curbed, suggests one researcher. The university's "basic missions of research, scholarship, and teaching" suffer, he says, as the result of huge increases in administrative programmes from which, as far as he can see, work like his fails to benefit.

But universities, of course, would rather have more money. One recommendation of the Stanford task force is setting up a consortium of leading research universities to negotiate higher indirect cost rates with the government. Another idea, proposed by Senator Christopher Dodd (D.Conn.), would earmark additional federal funds specifically for renovating and maintaining science facilities. But most observers say that the first approach has little chance of success, and the second provides too little money to really solve the problem. Says Rosenzweig, "The question doesn't have any fully acceptable answer."

• Ray Spangenburg and Diane Moser

(Courtesy: *The Scientist,* 30 May 1988)

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