



# Academy News

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## NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY

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 Juan S. Salcedo, Jr., M.D.  
 Alfredo C. Santos, Dr. phil.  
 Gregorio Y. Zara\*, Dr. Sci.  
 Fe del Mundo, M.D.  
 Eduardo A. Quisumbing, Ph.D.  
 Geminiano T. de Ocampo, M.D.  
 Casimiro del Rosario\*, Ph.D.  
 Francisco O. Santos\*, Ph.D.  
 Carmen C. Velasquez, Ph.D.  
 Gregorio T. Velasquez, Ph.D.

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Melecio S. Magno, Ph.D.	—	Vice-President
Tito A. Mijares, Ph.D.	—	Secretary
José Encarnación, Jr., Ph.D.	—	Member
Raymundo A. Favila, Ph.D.	—	Member
Dioscoro L. Umali, Ph.D.	—	Member
Carmen C. Velasquez, Ph.D.	—	Member

### Academicians:

Teodoro A. Agoncillo, Litt. D. (*honoris causa*)  
 Encarnacion Alzona, Ph.D.  
 Clare R. Baltazar, Ph.D.  
 Julian Banzon, Ph.D.  
 Luz O. Belardo, Ph.D.  
 Benjamin D. Cabrera, M.D.  
 Paulo C. Campos, M.D.  
 Magdalena C. Cantoria, Ph.D.  
 Gefia T. Castillo, Ph.D.  
 Amando M. Dalisay, Ph.D.  
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 José Encarnación, Jr., Ph.D.  
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 Jose R. Velasco, Ph.D.  
 Carmen C. Velasquez, Ph.D.  
 Gregorio T. Velasquez, Ph.D.  
 Gregorio Y. Zara\*, Dr. Sci.

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\* deceased

The Sixth Annual Scientific meeting was held at the PCED Hostel in UP Diliman, Quezon City, July 12, 1984.

Over the years, Dr. Paulo C. Campos, NAST president welcomed friends of the science community and participants to the Academy's annual scientific meetings. 1984 is no exception. His welcome remarks follows:

**The 6th  
Annual  
Scientific  
Meeting**

*Today, we meet to celebrate science and technology as a part of this week-long celebration. The National Academy of Science and Technology has decided to present over twenty original and excellent papers from the science community. These papers will subsequently be edited together with the discussions and published annually in a volume known as the "Transactions". This publication finds its way in the libraries of science academies around the world, major universities and research institutions including the libraries of international organizations involved in science and technology.*

*Today's meeting is the first to be held in the University of the Philippines Campus in Diliman; but it is doubly significant, not only because the biggest segment of the Academy's membership comes from the U.P. Faculty, but more so because this is the site of the science community for basic sciences. Although the Academy of Science is national in scope and transcends university barriers, for many years to come it is our feeling that most of the significant researches in basic sciences would still have to come from this campus.*

*This is, therefore, a significant development and may well catalyze the beginning of a renaissance in scientific research in this country. We are looking forward to closer working relationship with the Diliman community.*

*Permit me, therefore, to welcome you all to this year's scientific meeting of the National Academy of Science and Technology.*

U.P. Manila Chancellor Ernesto G. Tabujara keynoted the scientific meeting.

An engineer by profession, Dr. Tabujara recalled during his address what Lord Alexander Todd, president of the Royal Society of London during his visit in Manila in 1980 said about NAST. A nobel laureate, Todd looks up to the Academy whose independent and disinterested advise of highest quality which the government needs, the Chancellor said.

His address follows:

*When Dr. Campos invited me to this forum, I started to ask at the back of my head, what would be an engineer doing in a distinguished group of scientists? The question was not too difficult to answer particularly when National Scientist Dr. Carmen C. Velasquez and Dr. Magdalena C. Cantoria never gave me a chance to say no. And on second thought, I decided, perhaps it is about time an engineer should be talking to you.*

*Science and technology have been with us for a long time. But for many years, they were merely taken for granted. Without fully realizing it, man has been helped a lot through the development of science and technology in his day-to-day battle for survival. Not only has man gained some freedom from want and weary labor but also the increased amount of leisure time has given him the enjoyment of living.*

*It is only during the past few decades that the urgency for rapid development of science*

*and technology became imperative. There was a time when the needs of man were not so great. Resources were bountiful and many things could be had merely for the asking.*

*But as modern life becomes more and more complex, it had become necessary to identify factors that affect man's own existence. Adverse situations are brought because of rapid increase in population, and consequently, various kinds of problems cropped up.*

*Today, the average man on the street would not hesitate to enumerate the pressing problems confronting him. These are the general economic downtrend, the search for alternative and more economical sources of energy, the population explosion, the concomitant problems of food sufficiency, insufficient health care, moral deterioration, and so forth and so on.*

*Unless we forget, since 1945, mankind has been living under the sword of Damocles which is the threat of instant and total nuclear annihilation. Many of these problems have also been brought because of the irresponsible exploitation of science and technology themselves. These problems are clearly still with us despite the many beneficial contributions of science and technology which have brought about the general improvement of the quality of human life.*

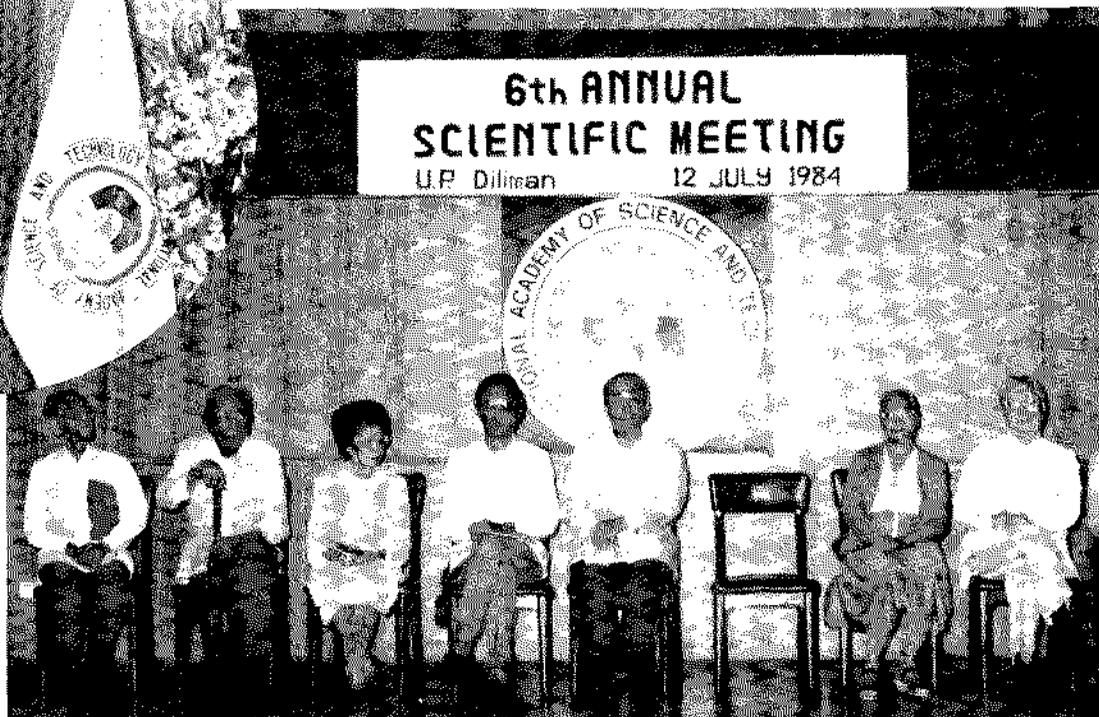
*Consider the machines and devices that liberated man from slavery of toil, the prolongation of life through the medical sciences, and the expansion of the technologies in agriculture, transportation and communication. The balancing of the blessings and the social heirs would logically require that since science and technology have brought about these unwanted conditions, they should likewise find the necessary solutions. Man should stay as the master of his environment. He has to keep complete control. So that is the rationale for the formation of continuing existence of scientific and technological communities whose goals are to alleviate current ills. Somehow new energy sources have to be tapped. Environmental pollution must be remedied. Population growth should be controlled. People must be properly and adequately fed and housed.*

*Basic Science Community celebrates National Science and Technology Week, we should not fail to reflect that one of the most significant events that has pushed science and technology as national priorities, is the birth of this National Academy of Science and Technology. Created under P.D. 1003-A, in December 1976, it is the articulation of the constitutional mandate and I quote "to promote scientific research as a national priority". There are other objectives which are crucial to the formation of this Academy which we now review as follows:*

- 1. to provide meaningful incentives to those engaged in scientific and technological research;*
- 2. to recommend to the President of the Philippines outstanding achievements in technology and sciences for due recognition; and*
- 3. to help professionalize government scientific and technological research activities.*

*Since 1978, the National Academy of Science and Technology has not been lethargic in its task of encouraging our distinguished scholars affiliated with the organization to produce technical papers which are the results of painstaking scientific investigations.*

*Judging from the variety and range of topics that will be presented and discussed in this 6th Annual Conference in the fields of biological and social sciences, chemistry, medicine, mathematics and physics, it has been proven once again that our science and technology families have been indeed conscientious in their responsibilities. The author-*



*National Scientists at the 6th Annual Scientific Meeting of the NAST. They are shown here at the stage as they listen to Dr. Ernesto Tabujara, UP Manila Chancellor (inset).*

*From left are: Dr. Gregorio T. Velasquez, Dr. Francisco M. Fronda; Dr. Fe del Mundo; (With them are Dr. Roger Posadas, dean, College of Science, UP Diliman and president P.C. Campos); Dr. Carmen C. Velasquez and Dr. Geminiiano de Ocampo.*

*researchers deserve our commendation; whatever have been their stimuli in their respective endeavors. I also know that there are those among you who are simply happy to be doing research, perhaps motivated only by the inner urge to search for the truth, to contribute to technological advance and add to theoretical knowledge.*

#### **A Personal View**

*At this point, may I inject a personal observation. The Presidential Decree No. 1003-A defines the scientist as, and I quote, "an individual who has earned a doctoral degree in any field of the sciences in an accredited university and has demonstrated and earned distinction in independent research or significant innovative achievement in the basic and applied sciences including agriculture, engineering and medical sciences, in mathematics and in the social sciences, as manifested by his published works in recognized scientific and technical journals". But while the definition is explicit on the numeration and I repeat, of basic and applied sciences including agriculture, engineering, medical sciences, mathematics and in the social sciences, I cannot help but note with some degree of disappointment that there are no engineer-researchers in your distinguished roster. An exception may be mentioned that former Minister Melecio S. Magno is indeed a mining engineer but I can almost guess that perhaps his membership is due to his being in statistics.*

*Perhaps in elaborating on this observation, it is relevant to point out that there is a general impression that engineers are doers, that they lack the quality of patience and that "their English is not that elegant". Notwithstanding these rather uncomplimentary remarks about me and my colleagues, I honestly believe that engineers are just as competent and just as eager and ready to contribute to the advancement of technological knowledge. In fact, engineers are understandably impatient because they prefer to see the results of their endeavors yesterday. I hope you do not take against me when there is that urge in me to blow my own horn. The works involving the tapping of alternative source of energy like waves and wind power, or solar energy, the utilization of indigenous materials for construction and the search for absolute substitute fuels are among the worthy contributions of engineers to the wealth of knowledge in the applied sciences.*

*Many technological inventions which support sciences have been developed by engineers. So I hope the Academy would recognize the contributions of these colleagues in our concerted efforts to bring about a better quality of life for our people.*

*Sometime ago, the Academy had the honor of the visit of Lord Alexander Todd, President of the Royal Society of London, himself a Nobel Prize Winner. There were certain things that he said which stand out very significantly as applied to our present situation.*

*He said, and I quote "The economic strength and with it national stability are dependent on technological progress and it is difficult to think of any area in national affairs in which science and technology are not involved directly and indirectly. It is hard to believe that correct policy decisions can be reached in a democracy when members are virtually ignorant of science and technology". And he concludes further that "there lies at the root of every national science policy the complex problems of education".*

#### **Academy Membership**

*As to the National Academy itself, he looks up to this as the body whose independent and disinterested advice, of highest quality the government needs. As to membership, he gave his suggestions: members be chosen on ground of scientific or technological merit and achievement alone without reference to political and other connections. Membership should cover the whole range of science and every effort should be made to keep down the average age of the members.*

*I am positive that the Academy conforms to the first two suggestions. The qualifications for membership are carefully spelled-out and that the fields of endeavors are enumerated. With respect to the third suggestion, however, this has also been partly satisfied with the search for the 10 young scientists who, eventually, from the core of those who may be elevated to full membership in a few years.*

#### **Applied Research**

*With the prevailing economic climate in our country, the more urgent need is on applied research. The theme of this year's celebration of the National Science and Technology Week which is self-reliance, is a healthy one. The government's Sariling Sikap Program is indeed applied technology using indigenous materials. Since the stress is in productivity, research papers on the utilization of still abundant local materials, energy conservation and production techniques are very relevant and should be welcomed.*

## Government Plans

*In addition to advisor to government planners, the task to promote science and technology, one other alternative rationale for the existence of the National Academy of Science and Technology is the resulting interaction among natural, behavioral and social scientists, the artists and the government officials themselves. This interaction also may be and should be extended to the international circles. With their concern for the welfare of our people, newer insights can be worked by interdisciplinary approach to problem. The dissemination of new knowledge is part of science which should be encouraged and promoted not only in forum such as the one we are about to have, but also the follow through in publishing the same in scientific journals.*

*I hope the presentation of papers and the ensuing panel discussion thereof will be received with eagerness and anticipation by this august audience of scholars. Once again, I warmly greet our National Scientists and Academicians, researchers, colleagues and congratulate the organizers of this Annual Scientific Meeting. May you have a fruitful forum this afternoon. Thank you very much.*

### The Scientific Sessions

Presentors include the following:



Dr. Rodolfo P. Cabangbang presented "Multi-Adversity Resistance Breeding Procedure in Cotton in the Philippines." He said that size and density are the selection criteria for cotton seeds, while deterioration and velocity are used in the germination stage.

In selecting seedlings on the other hand, he said that the criteria used are damping-off as well as resistance to nematodes. Other criteria include: aphid and leafhopper tolerance during vegetative stage; bollworm and flower-weevil tolerance during flowering and bolling stages.

His paper was premised on the fact that improved crop varieties are a key to progressive agriculture. The Philippines, he said, could benefit from the experience of cotton-producing countries, especially on insect and disease control researches.

He concluded by saying that the MAR procedure should be a standard breeding technique for multi-adversity resistance. Plants may be subjected to a succession of pressures from seed stage to harvest stage and this should yield an improved population.



Dr. Joventino D. Soriano presented "Mutagenic Response of Peanut (*Arachis hypogaea* L.) to Fast Neutrons." The study aimed at determining the mutagenic response of peanut to fast neutrons employing efficient pre and post irradiation techniques. He started by saying that the more widely known human achievements in the utilization of the energy of the atom lies ironically in the field of weaponry for mass destruction. Adding that unknown to many is the use of this energy for the improvement of crops for man's advantage.

Touching on the very few existing irradiation facilities today, he noted that this could be the cause of the very little work still available on the genetic effects of fast neutrons on seeds.

The emergence of a new technology for inducing hereditary change, he concluded, has once more revived a century old problem on the origin and future of the species.



Meanwhile, Dr. Rafael D. Guerrero III presented a paper on the culture of the earthworm, *Eudrilus euginae* and its use as feed for *Macrobrachium idella* and fertilizer source for *Brassica compensis*.

According to him, the country's foreign exchange crisis is expected to reduce importation of animal feed ingredients and chemical fertilizers, a situation which makes it imperative to develop import substitutes using locally available materials.

He continued that earthworms have been identified time and again as a potential source of animal protein, poultry, livestock and fish feeds, so that three studies were made: One, to determine the effect of different pig manure levels on the growth of earthworm; another, on feeding of dried earthworm to shrimps, and the third, on the use of vermicompost to fertilize pearsay plants.

The use of vermicompost was found to be appropriate for light soils low in organic matter.

*Increasing the Efficacy and Safety of Butachlor and Its 2, 4-D Mixture in Direct Wet-Seeded Rice (Oryza sativa L.)* was presented by Dr. P. M. Halos and R. W. Schumacher. It dealt with direct seeding of pre-germinated rice under puddled condition, which offers several advantages over transplanting. These cover increased planting frequency, and dramatic cost reduction both in manpower and production requirements.

The former, they said, is most relevant in the case of the Kabsaka program in Iloilo, using 235,000 ha. where two rice plantings are targeted per wet season for increased income for the farmers. Because of the time element, direct seeding was implemented during the 7-month wet period. Again to take advantage of the monsoon rains when labor is scarce, direct seeding was used instead of transplanting rice.

The research was aimed at determining the best time to apply butachlor and its 2, 4-D mixture for optimum weed control and yield and the possibility of using Mon 4601 (Screen (R)) as a safener to reduce herbicide phytotoxicity in broadcast wet-seeded rice.



In presenting his paper titled "Collection and Taxonomic Studies of the Bluegreen Algae and Natural Pollution" Dr. Gregorio T. Velasquez, in 1962, he said, a monographic treatment of these algae was published which gives a complete record of 162 species and three forms. His paper showed representative species of the collection purposely to show the nature of the habitat from where many bluegreen specimens are generally available.

However, he said additional bluegreen algae of wide distribution and where they grow in abundance should be studied further. He continued by saying that a biochemist must be available to study the relative potency of toxicity which these algae produce in many habitats. For example, he should be able to suggest controlled measures after consultation with the researcher.

When the necessary data is complete, he said, one very practical way to eradicate, if not control the growth of the bluegreen algae is to introduce currents which accelerate the aeration of the locality concerned. What presently appear to be clear like several standing waters can be colonized later by the fast growth of ubiquitous bluegreen algae.

The paper of Dr. Paciente A. Cordero, Jr. on *Seaweed Husbandry: A Socio-Economic Issue* attempts to present data obtained from completed and on-going researches on Philippine marine macro-algae and to trace possible linkage with the socio-economics issue.

According to Dr. Cordero, seaweeds and other marine plant materials compose only a small fraction of the resource taken from water habitat. Macro-algae have varied uses such as food staples, for industrial, biomedical and agricultural needs, to a more revolutionary use based on the concept of "biomass energy", he added.

Seaweeds, if properly tapped, could even be expected to favor the balance of the economy and improve the social status of the populace.

He argued for the need to introduce seaweed husbandry by judiciously utilizing specific seaweed species. This would include matters such as conservation of resources, propagation of superior species and an assurance of continuously renewable supply of the seaweed. When applied to seaweeds, he said that husbandry may cover both its sustained production, as well as the regulated foraging of economically useful species. And it may fall within the context of managed cultivation and harvest of marine plants seaweeds.

He concluded by saying that successful husbandry necessitates healthy R & D activities. The elements of responsible husbandry, he emphasized, are positive for two vegetable species, *caulerpa* and *eucheuma*.

The development and expansion of the local export trade of fish and fishery products can be facilitated by instituting a system of quality control measures. Thus remarked Dr. Florian Orejana in her paper *Quality Assurance in the Fish Processing Industry*.

She recommends highly that the organizational scheme of quality control and inspection in the Philippines be reviewed and the bureaucracy be reduced accordingly. The overlapping of functions of various agencies, which lessens efficiency, must be eliminated or well-coordinated. Voluntary rather than mandatory compliance to guidelines should be encouraged. The private sector on the other hand, she said, should be willing to share the task of improving product quality of financing semi-private or cooperative ventures similar to those found in Germany and Norway.

The development of standards that are applicable to local products is recommended, she concluded. However, for exported products the standards set by the importing country must be fully satisfied in order to create a good image for Philippine fishery products in the international market.

*Spectroscopic Studies of the Reaction of Dichloro-bis-N, N' – Diphenylthiourea-cobalt (II) with Oxidizing Agents in Non-Aqueous Solvents* was presented by Luzvisminda U. Rivero and Catherine Ballestil.

In the paper, the spectroscopic properties of solutions of bis-N, N' – Diphenylthiourea-dichlorocobalt in acetone, acetonitrile and ethanol were compared with those in the solid complex. The authors presented the changes in the electronic spectra upon the addition of oxidizing agents.

The formation of a stable intermediate species was discussed based on the shift of the absorption band maxima and the appearance of new absorption bands.





*Antimutagenic Effects of Some Inorganic Biochemical Systems* was read by Dr. Clara Y. Lim-Sylianco and E. C. Daya of the Department of Chemistry, College of Science, U.P. Diliman.

There have been efforts to discover substances and other physical agents that would exhibit genetic toxicity — not only to germ cells but to somatic cells as well. Efforts to discover some systems to tend to reduce or even abolish the genotoxic effects of some chemical and physical agents are being done.

She said that antimutagenic effects of some organic systems have been studied in their laboratories. So also have been studied were the antimutagenic effects against aflatoxin B1, aflatoxin G1, dimethylnitrosamine, mitomycin C and metronidazole. Vitamin A, E, C, riboflavin and thiamine exhibited antimutagenic effects.

She concluded that a combination of calcium and magnesium gave the best antimutagenic effects.



A paper on Chromatographic Analysis of Carbohydrates in Coconut Water was presented by Dr. Ernesto J. del Rosario *et al.*

The paper dealt with carbohydrate analysis, using both liquid and gas chromatographic methods, of fresh coconut water and of coconut water which had been concentrated by reverse osmosis.

He added that the experimental techniques are described in the paper to identify and quantify the carbohydrate components in coconut water. His presentation included a schematic flow sheet of methodologies for sample preparation and high performance liquid chromatography analysis.

Dr. Julian A. Banzon presented the *Coconut Palm as a Source of Firewood*. LPG has become expensive, and firewood is becoming scarce, according to Dr. Banzon, and worse, he said, LPG may no longer be available easily because of dollar restrictions. His paper dealt with a new source: the coconut palm.

He presented a table comparing coconut with others as firewood. Coconut husk he said is nearly as good, while the shell is better than other listed firewoods in terms of MJ/Kg.

The study aimed at determining how many coconut palms and how much contributing husk, shell and petiole as firewood, can sustain a kitchen indefinitely. Two quantities are needed: The energy output of a coconut palm and the energy needs of the kitchen.

Just how many coconut palms can sustain an average kitchen indefinitely with fuel? His study showed 11.

Institutions are essential to socio-economic growth and change although there are prevailing institutions that tend to hinder growth, commented Dr. Amando M. Dalisay in his paper *Institutions in the Transformation of Rural Life*.

He said that institutions are a function of a nation's culture. For viability and effectiveness, they must conform to the value systems of a particular culture. If they do not conform, as in many imported institutions, they lose their effectiveness after a while and eventually fade away.

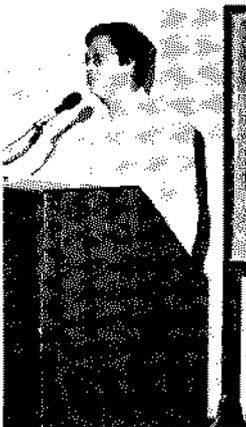
As a result, Dr. Dalisay remarked that a development strategy for institution building which calls for a combination of policies and policy instruments will ensure a high pay off in institutional effectiveness and viability as well as the proper timing of implementation. The best guide for such a strategy is a concrete knowledge of past performance among the supporting systems and a recognition of the kind and quality of available leadership in these institutions, together with an appreciation of the prevailing socio-political situation in the country.



Dr. Jose Encarnacion, Jr. presented his paper titled "Consistency Conditions for Group Decisions. The abstract of his paper reads –

Some Group rules that do not automatically satisfy Pareto optimality can be modified to do so by representing the alternatives in terms of lexicographically ordered vectors that depend on the feasible set. Certain conditions that have been considered as requirements for consistent group decisions might then be violated, however. Less restrictive versions of those "consistency conditions" are proposed.

The Bicol region is one of the regions with the highest fertility, infant mortality and rate of out-migration according to Dr. Alejandro N. Herrin in a study he undertook on *Fertility and Family Planning Behavior in the Bicol River Basin*.



The study on the correlates of fertility and family planning behaviour in the Bicol River Basin is part of a larger study aimed at assessing the long term impact of rural development programs in the area. A major survey conducted in 1978, he noted in his paper, provided most of the baseline data upon which future assessment of impact can be based.

His research concluded that the prospects of a more systematic assessment of the demographic impact of rural development appears bright. This should not only lead to more information immediately needed for policy and program purposes, but should also lead to a greater understanding of the dynamics of social change in contemporary rural settings.

There have been remarkable advances in medicine and public health, yet diarrheal diseases continue to be a major cause of morbidity and mortality in childhood throughout the world, particularly in developing countries.

This was discussed extensively in a paper senior-authored by Dr. Fe del Mundo titled *Bacteria Identified in Diarrheal Stools of Early Childhood and Sensitivity Tests, Manila (1980-1982)*.



In the Philippines, the latest health statistics show that among the ten leading causes of infant mortality gastroenteritis led and colitis was second in the list, resulting in 12,800 deaths under 5 years. She traced the causes of diarrhea in childhood, which range from trivial dietary indiscretions to such severe conditions as in cholera or malabsorption syndromes.

Two studies, bacterial and viral, the paper stated, may complement each other, as a contribution to efforts to determine the role of infections in the etiology of diarrhea

in developing countries. Conclusion: many lessons have been learned – all these should result in a more effective and efficient steps in the diagnostic work-up of diarrheas.

The control of ascariasis, trichuriasis and hookworm infection – all soil-transmitted helminthiases in developing countries like the Philippines is definitely not an easy job. Dr. Benjamin D. Cabrera claimed so because of the several factors that come into play in their transmission, such factors as poor environmental sanitation, poor personal hygiene, lack of health education, inadequate supply of potable water in the area and low economic status of the people.

Dr. Cabrera in his paper *Effect of Treatment Regimen on Reinfection of Soil-Transmitted Helminthiases in the Philippines* where he showed data on several methods tried in the field by the author using various treatment regimen of soil-transmitted helminthiases. Here, stool examination follow up was done after each treatment regimen to determine reinfection rates of ascaris, trichuris and hookworm.

He recommends the adoption of periodic treatment for three years in the control and/or eradication of soil-transmitted helminthiases in this country. This, he explained is based on the low reinfection rates of the three common intestinal helminths when subjects were given the above treatment regimen.

*Cycle Graphs* was presented by Dr. Severino V. Gervacio of the School of Graduate Studies of Mindanao State University – Iligan Institute of Technology.

His paper gives a characterization of cycle-vanishing graphs, and in particular proves that  $C^3(G)$  is acyclic if  $G$  is cycle vanishing.

A balik-scientist, Dr. Juan Ferrer, presented "*Acoustic Emission*".

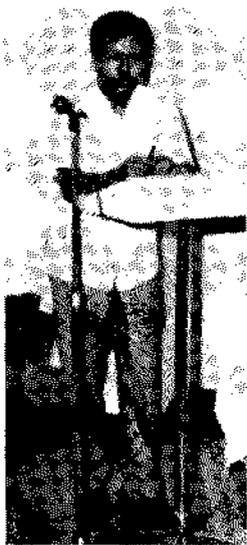
He started by defining acoustic emission and went on to discuss the sources of acoustic emission such as metals and advance deposits. He cited plastics which may be reinforced with fibers, thus it becomes fiber-reinforced plastics. These are materials, he said, which are stronger than steel and lighter than metals. Actually, these materials being light are considered for aerospace applications and car making for the simple reason that fuel consumption is not as much as when we use metal.

*Sources of acoustic emission in metals.* There is acoustic emission in cracks at the very crack tip or even old cracks which may become passive or active. In other words, one may detect acoustic emission in something that is about to fail or about to collapse.

The Japanese, he reported, have done a tremendous job in making hi-grade stainless steel but the movement of the dislocations within the metal itself can be a source of acoustic emissions.

Grain boundaries lining usually granular in materials and one can have grains of the different elements in the metals themselves. You can also have acoustic emissions when metal starts fracturing or breaking.

*Real-time detection.* Acoustic emission is the only method that one can use to do real time detection of a particular process that is happening. Similarly, and more importantly in some instances, is its capability to provide continuous monitoring. In the case of



nuclear plants, he pointed out, a lot of accidents or a lot of failure in nuclear power plants occur because of what is known as stress corrosion cracking. In fact he said, acoustic emission provides a means of continuously monitoring the system so that it will allow one to determine whether one is starting to crack or starting to have leaks. In Boston, there are structures made of glass or whose windows are made of glass, and in times of wind storm or thunderstorm or anything like that, glass starts to crack.

In acoustic emission, as in any emerging technology, one needs experience. That is, the experience of both the operator and that of the experimenter is important in the interpretation of results, including the need to understand the material behavior of whatever one is monitoring. Briefly, it calls for a fairly good understanding of its behavior under stress.

### **Present Applications of Acoustic Emission**

In his presentation, he touched on the kinds of industrial applications where acoustic emission is presently being used in the U.S. as well as all over the world.

The nuclear vessel of a nuclear power plant has to be tested — to find out whether it can withstand both pressure and temperature that a nuclear plant will be subjected to. Both the manufacturer and the buyer must try to determine whether the nuclear vessel will indeed survive the harsh environment of the nuclear power plant. He said, adding that — Another application is in-service testing. After using a nuclear vessel for five years, what assurance do you have that the deterioration of the nuclear vessel has not accelerated? Questions like this comes to the fore. This he said is an application where one would like to determine whether the vessel or the primary cooling pipes are still functional and can still withstand the harsh conditions.

The Filipino nuclear fusion expert further said that nuclear power plants are designed usually anywhere from 20 to 30 years, so one would like as much as possible to extend



*Dr. Ferrer is greeted by a media group.*

the life of a nuclear power plant. In fact, he said, a lot of nuclear power plants in the U.S. are now being subjected to continuous monitoring so that they can arrest and determine a catastrophe before it happens, whether they can do something about any of the components of the plant. One, it takes a long time to build a nuclear plant and two, it is expensive.

He cited on-line monitoring as another industrial application of acoustic emission. Japanese, Germans and the Americans use acoustic emission in welding cars to insure quality as well as to be able to determine problems and prevent waste of labor and time.

### **Other industries where acoustic emission is applied**

Briefly, the industries in which they have found applications of acoustic emission, are:

One, the petro-chemical industries.

Two, in the chemical industries, the storage tanks are of good quality and have sufficient strength to handle all these chemicals.

Three, automotive industry, where they need to minimize the amount of welds. It might interest you to know that in a single car, there could be as many as ten thousand welds and some of these welds are done by robots. And some kind of mechanism should be employed to determine whether the weld is good or not.

Four, in the aerospace industry.

Five, in electric utility companies. These companies usually own nuclear power plants and one needs to understand and preserve their plant.

Six, in the electronics area.

He went on to discuss the present technology employing acoustic emission.

*The world always makes the assumption that the exposure of an error is identical with the discovery of the truth — that error and truth are simply opposite. They are nothing of the sort, What the world turns to, when it has been cured of one error, is usually simply another error, and maybe one worse than the first one.*

— H. L. Mencken



*L to R: Dr. Paulo C. Campos, NAST President; Dr. Fernando Bernardo, Deputy Minister, Ministry of Education, Culture & Sports; with the awardees, namely: Dr. Filemon A. Uriarte, Jr., Engineering; Dr. Eufemio T. Rasco, Jr., Plant Breeding; Dr. Roger R. Posadas, Physics; Dr. Evelyn Mae Tecson-Mendoza, Chemistry; Dr. Reynaldo E. de la Cruz, Forestry; Dr. William T. Chua, Medicine.*

*To their right are: Minister Emil Q. Javier, Director General, National Science and Technology Authority (NSTA), an academican himself; Dr. Melecio S. Magno, vice president, NAST and Dr. Quintin L. Kintanar Deputy Director-General, NSTA.*

- a trophy and cash prize of ₱10,000 each

### **NAST Picks '84 Awardees for Outstanding Young Scientists**

*The Outstanding Young Scientist Awards for 1984.* — A group of young scientists who have made significant contributions to S & T were awarded in a simple ceremony at the NSTA Executive Lounge last December 10, 1984.

In his address, Minister Emil Q. Javier, Director General of the National Science and Technology Authority, said that the Outstanding Young Scientists Award has become more reputable than other popular awards because the selection is done by no less than their peers.

The award was carried under the auspices of the NAST and the selection was sent in by actual vote coming from the members of the Academy.

The six awardees for 1984 are:

**Filemon A. Uriarte, Jr., Ph. D.**

To waste utilization and industrial pollution control, Dr. Uriarte has made significant contributions. He has developed a number of appropriate pollution control technologies adapted to local conditions, which have found actual applications in industry.

These include the use of waste pickling liquor in the treatment of industrial wastes; the recycle and re-use of wastewaters in sugar mills and refineries, the development of local technology for the fabrication of high-speed floating, mechanical surface aerators and other pollution equipment; the utilization of waste carbide sludge in the treatment of industrial wastes; the use of wastewaters from synthetic detergent plants in the treatment of oil waste and research on the use of locally available and naturally occurring substances, such as starch, in the coagulation-flocculation of industrial wastes.

He got his B.S. in Chemical Engineering from the University of the Philippines, his Master of Engineering from the same institution, and his Ph. D. in Carnegie-Mellon University in Pittsburgh.

Dr. Uriarte was awarded the Vidal A. Tan professorial Chair in Environmental Engineering. A TOYM awardee (1974) in science and the President Roxas Memorial Award, among others. Born in Quezon on October 15, 1945 he is married to Genevieve Pacis, he has four children.



*At left is Dr. F. Uriarte, Jr. with Dr. E. Rasco*

## Eufemio T. Rasco, Ph. D.

As a plant breeder, he made significant contributions to agriculture. In a span of less than three years, Dr. Rasco, together with his research team, developed 46 varieties in 22 vegetable crop species and 8 varieties of white potato which are gaining wide acceptance among the farmers and the consumers.

Actually, three of these have already been approved by the Philippine Seedboard for use in the national program, namely: Arka9 (white potato), Esperanza and Corazon (Chinese cabbage). The others are very promising and are now being used by farmers.

A product of the UP College of Agriculture, earning in 1971 his B.S.A., and, three years after, his M.S. In 1979, he obtained his Ph. D. in plant breeding from Cornell University.

He is a plant breeder at the Institute of Plant Breeding, UP at Los Baños.

His more important awards include Special Award for the Best Paper 1983 from the Society for the Advancement of Vegetable Industry and Outstanding Research Team (82) from the Institute of Plant Breeding.

Dr. Rasco was born in Camarines Norte on February 3, 1950, and married to the former Precy Miranda, with whom he has a son and a daughter.



*From left, Dr. E. Mae Tecson-Mendoza, Dr. R. dela Cruz and Dr. W. Chua*

### **Evelyn Mae Tecson-Mendoza, Ph. D.**

Plant biochemistry researches which cover biochemical mechanisms of plant resistance of pests and diseases are her significant contributions. These works embrace factors affecting nutritional quality and acceptability of legumes and regulatory mechanisms of processes which are considered to be not only technically important but also have practical applications.

Obtaining her B.S. in Chemistry (*cum laude*) from Mapua Institute of Technology in 1967, her M.S. and Ph. D. both in biochemistry, all from the University of Massachusetts.

She is head of the Biochemistry laboratory, Institute of Plant Breeding, University of the Philippines at Los Baños.

In 1983, she was chosen Most Outstanding Alumnus in Academe by the CHE-CHEM Alumni Association of Mapua Institute of Technology. Her awards include two fellowships from the Japan Society for the Promotion of Science.

Biochemical-genetics is her special research interest.

Born on August, 1947 in Navotas, Rizal, she is married to Reynaldo C. Mendoza with two kids.

### **Reynaldo Dela Cruz, Ph. D.**

Dr. dela Cruz's research works in the field of forestry became one of the foundations of a successful nursery and field establishments of selected commercial species in the Philippines. He is credited with playing a major part in the establishment of some research laboratories in the College of Forestry, U.P. at Los Baños.

From the same institution, he earned his B.S. in Forestry in 1965. Six years after he obtained an M.S. and, in another three years, his Ph. D. with a major in tree nutrition, both from the University of Florida.

The young forester is Associate Professor III at UPLB.

He was awarded the "Most Outstanding Researcher of the UPLB College of Forestry in 1981". The next year he garnered again the "Most Outstanding Alumni, Researcher Category, UPLB College of Forestry Alumni Association."

His research interests are on mycorrhiza, tree nutrition, seed biology, reforestation, phenology of fast growing species and water relationships.

Born in Basilan City on December 31, 1944, he is married to Loretta Uri dela Cruz with two kids.

**William T. Chua, M.D.**

In the field of cardiovascular medicine, Dr. Chua made significant researches on the detection, assessment and evaluation of various forms of heart diseases with emphasis on cardiac electrophysiology.

He finished his B.S. pre-med at Letran College in 1969, after which he went to the UERMMM Center where he earned his M.D. in 1973. His post training includes among others his fellowship in cellular and clinical cardiac electrophysiology at the Northwestern University in Chicago, Illinois, U.S.A.

Dr. Chua is chief of the Clinical Electrophysiology section of the Philippine Heart Center for Asia (PHCA) and is a member of the faculty of both the UERMMM and the PHCA.

Awards include outstanding cardiology fellow for the year 1980, awarded by the Philippine Heart Association and recipient of the Cathay Drug Research Awards during the 11th PHA Annual convention in 1980.

The 35-year old doctor was born in Manila and is married to Ma. Theresa A. Chua, with whom he has three children.



*Dr. R. Posadas gives response in behalf of all the '64 OYS awardees.*

## Roger Dela Rosa Posadas, Ph. D.

One of the very few specialists in general relativity in the Philippines today, Dr. Posadas is recognized internationally along this field of physics. Indeed his works on the motion and structure of singularities has been widely cited for developing a fruitful new approach to the problem of motion in general relativity.

He has helped a great deal in the development of a local research tradition in physics through his continuing supervision of the thesis research of several local graduate students in theoretical physics.

While he earned his B.S. Physics from the U.P. in Diliman, he obtained his Ph.D. in Physics from the University of Pittsburgh. He is at present dean of the College of Sciences, University of the Philippines.

In 1978, he was invited as the only Southeast Asian physicist in the Organizing Committee of the Einstein Centennial. He is at present investigating the multipole structure of fields and sources in general relativity and mathematical formalism for space-time theories. In theoretical physics today, these are the frontiers.

Born in Lingayen, Pangasinan on October 17, 1944 he is married to Linda Santiago Posadas, with whom he has four children.

\* \* \*

### **INSA Nominates Dr. Kubra Bano to Visit RP**

The Indian Science Academy has nominated Dr. Kubra Bano, instructor at the Department of Zoology, College of BS and H of Bangalore, India under the existing exchange program between the two academies. Her field of specialization is soil biology and ecology while biodegradation of organic matter by soil animals is her research specialization.

While here, she intends to obtain firsthand information on the biotechnology, farming and animal husbandry; to discuss the merits and demerits of earthworm cultivations with the pioneer scientists in the field, to evolve a suitable methodology to overcome the shortcomings in the technology; to gather information on planning and building of large scale 'vermery'; to study the equipment, instruments, machinery and personnel involved in the management of 'vermery'; to undergo practical training (if necessary) to gain experiences in operation and maintenance of earthworm industry; and to learn the methodology involved in the production of protein products; to study and discuss the shelf-value, use, marketing etc. of the protein products, their influence on the livestock; to study the economy involved in the project in order to work out its feasibility of adoption in Indian conditions; discussion will be made on the use of 'worm cast' in agricultural and horticultural practices. Its popularity among the agricultural community and agricultural scientists.

She will visit a number of institutions such as the Philippine Earthworm Center; the Bureau of Animal Industry; both UP Diliman and Los Baños; Philippine Tobacco Research Training Center in Ilocos Norte, among others. Incidentally, the Philippine

Earthworm Center is involved in mass cultivation of earthworms for profit. The earthworm *Pheriterna asiatica* commonly called "red worm" and claimed to be a hybrid variety, is mass cultivated here for its products, the "worm cast," an organic manure and "worm protein". From the worm protein different products are manufactured under the names such as (1) 100% earthworm meal, (2) earthworm paste, (3) earthworm pellets and concentrates. These products are used as feed, additives and as starter feed for prawns, shrimps, fishes and other livestock.

## Recent Publications

(Latest publications on R & D management prepared by the staff and associates of the R & D Research Unit of the University of Manchester.)

### Books

Productivity and the R & D/Production Interface, by S. A. Bergen, published by Gower Press, 1983.

Managing Interdisciplinary Research, edited by S. R. Epton, R. L. Payne and A. W. Pearson. Published by John Wiley, April 1984.

### Papers

Planning and Monitoring in Research and Development — a 12-year review of papers in R & D Management. A. A. Pearson, *R & D Management*, Vol. 13, No. 2, April 1983.

Technical Progressiveness and Export Activity: a study of small and medium sized firms in a technology based society. C. H. Ong and A. W. Pearson. Presented to the *TIMS Conference, Chicago*, April 1983.

Some possibilities for personnel development in R & D during the eighties. S. R. Epton and A. W. Pearson. Paper presented to the *Symposium on Personnel Management in Industrial R & D*, Hamburg, September 1983.

Technology — an increasingly dominant factor in corporate strategy. A. Wilkinson, *R & D Management*, Vol. 13, No. 4, October 1983.

Project Management and Innovation in the Scientific Instrument Industry, S. A. Bergen & A. W. Pearson, *IEEE Trans. on Engineering Management*, Vol. EM-30, No. 4, November 1983.

Microcomputers in R & D: automation of the knowledge production process. G. Morse, C. H. Ong and A. W. Pearson. Presented to the *Second Annual Conference on the Organisation and Control of the Labour Process*, University of Aston, 28-30 March 1984.

For further information, contact the Director, R. & D Research Unit, Manchester Business School, Booth Street West, Manchester M15 6PN, U. K.

**NAST on  
RP's Official  
Reply to  
UNESCO's  
S & T Program**

The National Academy of Science and Technology was consulted by the Working Committee with respect to the preparation of the official reply of the Philippines on UNESCO's Major Program IX entitled Science, Technology and Society.

After the meeting, the committee's recommendation boiled down to UNESCO concentrating to very significant programs only.

Other developments —

President Campos said that UNESCO can be far better off and be more effective, if they can only limit to major programs adding that for the present involvement in cultural and historical matters may be good although more relevant would be Asian population problem and migration pattern.

While Dr. Melecio S. Magno, vice president of NAST, voiced concern over science education, opting for fewer projects.

Dr. Narciso Albarracin, secretary-general, UNESCO National Committee of the Philippines who was also invited during the consultation meet at the NAST conference room said that the USA and other developed countries expressed lament on UNESCO getting involved in so many projects.



*Attending the meeting, from left are: Dr. P.C. Campos; a MECS representative; S. Tan of the NSTA and Dr. M.S. Magno. With Dr. N. Albarracin (inset) also present during the meeting.*



**The KSP's  
Statement of  
Concern on  
PNPP I**

The Kilusan ng mga Siyentipikong Pilipino\* (or KSP) prepared a statement of concern over the Philippine Nuclear Power Plant I in Bataan.

In their open letter addressed to their colleagues in science, the KSP has identified these areas for objective discussions, namely: design and operational safety; environmental impact; economic viability; wastes management; emergency planning; liabilities and regulation.

The KSP president, Fr. Bienvenido F. Nebres, S.J., Ph. D. and likewise member of NAST, in his letter to Dr. Paulo C. Campos, NAST president, stressed that KSP's goal which is to make more precise the different areas of concern and to seek to provide some expert assistance in the evaluation of how these concerns are being met by Westinghouse, by the National Power Corporation and by the Philippine Atomic Energy Commission.

We are publishing in full the statement of concern of the KSP duly signed by the officials and some members of the federation on the nuclear plant for whatever worth it may serve. Ed.

## **A STATEMENT OF CONCERN**

An Open Letter from the KSP Regarding the Bataan Nuclear Power Plant

We, the officers and members of the *KILUSAN NG MGA SIYENTIPIKONG PILIPINO* (KSP), voice our deep concern over the Philippine Nuclear Power Plant (PNPP-1) in Bataan. Because of its unique nature, the risks, complexity and economics of this nuclear facility should undergo careful examination. We believe that numerous technological, environmental, regulatory and economic issues demand open discussion, clarification, and resolution before the PNPP-1 is granted a license to operate.

### **SPECIFIC CONCERNS**

**1.0 SAFETY ASPECTS. There are several items of safety that require careful attention.**

1.1 A nuclear power reactor may be conveniently divided into two sections: the Nuclear Steam Supply System or N.S.S.S. which includes the reactor, reactor coolant pump, reactor coolant piping, steam generator, pressurizer, and the Balance of Plant (BOP). Our main concern is for the design of the BOP because the design is *site-specific*. Thus it is variable and judgmental in nature. Our information about the supervision and regulation of the BOP makes us concerned about the soundness and appropriateness of the site-specific design.

1.2 As may be noted below in section 3 on regulation, the Philippine Atomic Energy Commission (PAEC) does not have adequate resources in terms of funds or personnel for its assessment, regulatory, and enforcement functions. We are thus concerned about the inspection and enforcement of quality assurance which should have been conducted by the PAEC during the course of construction. We feel that there is cause for reasonable doubt on the matter of adherence to design specifications.

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\*Federation of Filipino Scientists

- 1.3 We are very concerned about the handling, storage and disposal of the spent fuel and other radioactive material. Regarding spent fuel, while short-term storage on site of up to 10 years has been provided for, we are not aware of any plans for intermediate (up to 30 years) and long term (30+ years) storage and disposal. Regarding low-level radioactive material, it should be noted that they form the bulk of the radioactive material. While there is a 5-year on-site plan for them, there are no medium or long-term plans. We feel that it is an irresponsible risk to commence operation in the absence of such medium and long-term measures.
- 1.4 While an Emergency Response Plan (ERP) has been formulated, it is still untested and therefore, there is lack of confidence as to whether it will work. We would like to be assured that all concerned in this plan are able to cope during an emergency. Also that education campaigns and periodic drills are conducted in neighboring communities in order to minimize panic when evacuation of people becomes necessary.

## 2.0 OPERATION

The Operation and Maintenance of the PNPP-1 is the responsibility of the National Power Corporation (NPC). Because of the sophistication, cost and inherent dangers in operating PNPP-1, we worry whether the NPC has the adequate pool of competent and experienced manpower to run the plant efficiently and to cope with any emergency that may arise. We can not afford to treat a nuclear reactor like an automated black box. While under routine conditions, this may be such, in cases of emergency, we need knowledgeable, competent and experienced personnel who can analyze the problems and make the decisions.

The International Atomic Energy Agency (IAEA) has detailed the manpower requirements for a nuclear power plant of the size of PNPP-1. Below is a summary of their manpower requirements:

**TABLE 1. MANPOWER ACCORDING TO IAEA REQUIREMENTS**

<i>Function</i>	<i>Number with M.S.*</i>	<i>Average Years of Experience**</i>	<i>Number w/ B.S. Technical* Training</i>	<i>Average Years of Experience**</i>
Operation & Maintenance	12	8-10	170-270	5-10
QC/QA	1	5-8	80-120	2-3
Nuclear Waste Management	6	5-10	140	3-5

\*Education, Experience and Specialized Training must be in nuclear power plants.

\*\*Average Years of Experience refers to specific experience in nuclear power plants.

We are aware that the NPC has been sending personnel for training, but we question the adequacy of their background and experience when judged by the foregoing IAEA requirements.

The Operation and Maintenance activities comprise only one facet of a functioning nuclear power plant. In addition to this, expert and experienced manpower is also needed for other activities such as: Procurement, Quality Assurance/Quality Control (QC/QA) and Nuclear Fuel Waste Management. As can be seen above the IAEA has also detailed the manpower qualifications for these activities. We are unsure as to whether these aspects of the nuclear facility are adequately provided for.

### 3.0 REGULATION

The PAEC is empowered by law as the regulatory body, which will certify that the PNPP-1 complies with all safety requirements during all stages in the life of the nuclear plant. This is a tremendous responsibility which should not be compromised for any reason. In particular we are concerned that PAEC remain independent of any political or economic interests.

The IAEA has also provided norms for manpower requirements for this aspect of regulation:

**TABLE 2. MANPOWER ACCORDING TO IAEA REQUIREMENTS**

<i>Function</i>	<i>Number with M.S.*</i>	<i>Average Years of Experience**</i>	<i>Number B.S. Technical* Training</i>	<i>Average Years of Experience**</i>
Nuclear Licensing & Regulation	9	8-10	12-25	8-10
Inspection & Enforcement	2	8-10	45-65	2-3

\*Education, Experience and Specialized Training must be in nuclear power plants.

\*\*Average Years of Experience refers to specific experience in nuclear power plants.

A checklist of PAEC personnel, their background and expertise, and the duties (other than those connected with regulation of PNPP-1) assigned to them would show that PAEC does not have the needed personnel according to IAEA standards. Moreover, they also lack needed financial and other resources. Finally, we are concerned that they may not have the fullest support of higher government authorities in their difficult responsibility of regulation and enforcement.

### 4.0 ECONOMIC VIABILITY.

The economic considerations around the PNPP-1 should include *all* related costs, such as preliminary investigation, construction, fuel cost, operation, maintenance, radioactive wastes disposal, and emergency programs.

#### **4.1 *Preliminary Investigation and Construction Costs.***

The preliminary investigation by EBASCO Overseas Services cost at least \$30 million. In 1974, the estimated cost of construction was \$1.1 billion. The total outlay to date is about \$1.95 billion and is expected to rise.

#### **4.2 *Fuel Cost.***

The fuel for the reactor consists of 7,700,000 sixteen-gram pellets of uranium dioxide, which will cost some US\$60 million for the first loading. Each year thereafter, one-third of this loading needs to be replaced, thus adding at least US\$20 million to the annual operation cost of PNPP-1. The price of uranium was \$7 a pound in 1973. By 1977 the cost had risen to \$40 a pound. It is clear therefore that to change from uranium to oil does not modify our dependency but simply changes dependencies.

#### **4.3 *Services of Foreign Experts.***

Since the Philippines has essentially no experience in nuclear power technology, it will have to rely on foreign experts (i.e. Westinghouse), at least during its early years of operation. (From the IAEA requirements in 2.0 and 3.0 above it is clear that NPC will have to depend on foreign experts). We are aware of the very high cost of services of foreign experts.

#### **4.4 *Radioactive Wastes Management and Disposal.***

There is as yet no permanent provision for this highly-dangerous spent fuel and low-level radioactive material. Any such provision will surely be costly. Shipping out to countries like the U.S. and France for reprocessing is unlikely because reprocessing cost is presently higher than the cost of uranium.

#### **4.5 *Decommissioning.***

The PNPP-1 has a 30-year life, after which it has to be "decommissioned". Because the plant is highly contaminated, it must either be permanently entombed in concrete (present estimate: US\$10 million) or dismantled and all contaminated parts including several layers of the soil surrounding it buried (estimated cost, though of highly questionable feasibility: US\$100 million).

#### **4.6 *Cost of Electricity and Outages.***

In 1981, one estimate of the cost of generating electricity was US\$0.09 per kilowatt-hour, assuming the plant were operating at 60% capacity at least. Coal-fired plants were estimated to produce electricity at US\$0.05 per kw-hr and oil-fired plants cost US\$0.09 per kw-hr, using the prevailing oil price then. The above estimate of US\$0.09 per kw-hr is based on the plant performing at high efficiency. However it can be foreseen that there will be frequent outages because of safety requirements or technical problems. These will add considerably to the cost of generating electricity.

#### **4.7 *Cost of Accidents.***

The most recent publicized nuclear plant accident occurred at Three Mile Island (Pennsylvania, USA) in 1979. The cost of environmental clean-up and of installing additional safety features in the physical plant has so far cost the US ca. US\$2 billion, and the work is not yet finished. Even if we concede that the upwards of \$2 billion already invested is non-recoverable, if the plant does not operate, it is still valid to question the cost-effectiveness of PNPP-1 compared to

alternative sources of energy which may be developed. A study should be made of the expected costs over the expected lifetime of 30 years and a comparison made with alternate sources of energy to see if the economic arguments in favor of PNPP-1 still hold true. Even the U.S. in very recent times has abandoned nearly-completed nuclear plant construction projects due to escalating cost of the stringent safety requirements of these plants.

## 5.0 ENVIRONMENTAL IMPACT AND HEALTH HAZARDS

The waste heat and the radioactive wastewater that is released to the environment will threaten and disrupt the aquatic ecosystem near the PNPP-1. Such routine release of low-level radioactivity into the environment is unavoidable during the normal operation of the plant.

The correlation between exposure to low-level ionizing radiation and incidence of cancer, leukemia, birth defects and other genetic mutations is well-documented. In the case of genetic mutations, one cannot assume a "safe level" or "threshold" below which harm is impossible. There are no available studies to date regarding impact of waste heat and radiation on local ecosystems. Available data regarding such impact are for ecosystems in temperate climates. Thus the NPC monitors environmental parameters based on a model developed in temperate countries. There is no local model which considers our local ecosystems as well as the radio-sensitivity of Filipinos. Because of lack of such local studies and models there can be no valid interpretation of the data collected by NPC. NPC claims that it is not a research institute. This cannot be an acceptable excuse to forego an assessment of the environmental impact of PNPP-1. Competent researchers are available in several universities and research institutes in the country who may be contracted to perform this assessment.

## 6.0 THE SOCIAL AND CULTURAL FACTOR

There is also a serious risk from what we may call the socio-cultural factor. Recent incidents like the construction defect in the PASAR plant, the grave mistakes in the CELLOPHIL Plant, the serious error in the transformation of cement plants from oil to coal power, the frequent brownouts in the Luzon grid, raise serious questions about our ability to handle complex technologies. It is not only a question of technical expertise; it is also a question of discipline, safety, professional and social outlook. In the case of the above failures, we have paid a very high economic price. In the case of a similar failure in PNPP-1, we will also pay the price of a nuclear disaster.

## RECOMMENDATIONS

In view of the very serious consequences of a hasty decision to allow the PNPP-1 to operate soon, the KSP recommends the following courses of action to resolve the controversy surrounding this issue:

- (1) A structured and organized *public hearing* should be conducted soon, which should touch on all issues being raised by all sectors. The proper authorities and all competent persons available should be invited to this open discussion. Adequate time should be allowed, especially on the most controversial aspects. During this hearing, all needed documents and information should be made available.

- (2) PAEC must be provided all necessary *support* to execute its regulatory function. It should be given the necessary time and resources to carry out its evaluation and prepare its Safety Evaluation Report, with the assistance of international nuclear technology experts, such as the IAEA, if necessary.
- (3) The social impact of the PNPP-1 cannot be disregarded. This nuclear venture was initiated without any direct input from the Filipino people, whose taxes finance this project. The view of the general public should be consulted via a *plebiscite* in the affected regions (Region 3, 4, NCR) after the public hearing has been held and the major questions and answers brought forth in this hearing have been widely disseminated.

The license for NPC to operate the PNNP-1 should not be granted until all the three courses of action specified above have been carried out and a *positive affirmation* for the operation of the PNNP-1 is obtained from them.

### Scientists Journey to Pacific Islands

Twenty scientists from Australia and other countries will undertake a six-month expedition to the Bismarck Archipelago of Papua New Guinea to seek to study aspects of the origins of a Pacific people.

Mostly leaders in their particular fields of Pacific prehistory, the scientists will come from Australia, the United States, New Zealand, Papua New Guinea, the Netherlands and Britain.

They will join an expedition sponsored by the National Geographic Society and the Australian National University's (ANU) Research School of Pacific Studies. The expedition is supported by a 20m (65 ft) schooner- the Dick Smith Explorer — which left Sydney in mid-April and will return in September.

Technology relating to sea travel and horticulture will be the focus of some interest, and researchers will study the spread of obsidian, a volcanic glass valued by prehistoric Melanesians for its use as weapons and tools.

Dr. Allen said archaeological work had been carried out in the area for the past 20 years, but the effort had been piecemeal and fragmented. There remained enormous gaps in general picture of developments of the archipelago.

"We anticipate that by using this technique of bringing a lot of the people together for a large expedition we will not only get the work done faster, but there will be much intellectual exchange," he said. "The area we are studying is crucial to understanding Pacific prehistory as a whole."

### Chinese Academy of Sciences To Forge Tie With NAST

Preparations are up for an agreement on the scientific cooperation and friendship between the Chinese Academy of Sciences and the National Academy of Science and Technology (Philippines).

The draft of the Agreement is now under study by the Inter-Agency Committee on Socialist Countries, which is based at the National Economic Development Authority.

If things push through, the scientific cooperation between the two countries will cover under certain terms the following clauses —

- \* exchange of scientists for conducting short visits, giving lectures as well as participating in scientific work for purposes of carrying out joint research projects;
- \* undertaking joint symposia or conferences;
- \* exchange of scientific information, books, journals, microfilm, seeds and plant seedlings and copying photos;
- \* encourage direct liaison and scientific cooperation between institutes and universities.

### **American Anthropological Association Meets in Denver**

Dr. Alfredo V. Lagmay, Academician, was conferred the 1984 Distinguished Service Award for significant contributions to psychology and the social sciences, in special ceremonies held during the annual meeting of the American Anthropological Association in Denver, Colorado, USA, last November 17, 1984. The award of distinction to Dr. Lagmay, the only Asian to receive it so far, was given together with Prof. Cora DuBois of Harvard and Prof. George D. Spindler of Stanford by the Association of Anthropological Diplomacy, Politics and Society, in cooperation with the Association of Third World Anthropologists.

**Dr. Lagmay  
Is Conferred  
'84  
Distinguished  
Service Award**

In his acceptance speech, Academician Lagmay dealt with a growing focus of attention in Philippine and third world social science on the indigenization of social psychological concepts and the necessity for developing new epistemologies for the social sciences which emphasize the unique experiential endowments of the culture bearer. (Prof. Lagmay discussed this problem in an invitational experts meeting of 16 scholars he attended in UNESCO, Paris, on endogenous development last October 2-7, 1983 — Ed.)

Prof. Lagmay thanked the distinguished audience for the award in behalf of his country, the University of the Philippines, and the National Academy of Science and Technology of the Philippines.

### **The Meaning of Endogenous Development in Social Science**

Dr. Alfredo V. Lagmay had three occasions to discuss the idea of endogenous development in the social sciences during the two international congresses recently held in Acapulco, Mexico: the International Congress of Cross-Cultural Psychology (ICCP) held on August 29 — September 1, 1984, and the International Congress of Psychology (ICP) on September 2-7, 1984.

Academician Lagmay read two papers at the ICP: (1) *Idiographic Premises of Knowledge Formation and the Third World Social Scientist* and (2) *The Primacy of the Culture Bearer in Social Science Research: Indigenous Frameworks of Epistemology in Science*, both of which dealt with the problem of western social science concepts and how it has created special difficulties for third world countries, particularly in the Philippines, in

many areas of basic research on social phenomena and in behavioral technology as well. He traced some of the problems back to the nature of western epistemological assumptions on knowledge formation and how these dominating premises have influenced our ways of thinking as to what is important in our culture and our perceptions of it. He proposed that we study very carefully alternative ways of looking at our science, with emphasis on the role of the scientist-culture-bearer as the generator of knowledge. In the second paper especially, he indicated some issues on how the present day graduate training of social scientists may be modified and re-oriented so that the indigenous elements of his experiential equipment may be brought into greater prominence.

The ICCP paper entitled *Bahala Na: Exogenously-Induced Dysfunctional Interpretations of Filipino Risk-Taking Response Under Uncertainty* showed how a direct analysis of a culture bearer's response to an ambiguous situation can reveal unexpected dimensions of Filipino character and how gratuitous foreign interpretations have intruded themselves into an indigenous social response to uncertainty.

Prof. Lagmay, as representative of the Philippines in the International Congress in Acapulco, formally announced the intent of the Philippines to bid for Manila as the venue for the holding of the International Congress of Psychology sometime in the future.

**Indian  
Scientist  
Here**

Prof. B.K. Bacchawat, Director of the Indian Institute of Chemical Biology (IICB) in Calcutta was here from October 18-26, 1984. He was the first recipient of the benefits covered by an exchange agreement between the National Academy of Science and Technology and the Indian National Science Academy.

A noted biochemist, Prof. Bacchawat attended a symposium on plant proteins and toxins and the Council meeting of the Federation of Asian and Oceanian Biochemists, (FAOB) where he is also president.

He also visited several research institutes namely: International Rice Research Institute (IRRI), Institutes of Biotechnology and Applied Microbiology (BIOTECH), Institute of Plant Breeding (IPB), National Institute of Science and Technology (NIST), Food and Nutrition Research Institute (FNRI) and UP College of Medicine's Dept. of Biochemistry.

At a meeting with senior researchers of NIST, Prof. Bacchawat briefed them of his researches on lectins, glycoconjugates and liposomes as well as others being done at his Institute. The IICB, he said, has a staff of 77 Ph. D.'s and 50 M.Sc.'s. He invited NIST to send researchers for training or study visit at the IICB.

\* \* \*

*And science, we should insist, better than any other discipline, can hold up to its students and followers an ideal of patient devotion to the search for objective truth, with vision unclouded by personal or political motive.*

— Sir Henry Hallett Dalt

**Implementation of  
Academy Fellow  
Ready January '84**

Any member of the Academy may now apply for fellowship in research activities including scholastic pursuits such as writing technical/scientific papers or books. These research activities should be along the areas of specialization of the grantee. A monthly honorarium of ₱5,000 — 10,000 will be given. This was ruled during the Executive Council meeting held earlier this year.

Likewise it was ruled that awarding of this fellowship shall be done through a contract appointing the academician, including a memorandum of agreement between the NAST and the home institution of the grantee.

All grants shall not exceed one year, however, these, upon review, are renewable by the year thereafter.

**Evaluation  
Committee  
Formed**

Three academicians will compose the evaluation committees for each of the different fields. The Executive Council shall create these committees, and may solicit technical assistance from other fields.

In order to standardize the compensation for research assistants, the NSTA salary scale for science research specialist I-IV, science research assistants I-II and science aide. will be utilized.

The research fellow program was promulgated in pursuance of the mandatory provision of P.D. 1003-A section 7(c). It was ruled that the program shall be operationalized by the NAST Executive Council.

**at UK**

**C. R. Baltazar  
Visits London  
Completes  
Philippine  
Insects  
Inventory**

Dr. Clare R. Baltazar, Academician and Professor of Entomology at the University of the Philippines at Los Baños, visited London for six weeks starting March 14, 1984, to complete a research on the *Inventory of Philippine Insects*. The visit was made under the exchange agreement between the Royal Society of London and the National Academy of Science and Technology.

Since 1976, Dr. Baltazar has accumulated and systematically arranged data on the number and diversity of insects in the Philippines — a basic need to all researchers in entomology, particularly those parts related to agriculture, forestry, medicine and veterinary science. But, the work could not be completed because the libraries and facilities in the Philippines are incomplete in their collections of old European journals and insect reference collections which are needed in the study. According to Dr. Baltazar, early workers on Philippine insects were European entomologists and some of the specimens are with the British Museum of Natural History.

Dr. Baltazar worked closely for six weeks with leading entomologists at the Museum on the latest systematic arrangements of species in the different orders of insects. She also examined its vast collections of insects especially those from the Philippines and neighboring Pacific Islands and consulted references relevant to Philippine studies.

The research when published will be a source of information on both beneficial and destructive insects. Dr. Baltazar said: "At this time when imported pesticides are scarce and expensive, it is high time to utilize and tap our numerous parasitic and predatory insects to control pests of economic importance."

Dr. Baltazar donated specimens of parasitic wasps and gave lectures on Philippine wasps, bees, ants and butterflies at the British Museum.

**NAST  
Nominates  
Dr. Ricardo  
Lantican  
for Albert  
Einstein  
World Prize  
for Science**

The NAST has recently nominated Dr. Ricardo M. Lantican for the Albert Einstein World Prize for Science which gives recognition to researches in science and technology, such as investigations which bring real benefits to the countries where they have been undertaken. Those which is of real importance to other countries will also be considered. Research leading to increased natural food supplies, those which preserve the habitat, and exploitation of new forms of energy are examples of works that may compete.

Dr. Lantican, it will be recalled, was an IBM awardee during the silver anniversary celebration of the NSTA. Until recently, he served as director of the Institute of Plant Breeding at UPLB.

This announcement on Albert Einstein World Prize was sent in a communication to the Ministry of Foreign Affairs by Esteban Meszaros to the secretary general of the World Cultural Council (WCC), the body giving out this prize. Aside from the world recognition that the prize connotes, the council has established an amount in cash, which will be awarded by personalities recognized in the scientific world. Altogether the award will be an amount of MN 1,700,000.00 (roughly \$10,000.00), a gold medal and a diploma.

Once the nominations are received, a plenary session will be held among members of an interdisciplinary committee. The jury which will announce the winners will be presided by Dr. Charles Tanford, who is the actual president of the steering committee of the WCC.

Dr. Lantican who was nominated for his outstanding works — these have contributed to the country's agricultural growth — is aptly put by the Executive Council in his nomination to the Albert Einstein World Prize for Science:

"The country's development efforts depend to a great extent on the technical support given by men and women of science and technology. We are fortunate enough to have in our midst outstanding scientists who are committed to national development and progress.

Perhaps in no other area has the impact of science and technology been more clearly evident than in agriculture. Agricultural research has made possible the development and transfer of better technology now benefitting the Filipino farmer. The agricultural scientists, therefore, constitute a force that has kept Philippine agriculture moving. There are many who have contributed greatly to the nation's agricultural development program. A few, however, have distinguished themselves to be ranked among the leading agricultural scientists of the century. One of them is Dr. Ricardo Manzo Lantican, a professor, a researcher, an achiever, a man of science. Dr. Lantican's accomplishments typify the enormous and invaluable contributions of a scientist to national development."

*It was previously a question of finding out whether or not life had to have a meaning to be lived. It now becomes clear, on the contrary, that it will be lived all the better if it has no meaning.*

— Albert Camus

**FASAS  
Executive  
Council  
Meets**

A meeting of the Executive Council of the Federation of Asian Scientific Academies and Societies (FASAS) was held in Nepal, Katmandu, last December 4, 1984, at the Royal Nepal Academy of Science and Technology. Dr. Paulo C. Campos, NAST President and a member of the said Council attended the meeting.

According to Dr. Campos, the Council discussed future activities of the Federation for the next 5 years and these included:

- \* *Training/Workshops* — A number of training/workshops to be undertaken by FASAS were lined-up.
- \* *FASAS Newsletter* — FASAS must have its own newsletter for dissemination of information among the neighboring countries.
- \* *Low-cost Publication* — Subscriptions to periodicals are expensive and it was felt that FASAS negotiate with the publishers of important international scientific periodicals to reprint and make them available in Asian countries at low cost.
- \* *Asian Journal of Science and Technology* — Conditions of research and technology development in the Asian countries are different from that of the rest of the world; thus, the need for a journal reflecting useful work being done in the region.
- \* *Status Report* — Member academies/scientific societies collaborate in preparing regional scientific documents which may help national governments development planning in the region.
- \* *FASAS Funding* — To solve problems common in the region, such as those on health, population, inadequate and wasteful utilization of natural resources, and export of raw materials and import of finished products, it was felt that FASAS should collaborate with international funding bodies which are working for the common cause.
- \* *Inclusion of other Academies/Societies of the Asian Region* — Academies and scientific societies in Asia which are still not member of FASAS will be invited to join.

The next Council meeting will be held in Kuala Lumpur, Malaysia, December 1985.

Meanwhile a number of trainings/workshops to be undertaken by FASAS in 1985 were identified during said meeting. These are:

**FASAS  
Trainings/Workshops**

- \* *Malaysia*
  - \* Chemistry; Technology and processing of oils; and Management of natural oils
- \* *Bangladesh*
  - \* Enzyme engineering and Herbal medicine and drugs
- \* *India*
  - \* Water desalination; Central Salt and and Marine Chemical Research Institute, Bharnager
  - \* Pharmacological techniques for evaluation of medicinal plants; CDRI, Lucknow

- \* Population control; Institute of Health and Family Welfare, Advanced and study on heat transfer equipment design; Pune
- \* Promotion of space research.
- \* *Singapore*
  - \* Microcomputer interfacing to instruments and System science
- \* *China*
  - \* Population planning and technology

**FASAS  
to hold  
Two  
Workshops**

The Federation of Asian Scientific Academies and Societies (FASAS), of which the NAST is a founding member, decided in a recent meeting to hold two workshops: One, on geophysical explorations for groundwater resources at NGRI, Hyderabad, and another on enzyme engineering at the Indian Institute of Chemical Biology in Calcutta.

Workshops on population planning and technology in China, palm oil technology in Malaysia, microprocessors in Singapore, and biotechnology in India are also being considered for 1985.

**FAOB  
Meets in  
O.C.**

A regional symposium on biochemistry in food and energy production was held from October 21-24, at the Asian Institute of Tourism in Diliman, Quezon City.

This brought together biochemical researchers and educators, particularly the member countries of the Federation of Asian and Oceanian Biochemists who are working on different biochemical aspects of food and energy production.

Papers reflected efforts made in biochemical research in this region. According to Dr. Clara Y. Lim-Sylianco, Academician and adviser of the organizing committee, it is envisioned that the participants would in the future be able to collaborate in R & D work on food and energy. This symposium was held to promote regional collaboration in R & D to show participants the different aspects of biochemical research being done towards improved food and energy production, particularly in the Asian and Pacific regions.

This was organized by the Philippine Biochemical Society (PBS), and the Federation of Asian and Oceanian Biochemists (FAOB), a regional organization of 15 member countries devoted to the promotion of biochemistry in Asian and Pacific regions. The PBS has 170 regular members, mostly biochemistry teachers and researchers from all over the country, the object of which is to promote the advancement of biochemistry knowledge in the Philippines.

A conference on the International Scientific Study on the Impact of Oil Spill in the Persian Gulf was held in Tehran, Iran last May 20-27, 1984. It was sponsored by the scientific institutions of the Islamic Republic of Iran in cooperation with Tehran university.

**Other  
International  
Meets**

This was held following a study and research made on the adverse effects of the oil slick and the environmental contamination of the Persian Gulf.

Topics of papers discussed touched on researches made on water pollution with oil particles, effects of physical and chemical pollution, biological effects of marine life, pollution in connection with the international law of seas and point of view of Islam on the biological environment.

**Asian Congress of Pharmacology**

The Asian Congress of Pharmacology is scheduled to be held 15-19 January 1985 in *New Delhi*. This was announced by the International Union of Pharmacology, Indian Pharmacological Society and Indian National Science Academy, the sponsoring organizations. The scientific program was developed around the central theme of the congress, namely: Pharmacology for Health in Asia. The following subjects have been tentatively identified for symposia and plenary lectures: The current status of research on natural products including traditional remedies; chemotherapy of parasitic diseases; clinical pharmacology of contraceptive agents; nutrition and drug action; environmental toxicology in developing countries and many others.

**“Towards the Future”**

**Brisbane is Site  
of Parasitology Congress**

The sixth international parasitology congress with the theme “Towards the Future” will be held at the University of Queensland from April 24-30, 1985.

About 1000 delegates from 22 countries, including India and the Philippines, are expected to attend the one – week program which is held every four years as a forum for discussion of problems and developments in parasitology.

The Premier of Queensland, Sir Joh Bjelke-Petersen, said Queensland was especially suitable for the congress because of its tropical location and the state’s record of scientific achievements.

The head of the Department of Parasitology at the University of Queensland, Dr. Colin Dobson, said the Brisbane convention would cover six areas: molecules, cells and parasites; parasites and human health, the parasite assemblage; parasitism in aquatic environments; productivity; and animal health.

### **CIOMS Holds Health Policy, Ethics and Human Values Confab**

The Council for International Organizations of Medical Sciences (CIOMS) convened an international conference on "Health Policy, Ethics and Human Values – an International Dialogue" in Athens, Greece, 29 October – 2 November 1984.

The conference, coordinated with the World Health Organization, and its concerns coincided with those of WHO, particularly equity, justice, community participation and the dignity of individuals in sickness and health, as expressed in the goal of Health for All by the Year 2000.

As expected, an important outcome of this conference was the identification of major issues that are of interest and concern in this field, particularly those that would bear follow-on exploration and possible action steps. The identification of these major issues was the leading role of a core group – health policy makers, ethicists, philosophers, and sociologists from different cultural groupings. Discussion groups were used liberally to maximize creative exploration, particularly of national and cultural differences and similarities.

The conference was attended by 150-200 persons – health policy makers, scholars, representatives of international and national government and nongovernmental organizations and institutions.

English was the working language of the conference and the proceedings will subsequently be published.

Special room rates in the Astir Palace Hotel, Vouliagmeni were made available.

### **Different Forms of Health Care**

Many, perhaps most, health decisions raise ethical questions. Policies having to do with who shall receive health services, how resources shall be allocated, which criteria should be used in setting priorities, what constitutes acceptable forms of health care, when health care should be begun or ended, even the matter of who should be involved in making policy decisions, all have inherent ethical components.

Different national, cultural and religious traditions yield different ethical value systems, and their interactions with health policy-making will therefore vary from country to country.

Many factors other than ethics influence policy decisions. Political, economic cultural, religious and organizational issues can obscure, distort, displace, or promote ethical considerations. Of considerable interest and importance is the dynamics of policy-making whereby ethical values are taken into account or lost from sight as policies are formulated.

With these issues in mind, this international conference on ethics and health policy was convened. The conference aimed at:

- \* identification and comparison of the ethical content of selected health policy issues from the perspective of different national, cultural and religious settings;
- \* examination of the interaction of ethical factors and other determinants of health policy in the policy-making process in those different settings;
- \* exploration of activities and arrangements that could assist interested countries in enhancing their capacities for dealing with the interaction of ethics and health policy-making.
- \* consideration of the usefulness of this kind of dialogue, which draws from the roots of human values in each culture, in promoting better international understanding across cultural, economic and political lines.

Key participants were health policy-makers and health ethicists from different cultural, religious and ideological groupings. Other participants invited on the basis of their experience and insights into these issues. The heart of the conference were discussions among participants of the selected policy issues and their ethical implications, together with social, cultural, religious, political and scientific matters that bear on them.

Policy issues with ethical content were selected with a concern for their applicability to both less developed and more developed countries, such as:

- Allocation of Resources for Primary Health Care  
(Equality of access, Merit or social contribution; Improvement of health statistics; Roles of communities in decision-making about priorities and programmes)
- Public Policy and Hereditary Disease  
(Economic and social burdens; Voluntary or compulsory screening for trait and disease; Regulation of marriage and/or procreation)
- Care of Low Birth Weight Infants  
(A cut-off weight below which care will not be provided; The nature of the moral claim of the infant; Familial discretion; The technological imperative)
- Health Care of the Elderly  
(Age as a criterion for withholding care; Age as a priority criterion for providing care)
- Organ Substitution Therapy  
(The priority for organ substitution therapy; The method of allocating access to substitution therapy; Organ salvage vs. organ donation; The marketing of organ substitution and replacement)

*In teaching it is the method and not the content that is the message . . . the drawing out, not the pumping in.*

— *Ashey Montagu*

## Statistical Methods for Food and Agriculture

### Book Reviews

By F. E. BENDER, Ph. D., Associate Dean, College of Agriculture; L. W. DOUGLASS, Ph. D., Associate Professor of Dairy Science A. KRAMER, Ph. D., Professor Emeritus, Food Science All of University of Maryland, College Park, MD

The range of techniques and applications explained and demonstrated in each section provide a substantial course of study for those in business, government and universities dealing with food, agriculture and economics. References lead to more detailed presentations for those desiring additional specialized information.

### Tissue Culture of Trees

Edited by JOHN H. DODDS, Ph. D., Professor, Centro de Investigacion y de Estudios Avanzados del IPN University of Irapuato, Irapuato, Mexico

This new book covers the *in-vitro* growth of major groups including hardwoods, softwoods, palms, ornamentals and fruits. Emphasis is placed on the technique of micropropagation, as well as in more specialized areas such as storage of genetic resources and application of protoplast technology.

"The brevity of the book should not be interpreted as an absence of data, but as a reflection of a newly emerging aspect of tissue culture. This book serves as a good introduction to, and a review of, the field of tree tissue culture. Recommended for college and university libraries serving the needs of students and researchers in plant tissue culture, forestry, horticulture, and biotechnology." *Choice/American Library Association*.

### New Tropical Vegetable Book Aids Growers and Researchers

*Vegetables in the Tropics* by H. D. Tindall provides concise information on the cultural and environmental requirements of about 140 vegetable crops grown in tropical regions.

Information given for each vegetable crop includes: climatic and soil requirements, propagation and establishment, crop density, soil fertility, irrigation, and reference to any special treatments such as staking or pruning. The crop details are given under family headings since many crops of the same plant family frequently have similar cultural requirements.

Major pests and diseases which affect these crops are listed for each family in a comprehensive appendix. Brief details of yield, nutritional content, postharvest handling, preparation for market and storage, are included for most crops, together with outlines of seed production techniques. A thorough list of references, a bibliography to aid extended reading, and many photographs, charts and drawings, also support the text.

*Vegetables in the Tropics* will serve well as a textbook, and as a reference for extension service staff and researchers who work with tropical crops and seek to develop the potential for increased production.

H.D. Tindall is Professor of Tropical Agronomy at the National College of Agricultural Engineering in Silsoe, England. In over 30 years of research and practical experience, Professor Tindall has published two other related books, many scientific papers, and he has traveled extensively in the tropics as an acknowledged expert in tropical horticulture.

# Academy News

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