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Tea terraces on state farms in Anhui Province, China. See page 898. [Nancie L. Gonzalez, Department of Anthropology, University of Maryland, College Park 20742]

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Applied Biology in Developing Countries

In the near future, advances in biology will be important to the developed countries. However, the impact of advances on some of the less developed countries will be even greater. In the developed countries the big unmet need that will be supplied is for pharmaceuticals effective in combating viral diseases in humans and animals. Improvements in medicine will be welcomed everywhere, but the people of the less developed countries have even more urgent needs—food, cooking fuel, and other forms of energy. In most of the world, outside of Africa, per capita production of food has been increasing, but to maintain this trend will require continued efforts and new advances. In many countries supplies of firewood are being depleted, accompanied by soil erosion. Costs of oil and fertilizer have become nearly prohibitive and long-term prospects are even worse. Thus, around the world, news of advances in applied biology has been noted with great interest. Research has been discussed, planned, or initiated in many countries. Priorities differ according to local needs. For example, in the Philippines,* the National Institute of Biotechnology and Applied Microbiology has accorded priority to research in biofuels; nitrogen fixation; food fermentation; plant hydrocarbons; antibiotics, vaccines, and microbial insecticides; and biomass production. India has chosen genetic engineering, photosynthesis, tissue culture, enzyme engineering, alcohol fermentation, and immunotechnology as priority areas.

In the Philippines, Imelda Romualdez Marcos, who is First Lady of the Republic, Minister of Human Settlements, Member of Parliament, and Governor of Metropolitan Manila, has been active in pushing for reforestation. In a book which she edited,† she has written of the potentials of plantation forestry. She points out that managed forests can outproduce natural growth by factors of 5 to 10. She also notes the potentials of biomass as a source of glucose for fermentation or as a fuel for small rural electric power plants.

Nitrogen fixation by plants is universally regarded as a high-priority goal. In the United States there has been much talk of incorporating nitrogen fixing genes in corn. But at least 17 genes are involved in the nitrogen fixing systems, and success in reaching the goal may be elusive. Practical success is likely to come sooner in the rice paddies of Southeast Asia. Indeed, for centuries the Chinese and Vietnamese have maintained agronomic practices leading to natural fixation of nitrogen. A number of mechanisms exist. In the rice paddy, conditions are favorable to fixation of nitrogen. Blue-green algae are one type of nitrogen fixer. Another is bacterial flora associated with rice roots. Improvements in the capabilities of such organisms through either selection or genetic engineering may be feasible.

Rice is the principal cereal grain consumed by most of the world's population. Development of new strains at the International Rice Research Institute (IRRI) in the Philippines during the past two decades has been an important factor in meeting increased needs for food. Recently, new strains have been developed that grow well under such adverse soil conditions as salinity and alkalinity. Their adoption will increase production. M. S. Swaminathan, the director of IRRI, suggests that additional improvements in yield can be obtained at his institute by applying both conventional and new recombinant DNA methods.

If and when advances in biotechnology are achieved that are applicable to world needs, mechanisms will exist for their transfer around the world. A remarkable international framework is in place, financed in part by the Agency for International Development. As a result of the stimulus of the Green Revolution, governments are aware of potentials for improving crop yields and are maintaining indigenous agricultural stations capable of acting as centers for technology transfer.—PHILIP H. ABELSON

*M.S. Swaminathan, paper presented at the Workshop on Priorities in Biotechnology Research for International Development, National Academy of Sciences, Washington, D.C., 26 to 30 July 1982. †*The Energy Crisis and the Philippine Experience*, Office of Media Affairs, Manila, 1982.