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War on Hunger

A Report from The Agency for International Development

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COVER: Nigerian women lay out cassava to dry. This eliminates the toxic substance naturally present in the tuber. The improvement of cassava is one of the activities of the International Institute of Tropical Agriculture. (See page 1)

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Farmers in a field capture rats by traditional methods in the Philippines. An AID-funded research project has developed new techniques for controlling rodent damage to crops. (See page 5)

Of Seed and Man—II

Mechanization appropriate for small farmers is being studied in IITA's farming systems program. Several simple, inexpensive pieces developed by an Institute engineer are being tested for feasibility in the development of tropical agriculture.

International Institute Of Tropical Agriculture Wages Battle to Improve Food Crops in Poor Lands

By Alexanderina Shuler

The harvest is over in Liberia and a local farmer tallies the entries in his record book. He discovers that his five-acre farm has yielded twice as much rice as in any previous year.

In Tanzania, a rural family harvests more than double the yield of cowpeas they were able to get from their small plot the year before. Another boon—cowpeas are high in protein, something many people of the tropics sorely lack in their daily diets.

These are some of the tangible benefits of research being performed by a team of agricultural scientists at the International Institute of Tropical Agriculture, an institution located at Ibadan, Nigeria, and supported by

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Ms. Shuler is Editor of Front Lines, *an internal AID publication. Her article continues the* War on Hunger *series on the international agricultural research centers. Photos by IITA and author.*

Field days are emphasized at the Institute. Trainees note mosaic disease on the leaves of cassava plants.

the U. S. Agency for International Development along with the Ford and Rockefeller Foundations, the Canadian International Development Agency, the Overseas Development Ministry of the United Kingdom, the International Bank for Reconstruction and Development, the U.N. Environment Program and the Governments of Nigeria, West Germany, Belgium, the Netherlands, and Iran.

The IITA was created eight years ago, primarily to respond to the urgent needs of the developing countries in Africa which face a common problem—how and what to feed their growing populations. Quantity is critical; they need more food. Quality is a close second; diets must be made more nutritious.

The IITA is one of the eight facilities that make up the AID-supported Consultative Group for International Agricultural Research. All have the same goal: to develop better plants, improve farming systems and increase the nutritional value of indigenous foods. All are responsible for work that extends beyond the scope of a single nation and to ensure that intracontinental efforts reinforce, not duplicate or compete with one another.

U.S. agriculturist William K. Gamble heads up the 55-member senior scientific staff from 19 countries. He notes that the Government of Nigeria contributed 2,500 acres for the facility and the IITA is established as an autonomous, nonprofit corporation. The Ford Foundation provided funds for the construction of the facilities for IITA and a number of donors including AID provide the continuing support required. Each year AID provides about 25 percent of the Institute's budget and in 1976 AID's contribution will total approximately $2.5 million.

Dr. Gamble says, "In the humid tropics, IITA's work involves more than developing new crop varieties or finding ways to control the factors that limit production. A major goal is to develop continuously productive farming systems for the humid tropics to replace shifting cultivation. Distributing improved plant material and disseminating knowledge of improved farming practices to other research centers and to national food production programs throughout the tropics will be the measure of our success."

The IITA cooperates with in-country and foreign research and development institutions and agencies to assure that crop varieties and farming systems developed are suited to a specific ecological zone and its soil, climate, and other agricultural variables.

"The Institute was created to serve as a backstop and is not intended to replace on-going research by other facilities, each of which has its own area of concentration, ranging from cocoa to maize or rice production to storage problems, to livestock production, to agricultural economics," Dr. Gamble says.

Most of the early research efforts were carried out at the Ibadan site, but the Institute now places great importance on strengthening existing and developing new cooperative contacts or "linkages" with national programs in other African countries. These cooperative relationships are basic to the international character of the Institute and provide essential feedback and generate new knowledge to add to IITA's research base, while assisting the host country involved.

"Because of the Institute's wide mandate," Dr. Gamble explains, "close working relationships with other international institutes are essential. In its rice improvement work, for example, IITA works closely with the

International Rice Research Institute (IRRI) in the Philippines; in its maize work, with the International Maize and Wheat Improvement Center (CIMMYT) in Mexico.

"While IITA now maintains informal relations with the international centers, it currently is discussing with CIMMYT and IRRI a more formal relationship similar to the one shared by CIMMYT and the International Center of Tropical Agriculture (CIAT) in Colombia and by IRRI and CIAT," Dr. Gamble notes.

IITA's research efforts are concentrated in four research programs. Three of the programs are centered on the staple food crops of the African tropics: the cereals, grain legumes, roots and tubers. The fourth program—farming systems—is designed to synthesize all IITA research and use the results to develop viable alternatives to the traditional agricultural practices in the tropics. The materials and methods developed in the crop programs are used by farming systems program researchers to determine the most efficient uses of available resources. The results of farming systems program research are fed back into the crop programs to guide researchers in the development of improved varieties and agronomic practices.

Roots and Tubers

About 50 million tons of roots and tubers are produced annually in tropical Africa. Cassava, yams, and sweet potatoes produce more calories than any other lowland crop. They are adaptable to diverse climatic conditions and are less severely affected by insect problems than are cereals. They require less labor, production capital, and management. They can be used as livestock feed as well as for human food. Several countries now are exporting cassava chips as a source of carbohydrates in livestock feeds, especially in northern Europe.

The IITA economics and crop specialists are cooperating with their counterparts at CIAT and other national research stations in Africa to strengthen their root and tuber programs.

Dr. S. K. Hahn, leader of IITA's Root and Tuber Improvement Program, has great hopes for this crop category, particularly cassava.

"In the southern parts of Nigeria," Dr. Hahn notes, "the average person consumes more than two pounds of cassava a day. Thirty million tons of the starchy root is grown annually in the African tropics. Unfortunately, it generally has less than 1 percent protein content and the average dry-matter content is only 25 percent."

Nigerian farmers who plant cassava usually harvest about 5 to 10 tons per acre on a fresh weight basis. A new high-yielding cassava developed at IITA is expected to yield two to three times as much as local varieties in addition to having an improved protein content.

"We are now at the stage of testing several thousand clones," Dr. Hahn reports. The most promising have been multiplied and planted in farmers' fields. "The farmer will pick what he likes best—texture, color, leaf size, plant height, and so on—and this information will be fed back to us to perform further work as necessary."

Alternatives to traditional farming practices are being developed simultaneously with crop improvement at IITA.

Developing material that will produce a higher yield and a more nutritional food is just part of the task facing the breeders. Cassava bacterial blight causes crop losses of 30 to 50 percent. A 100-percent loss due to the disease is not unheard of, Dr. Hahn says. When a crop is lost in the field, planting material for the next season also is lost and, once the crop is harvested, it must be used almost immediately because it spoils rapidly in storage.

'True, cassava can remain in the ground for as long as two years to be harvested as needed, but this practice ties up land that otherwise could be productive," Dr. Hahn notes.

Still another concern of the IITA cassava specialists is the hydrocyanic acid (HCN) content of the tuber, which makes it poisonous. Cassava must be carefully processed —traditional methods are tedious, not always effective— to eliminate the toxic substance before the tuber can be eaten. Several low-HCN lines now have been developed, thanks to the IITA breeders' persistence.

More yield, improved nutrition, improved storability —a large order, but the IITA scientists are working on many aspects of crop improvement including a rapid multiplication scheme to make improved cassava material readily available to national agricultural research programs for testing and demonstration.

Discovery of a seed-dormancy period in yams has opened the way for improving yams through breeding. Traditionally, yams have been propagated by vegetative means—cutting pieces from the yam and rooting them. As much as 30 percent of a crop is retained to reproduce new plants. And vegetative propagation does not allow the plant breeder to use inherent genetic diversity to develop new plants. Now that a way to produce yams from seed has been developed, work is being concentrated on improving yams by hybridization.

Specialists working on sweet potatoes have come up with a variety that has a potential yield of 30 tons in 120 days without fertilizers, a commodity in short supply as well as unaffordable by the average small farmer in the tropics. But virus diseases and insects, especially weevils, continue to plague the crop. In addition, field testing by Nigerian farmers of a locally-preferred lower-sugar content sweet potato is in initial stages. Breeders also are attempting to build improved storage characteristics into improved sweet potato varieties.

Low-Cost Protein

Grain legumes are important sources of low-cost protein for the people of the tropics and have the potential to become even more important as yields are raised. Cowpeas, especially, hold considerable immediate potential for alleviating malnutrition. Nearly one million

(Continued on p. 11)

A trainee from Senegal discusses swamp-rice cultural practices with students visiting IITA. Exchange of information and cooperation with other institutes as well as schools is crucial to improving and increasing overall crop production in the tropics.

AID RESEARCH

Rodent Control Saves Crops

There's a legend among some farmers in the Philippines that when people curse rats, the small mammals retaliate by destroying property. Accordingly, when within hearing range, rats are called "mababait" (the good ones) by some who believe this prevents destruction to household items such as wood, furniture or clothing.

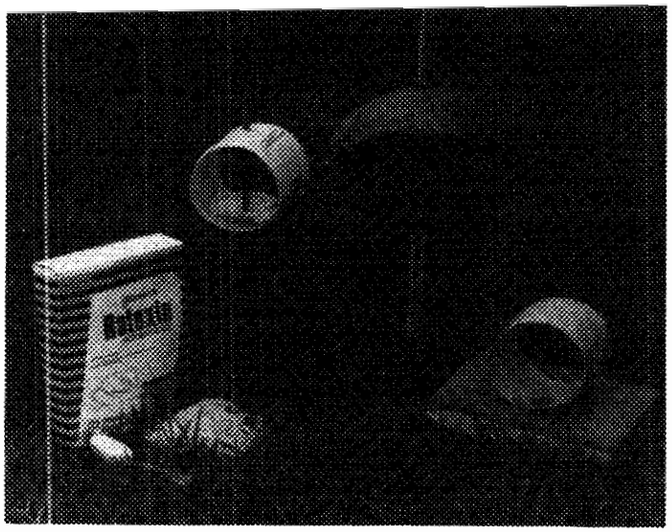
Superstition? Perhaps, but just one of the many factors considered by scientists working on an AID-sponsored research project that has developed a procedure for controlling damage to crops by rats. The result—more food should become available in a number of hungry nations.

This article combines reports received from the AID Mission in the Philippines and scientists at the Wildlife Research Center in Denver.

Rodents annually destroy millions of tons of sorely-needed cereal crops in food-short developing countries. AID officials estimate that the loss in rice alone—the staple for more people than any other food—is 48 million tons annually, enough to feed 1 billion people for three months.

Funded by AID and assisted by the Government of the Philippines and the AID Mission in the Philippines, the research has been carried out for the past eight years by the Department of Interior's Wildlife Research Center, headquartered at Denver, Colorado. The Center also was responsible for developing effective means of controlling vampire bats under an associated AID research project. (See *War on Hunger*, February 1976.)

AID has provided $3.5 million since 1968 for the Wildlife Research Center project which, in addition



Left: Some bait station designs which have worked effectively. Right: Feeding station made of readily available bamboo placed in a rice paddy. Stations can be constructed at negligible costs from locally available materials.

to rat and bat control, is seeking ways to control crop ravages by birds.

Field research for the rat control program has centered in the Philippines, where rats have caused serious agricultural damage for many years. Field losses of rice in this Asian country are conservatively estimated at $50 million annually—approximately 5 percent of the total crop—but individual farmers can, and do, lose their entire crop as a result of rodent damage.

Rice farmers in the Philippines using the new control method have been able to increase their own yields at harvest by as much as 50 percent and in some cases have nearly tripled their profit. Cost to the farmer is generally less than $7 per hectare (2.47 acres).

The rat control method devised by Philippine and U.S. scientists is simple, inexpensive, and available to small farmers. It differs from the majority of past approaches to rat control by stressing protection of the farmer's crop rather than aiming for high kill rates. The change in strategy is partially in response to new knowledge gained of the rat's easy environmental adaptability and awesome potential for reproduction, a potential apparently limited only by the availability of food and shelter. The technique takes advantage of a characteristic shared by rats and humans alike—a clear preference for the best food when it is available.

It works this way:

A farmer puts out bait stations made of coconut husks or other locally available waste materials at about the time he plants his crop. The bait is polished rice, which rats prefer to the plants growing in the field. The bait rice is treated with a slow-acting anticoagulant rodenticide which interferes with the natural blood clotting mechanism in the animal and causes death after three or four days of repeated feeding. The Philippine Government recommends a number of commercially available anticoagulants.

Bait stations are checked every two or three days to replenish the bait, and additional stations are put out if all the bait has been eaten at one location, thus ensuring that sufficient food is available at all times during the growing season. Bait consumption varies according to the density of the rat population in the field but the farmer's total output of bait over the entire crop period is generally less than 20 pounds per acre—a very small fraction of the increased yield he will receive from his land by using the rat control procedure.

Although rats feeding on the bait will be killed, complete eradication is not considered necessary or possible because of population reproduction and immigration of other rats. However, crop protection is achieved by providing bait that is preferred by the rats to the growing plants in the paddy.

An additional and significant advantage to the control method is that it will work for the individual farmer in his own field even if his neighbors are not attempting rat control.

Major features of the eight-year research effort on rat control included extensive behavorial studies of several species in farmers' fields and in laboratory tests. Among the findings from these studies was the identification of foods preferred by the rats and which of these could be used most effectively as baits. Observation of the rats also revealed that they would fight other rats attempting to eat at the same place at the same time. This knowledge led the scientists to experiment with a variety of small feeding stations placed in different locations. Traditional means of rat control ranging from scarecrow-like figures placed in a field, to killing roundups, as well as modern approaches incorporating chemo-sterilants and a variety of toxicants, also were investigated in the course of research.

The field studies on rat control have been a cooperative enterprise with personnel from the Wildlife Research Center working with scientists from the Philippine Bureau of Plant Industry and the University of the Philippines at Los Banos. The Rodent Research Center (RRC), located some 40 miles outside of Manila and established in cooperation with the Philippine Government, serves as a field headquarters for research. The Center also provides training for scientists and vertebrate pest control specialists from other Asian countries.

Sophisticated research equipment and expertise in pest control techniques were provided for the field investigators by the Research Center in Denver. Technology developed and made available for use by the Denver Center for the project included miniature radio transmitters that could be attached to rats and sophisticated infrared photography equipment which was used to record feeding habits in rice fields at night.

In establishing a practical and effective research approach, the RRC staff evaluated traditional attitudes and rodent control measures practiced by farmers as well as gathered some important biological information about the pests themselves. Extensive trapping studies in the Philippines revealed the presence of about 30 different rodent species. Of these, four were pinpointed as major pests. In behavioral studies performed on fieldcaged specimens of pest species, these animals cut about 80 rice stems each night in developing rice, explaining in part their tremendous damage potential. By placing radio transmitters on rats and using dyes in baits, the RRC researchers learned that these animals can move several hundred yards nightly and that their movement patterns were heavily influenced by their physical environment. Information such as this was vital to the development of suitable damage reduction procedures.

Many Philippine farmers have used a variety of traditional methods for eliminating rats. They burn strawpiles before they prepare their farms for planting; they clean dikes surrounding rice paddies; they flood burrows inhabited by rats; and, many just pray that rats won't destroy their crops. When damage becomes more apparent, usually at the time the rice plants are flowering, the more "modern" farmers will use acute rodenticides (poisons which kill rats shortly after they've eaten small amounts of bait).

Evaluations of these traditional practices by RRC researchers revealed that while the farmers are sometimes highly efficient in killing rats their practices are usually ineffective in reducing damage to the crop in the fields. The most common cause for this failure appears to be rapid reinvasion of the fields and replacement of dead animals with new ones, alive and destructive.

Because the major objective is to reduce crop losses to rats—not just to kill rats—RRC biologists use an actual measurement of in-field damage to determine the

The kill after a traditional roundup of rats. Some farmers have lost their entire crop because of rodents.

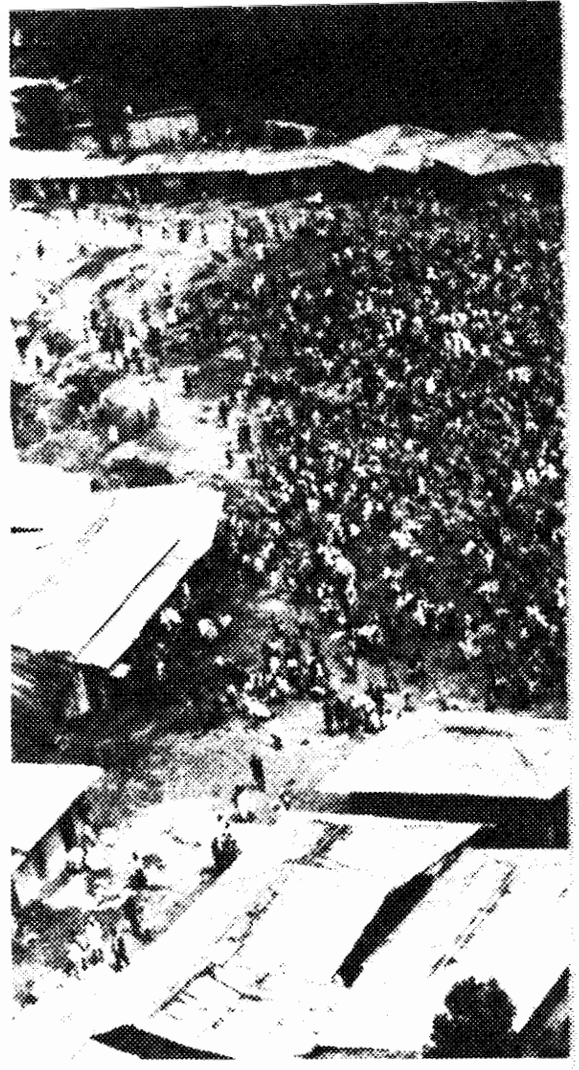
effectiveness of a program, not rat counts that are commonly used to judge the success of extermination campaigns in many countries. Since no scientific method existed for measuring rat damage to rice plants, one had to be developed early in the project. This method, called the tiller cutting index, has been adopted by the Philippine Government for national surveys of ricefield losses to rats—data essential for the development of a strong national rat control program.

The procedure developed by the scientists at the Center is technically described as sustained baiting with chronic toxicants. The toxicants, anticoagulants, are among the safest rodenticides known to man.

One of the most spectacular features of the sustained baiting program is its low cost. RRC researchers believe that damage can be reduced significantly in the most severely infested fields by an investment of less than $7 per hectare. Current production investments are about $171.42 per hectare for other factors, so this represents only a small portion of the farmer's total commitment; one that he can hardly afford to overlook. The baiting system has recently been incorporated into the Philippine national rice production program, Masagana 99 (Bountiful Havest-99 cavans). This program makes use of a tested production package that includes high yield seed varieties, fertilizers, and pesticides—and now rat control materials. Government support is given to small farmers through non-collateral loans, repayable after each harvest and renewable for each crop season. Since the rat control innovation is a new addition to the Masagana 99 package, how quickly the new technology reaches the farmer, and how soon its effects will be felt on a national scale remains to be seen.

The Rodent Research Center has also been playing a vital role in getting the findings of its staff to the farmer. During the past few years, the RRC has participated in training thousands of agricultural technicians and extension workers on the latest developments in rat control and technology. Its staff has participated in regional discussions and workshops and a participant trainee program at the RRC also has brought students from many nations for research training.

The Final Days of Smallpox— Ethiopia . . . the Last Stronghold



Left: A smallpox victim. Top right: Ethiopians gather to be vaccinated against smallpox. Right: In one day, several thousand villagers, such as this youth, will receive a smallpox vaccination.

AID is providing up to $2 million to the World Health Organization to achieve man's final conquest over smallpox—a disease that has killed and scarred millions of people throughout the ages. (See *War on Hunger*, January 1976.)

WHO will use the AID grant, plus proposed support from the Department of Health, Education and Welfare and approximately $1 million from its own and other sources, to wipe out the last remaining cases of smallpox in Ethiopia, the only country still reporting active cases.

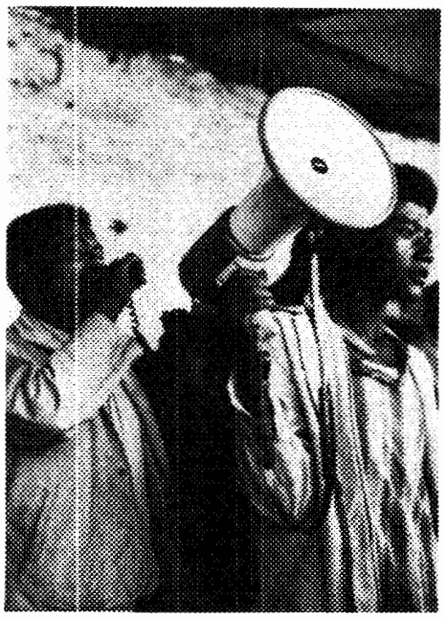
The last active case of smallpox will be treated before the end of this year according to Dr. D. A. Henderson, Chief of WHO's Smallpox Eradication Unit. Surveillance for at least two more years, however, is necessary to assure the final conquest of the disease.

WHO, an independent specialized agency of the United Nations system, is providing $612,000 for permanent staff and consultants and the Ethiopian Government is contributing $300,000 for costs of Ethiopian personnel. In addition, other donors are supplying $100,000 for vaccines. About $211,000 for additional program costs will be funded later. The total cost of the program will be about $4.22 million for Ethiopia.

The smallpox eradication effort in Ethiopia is the final stage of a worldwide drive that began 10 years ago.

Since that time, all of Africa except Ethiopia has been declared free of the disease. Meanwhile, the smallpox battle in South Asia, waged by WHO with assistance from the United States and other countries, reached its successful conclusion when the last cases in India and Bangladesh were reported last year. No cases of smallpox have been reported in other areas of the world for a number of years.

The campaign in Ethiopia began in 1971. It was the last country to join the campaign. At the present time about one-half of the country's approximately 29.5 million people have been vaccinated.



Above: The Ethiopian smallpox teams use loudspeakers to call villagers to be vaccinated. Top right: An isolated Ethiopian village is one of many which the smallpox team visits. Right: Two members of a surveillance team stop to vaccinate people enroute.

In the first eight months of 1975, 2,727 cases were reported in Ethiopia, a reduction of 1,020 cases from the same period in 1974.

According to WHO, there are now less than 50 villages in four provinces in Central Ethiopia with active cases of smallpox. Most of these areas are accessible to eradication teams. For inaccessible areas, the disease can be prevented from spreading by containment and may die out naturally.

The eradication of smallpox in Ethiopia is regarded as an important factor in the East African nation's development. One of the poorest countries in the world, life expectancy is 38 years and there is one doctor per 76,000 people. About 95 percent of the people cannot read or write. The average person has an income of $90 per year.

AID has been assisting Ethiopia with programs that have concentrated on food production and nutrition, population planning and health, and education and human resources development.

The assistance provided WHO in Ethiopia is directed against an ugly, highly infectious disease few Americans of this generation have ever seen. Smallpox is caused by a virus and initially characterized by chills, high fever, headache, and backache, with subsequent widespread eruption of pimples which eventually blister, produce pus, and form pockmarks. There is no cure. Vaccination is the most effective protection for the individual.

The only way smallpox can spread is by a person in the infectious stage of disease to transmit it directly to another susceptible person. A person with the disease either dies or recovers. In either case, the virus dies if it has not been transmitted to another person during the limited two week-infectious stage of the disease.

Once the disease has been eradicated from an area, new cases cannot break out unless a person with the disease comes from outside the area and has direct contact with another susceptible person during the infectious stage.

The administration headquarters in Addis Ababa, Ethiopia, will be staffed by WHO experts, other consultants and Ethiopian personnel under the general administration of the Ethiopian Ministry of Health.

Under the program, two or three eradication and surveillance teams will be ferried to remote areas by helicopters. Other teams will travel by mule and vehicles. The teams, carrying vaccine and bifurcated needles, will vaccinate in a selective manner. By using bifurcated needles, health specialists can give 1,000 to 1,500 vaccinations a day. Because better vaccines and vaccination equipment have improved efficiency and strategy of surveillance and containment, the teams are eliminating smallpox without necessarily resorting to mass vaccinations. Altogether, about 500 to 600 technicians and helpers, mainly Ethiopians, are in the field, on teams, or providing direct logistic support.

Scientists who have been involved in the intensive campaign of the past decade consider the incipient eradication of smallpox as one of medicine's most significant achievements in communicable disease control. It will be one giant step for mankind.

Of Seed and Man, from p. 4

tons of cowpeas—most of the world crop—are grown in Africa every year. One of the most important characteristics of certain cowpea and pigeon pea varieties is the fact they reach maturity in 90 days. As many as four crops a year are possible using irrigation during the dry season.

The first IITA developed strains of cowpea, high in protein content, are ready for distribution to national programs for further testing or use as parental stocks. The improved lines incorporate resistance to key diseases, have high tolerance or resistance to insects and pests, and have good adaptive ability—three previous barriers to good yields. Tests in Nigeria, Liberia, Ethiopia, Ghana, and Colombia produced yields as much as six times the yields of local varieties, with a minimum of pest control.

Other legumes, particularly soybeans and lima beans, continually are being screened at IITA for nutritional quality in terms of protein and amino acid composition. Selected seeds already have been distributed to several tropical countries for testing. And work on pigeon peas is being coordinated with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India which has major responsibility for this crop in the network of international institutes.

IITA scientists also are studying the nitrogen-fixing bacteria associated with several legume species to assure they provide as much nitrogen as possible to improve soil fertility.

Cereal Types for Africa

IITA has a large cereal improvement program, emphasizing maize and rice and working in close collaboration with other international and regional institutions. IITA maize program scientists cooperate with maize scientists at CIMMYT; rice program scientists collaborate with scientists at the West African Rice Development Association (WARDA) headquartered in Liberia, and at IRRI.

A participant in IITA's training program observes disease reactions on cowpea plants, part of his research.

A light table is used to sort maize grains. Maize improvement is one of the four major programs being conducted at IITA.

Major emphasis of the maize program is on breeding and selecting for high production under the stresses present in Africa, says IITA maize breeder M. N. Harrison. Insect problems that occur in Africa differ from those found on other continents. A key disease, maize streak, is found only in Africa.

Another stress factor that is receiving considerable attention is high soil temperatures. The temperature of tropical soils is higher than that of temperate zone soils when the seed is planted. This inhibits germination and early seedling growth. The IITA maize workers have identified maize varieties that can tolerate the higher temperatures.

According to IITA rice breeder A. O. Abifarin of Nigeria, more adaptive work is needed on upland rice, which accounts for at least two-thirds of the total rice acreage in West Africa, where most of Africa's rice is grown. Upland rice is especially susceptible to blast disease. Dr. Abifarin says, "Several varieties exhibiting promise currently are being tested in different ecological zones."

The plant breeders are building resistance factors into the improved materials particularly for the varieties to be grown in upland areas where drought is a problem. Upland rice yields of nearly 4,500 pounds per acre have been produced in plots at IITA and at other experiment stations, reports Dr. Abifarin. But problems remain in raising upland rice yields of farmers' fields.

WARDA and IITA scientists are working together in West Africa to design and conduct a series of coordinated trials on rice adapted to different ecological conditions under which rice is grown in West Africa.

Improved seeds and plant materials mean little unless they are incorporated into farming systems that

enable the small farmer of the humid tropics to produce sustained high yields of food crops. This is where IITA's farming systems program fits in.

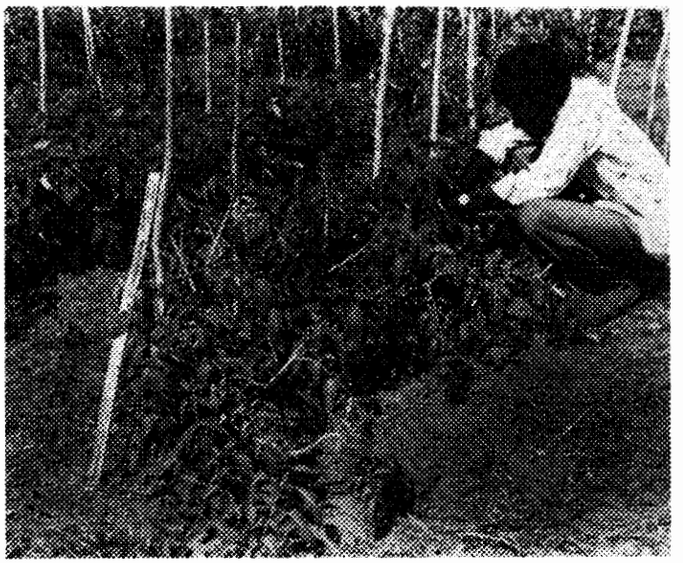
Mr Ayoade, who lives near the IITA, holds about five acres of land. He is typical of the average tropical farmer. The small acreage provides enough food for his family and a surplus which he markets to provide for his other needs.

To help the tropical farmer get the most out of his land IITA has been studying ways to improve the traditional system of shifting cultivation. Under the traditional method, the forest is cut, crops are grown for one to three years and the forest is permitted to regenerate, replenishing the soil before another cycle starts. But as the population increases the farmers must shorten the period of natural fallow or perhaps even eliminate it. Replacing this time-honored system with more intensive land use means problems—fertility of the soil decreases while the chance for erosion increases. The physical properties of the soil deteriorate, weeds proliferate and pests and diseases attack the crop. IITA's farming systems research program involves a wide range of expertise emphasizing the development of more productive cropping systems including mixed (two or more crops grown at one time on a parcel of land) or continuous cropping, soil management studies, and development of appropriate technology to assure that new systems can be adapted to different local conditions.

"If we are to reverse the downward trend in food production," IITA Director of Research D. J. Greenland says, "a fundamental change has to be made in African agricultural systems in the humid tropics. This means not only using high-yielding seeds accompanied by improved practices, but an assault on the farmers' concept of land use. This would change not just their patterns of cultivation but of their lives."

Farming systems research at the Institute also integrates the results from the commodity-oriented research programs and feeds back to these programs results that help determine priority problem areas.

Field experience is considered of prime importance for students from regional institutions studying at the Institute.



A trainee from Ghana conducting a study on pathogens that reduce tomato yields checks a crop plant for productivity.

Further testing and development is necessary and modifications will be required for different areas, but to date, some systems already have found favor among local Nigerian farmers who believe in the concept of "seeing is believing". Field demonstrations carried out by IITA scientists in cooperation with national programs have led many farmers to break with a system that dates back to their ancestors.

The multi-cropping system—such as mixing cereal and legumes in combination with root crops—now is in advanced study at the Institute. In addition to higher yields, pest attack has been reduced without use of chemical pesticides. IITA plans a special project on the incidence of pests in multi-cropping compared to mono-cropping.

Physical and economical environments require different farming systems and IITA economists are taking into consideration such factors as limited labor and capital. Integrated systems for extended testing are ready for field trial.

In the meantime use of small farm equipment still is in the investigative stage. IITA Agricultural Engineer Ray Wijewardene has developed many simple and inexpensive pieces and is testing their feasibility in the development of tropical agriculture.

IITA's location in Nigeria affords Nigerian farmers the most immediate advantage of its research. But the Institute also works in cooperation with national research and development projects in five other African countries.

In Tanzania, the Tropical Food Crops Research Project, initiated with CIMMYT participation in maize research, is supported by a three-year AID contract. Along with IITA, the Ford Foundation, and AID, the Tanzania Government has developed a long-term accelerated food grain production program with principal research activities at the Ilonga Research and Training Institute. In the process the program

will produce a cadre of Tanzanian scientists to enable the country to be self-sufficient in its manpower requirements for research and production. IITA, in cooperation with CIMMYT, has five staff members working in Tanzania on research and development of maize and grain legumes.

In Sierra Leone, a project financed by the U.N. Development Program with IITA as a subcontractor to the Food and Agriculture Organization, is conducting applied research and training in a national program based at the Rice Research Station in Rokupr, where IITA has assigned an agronomist, a plant pathologist, and a rice extension specialist.

In Liberia, an IITA rice breeder is helping conduct rice research at the Central Experiment Station at Suakoko. Funds are from the International Development Association.

At the Zaire Cassava Research Project, an IITA plant breeder, agronomist, and plant pathologist are seeking a solution to low-cassava yields and bacterial blight disease in Bandundu Province, in Bas-Zaire, and in the Kinshasa area. Financing is provided by the Government of Zaire.

In Nigeria, IITA has provided support for the Nigerian Accelerated Food Production Program by supplying an economist, a coordinator, and a rice and maize specialist to the National Crop Center located at the Federal Department of Agricultural Research at Moor Plantation, Ibadan; a coordinator for cassava research and extension at the National Root Crops Research Institute at Umudike, and a wheat breeder to the Institute of Agricultural Research Station at Kano.

Training Office Plays Key Role

The IITA's Training Office plays a key role in meeting the Institute's mandate by assisting in the planning, organization, and coordination of Institute activities in research, production and outreach training, post-doctoral fellowships, and seminars, conferences, and workshops.

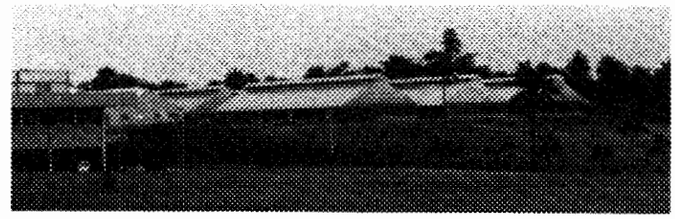
Research training, provided under the supervision of IITA's scientific staff, is suited to the individual while at the same time contributing to the Institute's research effort. Emphasis is on field experience. More than 120 persons from 23 countries have conducted the research portions of their degrees at IITA. Non-degree research training also is provided for representatives of nine cooperating international institutes. One of these is AID participant Patrick Aina, who recently returned to Ohio State University to complete his Ph.D. Mr. Aina, who received his bachelor's degree from Nigeria's University of Ife, had high praise for the IITA program.

"The facilities here and the opportunity to consult with experts involved in all phases of agricultural development has benefitted me greatly," he said.

Mr. Aina, 26, briefly lectured and taught laboratory courses at Ife's Faculty of Agriculture before attending Ohio State from 1973 to 1975, when he returned to Nigeria to work on his doctoral thesis.

He calls his academic training in the States "excellent," but says "it's important to return to my home environment and apply what I have learned to my country's own conditions, which are very different." In December 1976, he will return to Nigeria having completed his thesis and continue his research on soils while teaching at the Faculty of Agriculture.

Another aspect of the program is production training to familiarize extension agents with one particular crop. Assistant Director for Training W. H. Reeves said the program aims at training people "who will not only be able to diagnose problems but can evaluate production and marketing strategies. In addition, they need to be able to conduct field trials passing their knowledge on to other agents in their home countries."



International Institute of Tropical Agriculture

Post-doctoral fellowships are offered each year to help orient young scientists who have studied in temperate zone countries to careers in the tropics. The scientists work with experienced research scientists on relevant problems of tropical crop production. This arrangement adds to the manpower resources of the permanent scientific staff. Later, the fellows may join the IITA team or other agricultural research institutes and agencies. During 1975 there were six fellows of four nationalities in residence at IITA, conducting a wide variety of research from plant breeding to nutritional biochemistry.

"It's been a long road from IITA to the farmer's field," says Winton Fuglie, AID agricultural project manager for Nigeria's National Accelerated Food Production Program. "But the Institute is making rapid strides in closing this gap. It continues to improve and expand its ever more important research program designed to meet the needs of the farmer while improving the quality of life for people not just in Nigeria, but throughout the tropics."

Joseph Akinwolomiewa, Permanent Secretary of the Ministry of Agriculture and Natural Resources in Western State, Nigeria, sees much hope for his country in IITA.

"The need for a coordinated effort between the Institute and our national and state research institutions is obvious. The IITA can help us achieve our goals in the National Accelerated Food Production Program in addition to serving as a backup for other agricultural research on-going in Nigeria."

IN PRINT

Choosing Agricultural Strategies

A Review by Lehman B. Fletcher

Agricultural and Structural Transformation: Economic Strategies in Late Developing Countries by Bruce F. Johnston and Peter Kilby. Oxford University Press, New York, 1975. 474 pp., $6.95 paper.

This is in an important book that deserves to be widely read by development specialists. It is a joint effort by an agricultural economist (Johnston) and an industrial economist (Kilby), both with extensive research and field experience on developing country problems. Although written by economists, the book is relatively free of complex economic analysis and hence is easily available to a wide reading audience.

The Most Important Idea

The most important idea in the book is the distinction that is drawn between a "unimodal" and a "bimodal" approach to agricultural development. A unimodal strategy aims at the progressive modernization of the majority of more or less equally-sized farm units in a less developed country. In contrast, a bimodal strategy depends on a commercial sub-sector of large farms to increase output while the subsistence sub-sector that contains a large number of small farmers remains technologically stagnant. The authors argue convincingly that most developing countries will benefit from a unimodal approach, especially when weight is given to equity and employment objectives as well as to expansion in output. This thesis is central to the widespread concern in developing countries and assistance agencies that agricultural development should result in an improvement in welfare for the poor majority of the rural population.

The book begins with a general survey chapter on "Agriculture in a Traditional Economy", which includes a discussion of common structural features of low-income countries such as a high proportion of population in farming, low productivity of a large rural labor force, and subsistence diets dependent on starchy staples. Other chapters deal with structural transformation as the key element in the overall process of economic development in a country and with the premise that a large stock of proven technical innovations exists in the developed countries, much of which is transferable to less developed countries. The authors emphasize the dangers inherent in borrowing technology that is not appropriate for factor availabilities in less developed countries and the degree to which high capital-labor technology has been encouraged in many less developed countries by public policies that distort factor prices. While they also recognize the difficulties in the technology-transfer process, they seem to be much more optimistic about the transfer possibilities than are other observers.

The Core of the Book

A chapter on "The Design of an Agricultural Strategy" is the core of this book. It calls for a strategy aimed at the progressive modernization of the large number of small-scale, traditional farmers in less developed countries and views the widespread adoption of scale-neutral, advanced agricultural technology that raises yields as the primary means for achieving that goal. The authors point out that demographic factors are such that most countries cannot simultaneously achieve sizeable increases in area cultivated per worker and in yield per unit area and they go on to demonstrate that yield increases in most developing countries are consistent with the more productive utilization of the abundant labor in agriculture. They warn against the premature release of labor from agriculture and the tendency for large operations to adopt capital-intensive techniques of production. The argument is placed in a context of multiple objectives that include output, welfare of the rural population, and institutional changes leading to social modernization.

Two chapters are devoted to agriculture-industry linkages and interactions. This is a useful addition to much of the literature on agricultural development although these chapters are less analytical and less impressive in their conclusions and policy recommendations than those dealing more specifically with agricultural development.

No Easy Answers

The book ends with policy recommendations for advancing the unimodal development process that it advocates. No easy answers or simple solutions are offered in the fairly conventional list of priorities for development of the rural sector that is presented. It is, however, easy to agree with the authors that generalized priorities are only a beginning and that the concrete design of an agricultural strategy must be specific to each country. Little insight on this strategy-formulation process is given but the authors have succeeded in designating the fundamental features of an efficient unimodal strategy.

This is of primary importance to practitioners as they struggle with the practical problems of identifying and implementing specific measures that will permit large numbers of small farmers to benefit from rising productivity and income.

Dr. Fletcher, an economist and former Chief of the Economics and Sector Planning Division within AID's Bureau for Technical Assistance, is presently with the Brookings Institution in Washington, D.C.

IN BRIEF

AID Asian Expert, Herb Rees, Dies

C. Herbert Rees, an outstanding expert on development whose long service in the U.S. foreign assistance program helped better the lives of millions of South Asians, died March 24 after a brief illness. He was 56.

At the time of Mr. Rees' death he was Director of South Asian Affairs in the Asia Bureau. He had been with the U.S. foreign aid programs since 1948, when he joined the Economic Cooperation Administration as a placement officer.

In a tribute to Mr. Rees, Senator Edward M. Kennedy (D-Mass.) called the foreign aid veteran an "unsung hero".

The praise was included in his introduction to an extension of remarks in the April 13 *Congressional Record*, in which Senator Kennedy inserted an obituary on Mr. Rees which appeared in *Front Lines*, an internal AID publication.

The Senator added:

"Every day the dedicated work of thousands of Americans serving in the Agency for International Development give shape and purpose to our Nation's foreign assistance program—a program which not only helps to better the lives of millions of people abroad, but which also brings great credit to our country. . . ."

Potash Plant Study

Jordan is undertaking a $10 million study to determine the feasibility of constructing a potash production plant to be located at the southern end of the Dead Sea. The Government of Jordan is providing $3 million for the study and the International Development Association is providing a $1 million credit. An AID loan of $6 million will complete the financing requirements for the study which will cover the technical, financial, and economic feasibility of building a plant that can produce up to one million tons of potash a year using solar evaporation of Dead Sea brine and the processing of precipitated salts. The consulting engineering firm of Jacobs International Incorporated of Pasadena, California, in collaboration with Sir Alexander Gibb & Partners, of Reading, England, and Technical Services Organization, a Jordanian firm, will perform the study.

Loan for Malaria Control

Ethiopia's malaria control program, now in its eighth year, is being assisted by a $7.2 million loan by AID.

The program is designed to suppress malaria in the heavily populated lowlands of Ethiopia which are considered to have the greatest agricultural development potential. Efforts to develop much of this land have been hindered since approximately 70 percent of the land area and an estimated 50 percent of the population are exposed to the risk of contracting the disease.

The AID loan, the fifth of its kind to Ethiopia, is being used to finance 100 percent of the foreign exchange costs of insecticides, drugs, vehicles, and spare parts as well as 30 percent of all local operating expenses in the first year of the loan and 15 percent in the second. The Government of Ethiopia is financing the balance.

QUOTES

"Urban growth probably will continue undiminished into the next century, creating huge megalopolises. By the year 2000, some 50 percent of the world's population is expected to live in urban areas, compared with 39 percent now. The trend will be particularly marked in the developing lands, where urban growth rates are now more than twice as high as in the industrialized countries. . .

"On average, the populations of most developing nations will remain young, because of high birth rates. In the year 2000, it's expected, almost half their inhabitants will still be below the age of 20; the demand for education and jobs will be tremendous."

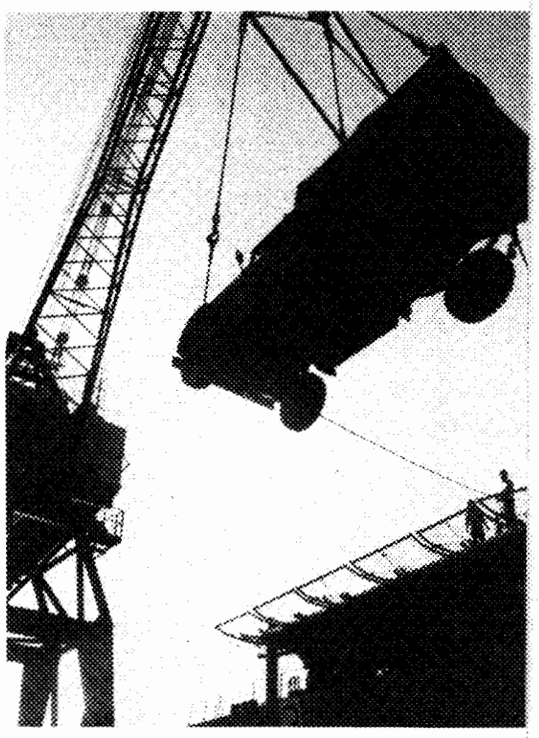
Jonathan Spivak
The Wall Street Journal
April 12, 1976

"There was a series of excessive rains and droughts in Rwanda in 1974 and 1975. The American government responded in accord with our humanitarian tradition and we provided what were modest sums of 5,000 tons of sorghum and some 25,000 dollars, for a total input of about $1.3 million.

"The international assistance effort in Rwanda was considered by those who were engaged in it as a model of emergency assistance in Africa. We had a situation of some 45 percent of the food crops having been destroyed or in jeopardy. We had 1.3 million people out of a population of four million affected, some 365,000 seriously. And the assistance put in by the United States, plus other donors . . . had a major impact in mitigating the developing crisis. We didn't just respond to a tragedy; we were in soon enough, with enough, to prevent a serious situation from developing. And between the integrity of the Government of Rwanda and donor cooperation, we solved that problem."

Robert E. Fritts
U.S. Ambassador to Rwanda
February 18, 1976

Equipment for the U.S. Army Engineers was readied for loading at Morehead City, North Carolina. The race to rebuild the highway in Guatemala was on.



Trucks and other equipment would play a major role in rebuilding.

A Race Against Time in Guatemala

In a close race against the rainy season, U.S. Army engineers in earthquake-ravaged Guatemala completed repairs on the major Puerto Barrios Highway on April 22—two days after the heavy rains began.

The two-lane highway, the country's most important transportation artery, is now open to full commercial traffic. It had been closed to full traffic since the earthquake struck Guatemala February 4.

Under the AID-funded project, 465 members of the 548th Engineer Battalion out of Fort Bragg, North Carolina, made extensive repairs on a 42-mile stretch of the damaged highway between Puerto Barrios on the Caribbean Sea and Guatemala City, the nation's capital.

Working 14 hours a day, six and a half days a week for 46 days, the Army engineers built two "Bailey" bridges, cleared 44 rock slides caused by the earthquake, used 4,608 cubic yards of coarse material to repair severe cracks in the road, and removed 325,676 cubic yards of landslide material.

The "Bailey" bridges, prefabricated structural steel bridges assembled on site, were shipped to Guatemala in huge sections on U.S. Navy ships.

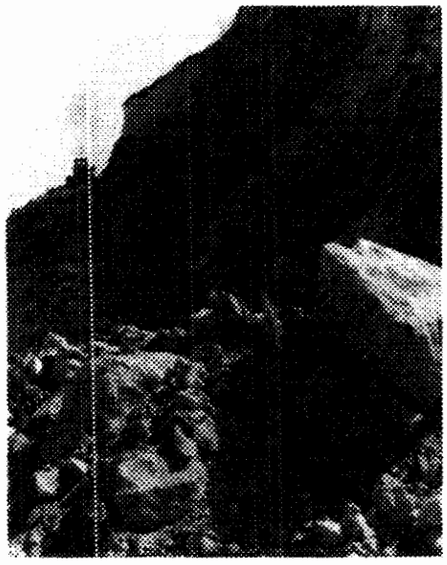
Sparing no effort, the U.S. Army engineers installed a 90-foot "Bailey" bridge in 24 hours just outside the town of El Progresso. Impressed with the bridge-building speed, the Guatemalans named the bridge Puente Pronto—Spanish for rapid bridge. Made of heavy steel, the bridge weighs more than 61,000 pounds and can handle massive truck traffic.

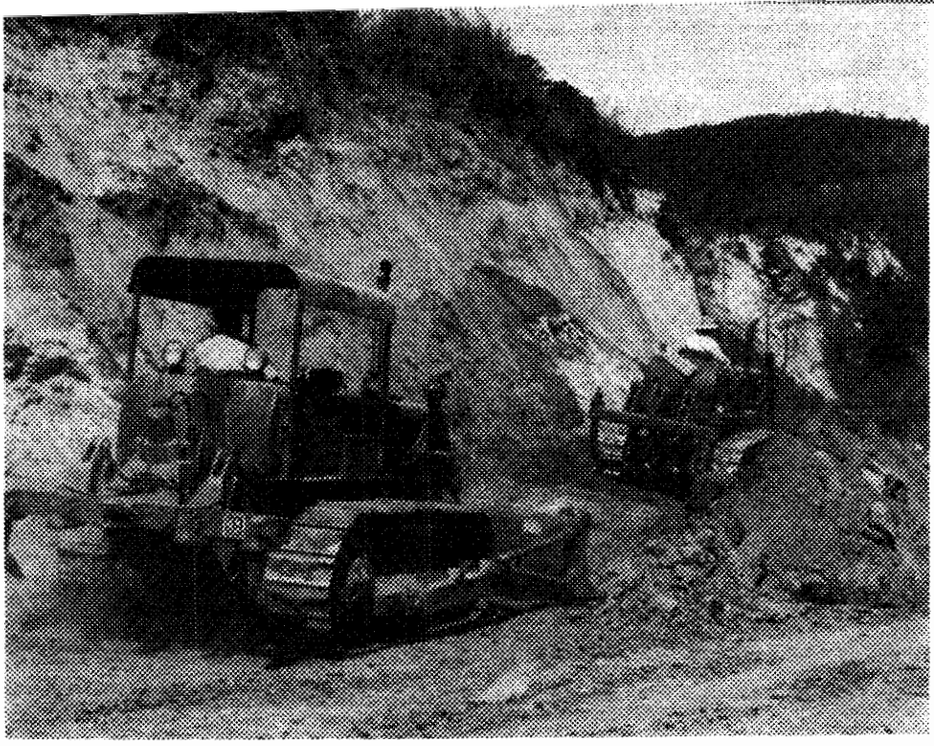
The engineers also built a 170-foot "Bailey" bridge near the town of Agua Caliente, about 18 miles northeast of Guatemala City. The 115,940-pound bridge is called Puente Essayons.

To get the job done before the heavy monsoon rains hit, the U.S. Army engineers used massive earth-moving equipment such as gigantic industrial tractors, bulldozers, bucket loaders, road graders, air compressors, rock drills, and water distributors (to keep the dust under control and compact the sand). Altogether, the equipment weighed 1,414 tons.

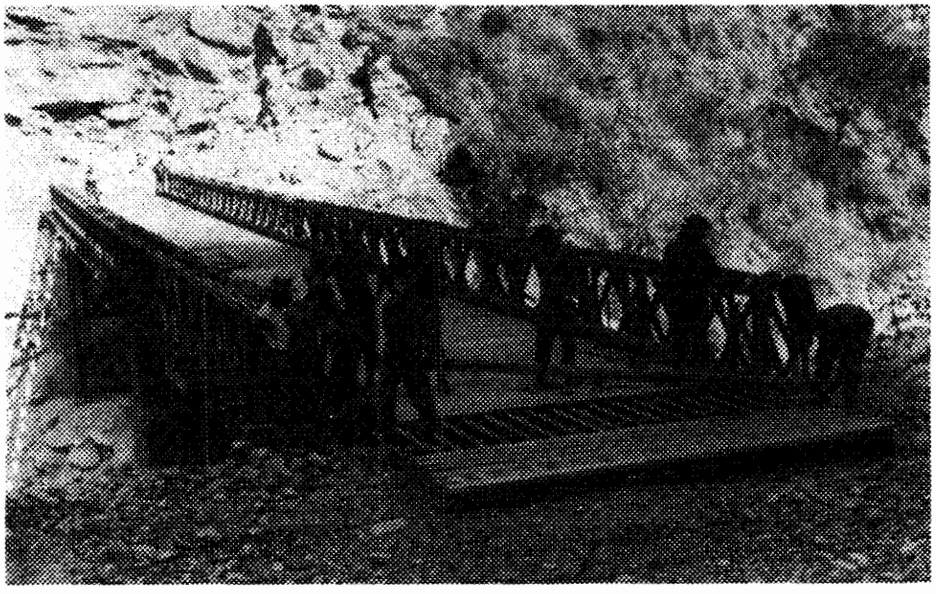
In addition to the engineer battalion, the 676th Medical Detachment from Fort Benning, Georgia, also served on the road-building project, providing medical care to the soldiers and earthquake victims. The U.S. Southern Command in the Canal Zone also provided helicopters, supplies, and personnel.

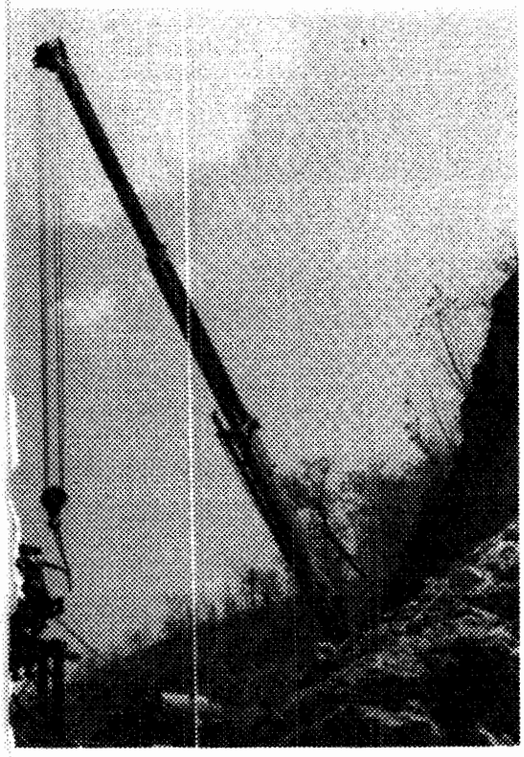
To show his appreciation to the engineers, the President of Guatemala, Kjell Eugenie Laugerud Garcia, wrote the following letter to Lt. General Henry E. Emerson, Commander of Fort Bragg: "I would like to extend on behalf of the people of Guatemala our most sincere thanks for the magnificant job the 548th Engineer Battallion has done in our





Bulldozers worked overtime to rebuild the Puerto Barrios Highway before the rains set in. A bridge on the highway was destroyed. Below: a U.S. Army engineer guides a support beam into place. The bridge nears completion (right). AID financed the repairs on the highway which connects Guatemala's port with the capital city.





country. I would also like to extend my personal appreciation to you and your staff for the excellent support and personal interest that you gave to the project. The clearing of the Highway and the bridging at Agua Caliente were tasks that only a well-trained and efficient organization could have performed in the time alloted. Working on a tight schedule with the knowledge that the rains would inevitably arrive, the task force opened the principal commercial, economic lifelines to the Atlantic coast in record time. I wish to thank personally, through you, all of those who in the background made the job possible. I hope you can convey to them my most profound thanks and appreciation for a job well done."

To commemorate the completion of the road-building project, a brief ceremony was held on April 22 in the Azacualpilla base camp. The U.S. officials present included George Andrews, Deputy Chief of Mission, U.S. Embassy; Edward Coy, AID Mission Director; and Col. Charles Corbett, Commander, U.S. Military Programs in Guatemala. Guatemalan officials included Richard Argufdas Martimer, Minister of Communications and Public Works; General Juventino Gomez, Vice Minister of Defense; Mr. Rodolfo Rubio Aguilar, Director General of Roads.

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U.S. MAIL

The U. S. Army helped to repair Guatemala's most important highway, linking its seaport to the capital city, before the rainy season began. The Agency for International Development financed the project. **(See page 16)**