because they have been disappointed in the past. Some projects by foreign investors never get finished. We are working to build a strong relationship with these countries, not in the political sphere but rather through one-on-one relationships with the technical people of the country. By conveying a true image of American professionals, we are gaining trust.

Science: *In terms of the politics, does the State Department help you?*

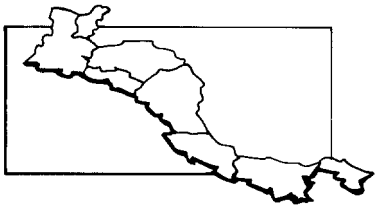
Hanold: Yes, through the AID. Normally our first stop in a country is at the AID mission office. We brief them on the purpose of our trip, and they give us an up-to-the-minute report on the country, advising us about any tense situations and any regions of the country that we should avoid. As we are leaving the country, we give the mission office a report about what was done during the trip and how successful it was.

Loose: The AID missions have been very helpful because they have a corporate memory of the country's history and an extensive network of contacts. Many of the AID people speak fluent Spanish. Most important, they have a finger on the pulse of the country. They are able to give us reliable information on how to get the job done and on which people and organizations are likely to be effective.

Hanold: They are also very helpful with more mundane things, such as providing transportation and meeting us at the airport on late-night flights and seeing that we get to our hotel safely. Many of our field operations take place in very, very remote areas, and the field crews may come through a city only every five or six days. The AID mission has our itinerary and knows the people involved. If a problem were to arise, we feel confident that they would take it upon themselves to go out after our people.

Loose: The AID and Los Alamos have one aim in common—to see that when something is started, it is finished. We have an effective working relationship with the AID, and it is improving daily.

Hanold: In technical areas we act as a filter for the AID. We hear requests from local experts for training or for equipment, and we separate the technically less important requests from those that have merit. We submit to the AID the proposals that we think will have the greatest economic impact on the country. From the beginning our intention has been to involve people from the host countries in all stages of the



The Costa Rican Peat Project

by Gary R. Thayer, K. D. Williamson, Jr., and Arthur D. Cohen

Scientists from the Laboratory and Refinadora Costarricense de Petr6-leo (RECOPE) are working together to assess the development potential of peat, an indigenous, unused resource in Costa Rica. This carbon-rich organic sediment, produced in swamps and marshes from partially decayed organic matter, could become a significant asset in a number of different ways. If made into briquettes and used as a fuel for heating and cooking, it could help reduce the heavy dependence on fuelwood, which now supplies 50 percent of Costa Rica's energy. If used to fuel electric power plants, it could help reduce oil imports. Since harvesting of peat is a labor-intensive operation, its development would provide jobs for the people in the areas where it is found. Further, its availability as a fuel might bring industries to those areas. Eventually peat might become the basis of "high-tech" industries converting this resource into liquid and gaseous fuels or valuable organic chemicals such as waxes, resins, and medicinal.

Despite all this promise and the extensive literature documenting the wide and growing use of peat in northern Europe, Ireland, and the Soviet Union, the development of peat in Costa Rica entails facing many unknowns regarding harvesting methods, appropriate and acceptable end uses, and overall economic impact.

So far we have surveyed the literature on harvesting and end uses and have made

projects, including planning. Even for our original proposal to the AID, we solicited their opinions concerning their biggest energy- and mineral-related problems. And then we tried to address those problems squarely in the proposal.

Loose: We worked with geologists, engineers, economists, and fairly senior administrators of both utilities and government organizations such as ministries of energy and mines.

Science: *Had they had much contact with Americans before?*

Hanold: Yes. Since many Central American schools do not offer advanced degrees, many technical people have pursued such degrees in the United States. As a result most of our Central American counterparts speak English very well.

Loose: The AID regards education as a basic human need. In addition to their program of education at the primary and secondary levels, they help people with university potential to get an appropriate education at American universities.

Hanold: The local culture and pride are such that they don't want someone just coming down, doing a job, and walking away. They appreciate the assistance but want to participate in the doing. They want to be involved technically and physically. In all our interactions we stress working with the people in the region. We have the techniques to do certain tasks, and through our work they get exposed to the cutting edge of geology, volcanology, geochemistry, and geophysics. That experience will be left behind. In some cases we are actually leaving equipment behind so that they can continue on their own.

Loose: The people are very nationalistic and very proud of their countries. They have definite ideas on how to use the new knowledge we are giving them. A concrete example is the peat project in Costa Rica. We were very interested in the possibility of briquetting the peat for use as a cooking fuel in place of wood. It was a way to save the fast-disappearing forests. The national oil refinery, whose charter is to promote high-tech industry, was initially more interested in using the peat to produce petrochemicals, waxes, and resins and to generate electricity. Through discussion we have reached a mutual agreement to investigate both high- and low-tech uses of peat. That gives you an idea of how the input of local people is reflected in the projects. [See "The Costa Rican Peat Project."]

a preliminary field assessment of Costa Rica's peat resources. Two moderate-size peat bogs have been identified. Other sites exist but have yet to be explored. One identified site is in a sparsely populated region on the Nicaraguan border whose settlement would promote Costa Rica's national security. The other is a jungle site near the Caribbean coast. Both sites are large enough to provide fuel for a 10-megawatt electric power plant for 100 years or more. One of these locations may be chosen as the site for a demonstration peat project.

Peat, in its natural state, contains up to 95 percent water and must be dried to a water content of 50 percent or less before it can be burned. In Europe solar drying is used almost exclusively to reduce the water content. Milled peat is produced by draining the top few centimeters of a peat bog, scraping off the exposed layer, allowing the sawdust-like product to dry in the sun for a day to a week, and then collecting it with rakes or large vacuum cleaners. Sod peat is produced either by cutting out

A view of the flora characteristic of the peat site located in a tropical jungle region of Costa Rica near the Caribbean coast. The peat deposit here is extraordinarily thick, at least 12 meters. In the center of the photograph is a species of palm that is often associated with peat deposits.

Science: *What difficulties do you face in carrying out your work?*

Loose: Coordination, communication, and logistics are among our biggest difficulties. We have Washington looking over our shoulders as well as the local AID missions. In addition, we maintain contacts with government people in the five countries. The wide range of the projects, which include economic analysis, mineral exploration, and development of geothermal power, compounds our difficulties.

Hanold: Another difficulty is that sometimes the technology involved in a project is unfamiliar to the people in the host country, and they find it hard to understand how the project will get from A to Z. For instance, a geothermal energy project starts with geologists mapping the area and geochemists collecting water and gas samples from hot springs. These activities may seem mystifying. What do hot water samples have to do with electricity on line? To lessen this problem, we recently took two Honduran visitors to an operating geothermal power plant in the United States. These gentlemen were from the national organization that generates much of the electricity in Honduras, mostly from hydropower. They were at Los Alamos to help make long-range plans for a geothermal project in their country, and we spent a day at the Geysers plant in northern California as preparation. The Geysers, the largest geothermal power plant in the world, supplies much of the power for San Francisco. We took them up on drilling rigs, showed them how the wells are drilled. talked about the site's geology, geochemistry, and geophysics. and showed them how the geothermal steam is extracted, collected, and run through turbines at the power plant. The tour gave them a concrete understanding of the whole technology. I think many of our projects will require a similar educational effort.

Science: *Are you in contact with the rural populations of the Central American countries?*

Hanold: Very much so, particularly during our geothermal work in the remote areas of Honduras and our explorations for minerals in very remote areas of Costa Rica. Since these areas have no conventional hotels, arrangements are made with local people for sleeping accommodations and food. We usually hire someone local to buy and cook food for the field parties

blocks of peat by hand and stacking them to be dried or by cutting sections of peat by machine, grinding the peat, and extruding it in 2- to 10-centimeter-diameter cylinders. These "sods" are allowed to dry and then collected. Since both methods involve a solar drying step, they may be impractical at the two Costa Rican sites, which receive between 3 and 5 meters of rain per year. Instead, the peat may have to be dried artificially. Alternatively it can be collected in a slurry and heated to about 200°C to initiate exothermic oxidation reactions that produce free carbon, which can be collected and compressed into a coal-like substance, or, if the oxidation is earned to completion, heat for industrial use. Such wet harvesting methods are generally more expensive than the traditional methods described earlier, so their use in Costa Rica will make the economics of peat development different from that documented in the literature.

The environmental impact of peat harvesting and the economics of various end uses are also being examined. Mining of peat results either in changed drainage patterns or lake formation, both of which can be beneficial. Changed drainage patterns might permit reclamation of the mined areas as prime farm land, or the lakes could, according to a study done in Jamaica, be used for aquiculture.

Appropriate end uses for peat depend, first of all, on the quality and size of the resource. The higher ash content of presently known Costa Rican peat versus European peat may affect production technology and costs as well as quality of the end products. This possibility needs to be investigated. We are hopeful that the Costa Rican peat will be suitable as a fuel for electric power plants. Although these plants will be smaller in scale than typical European plants and the cost per unit output will therefore be higher, the additional cost might be offset by reduction in oil imports. We are most excited about the use of peat as a cooking fuel in place of wood, but the local population may not be equally enthusiastic, especially in areas where wood is plentiful and free for the gathering. The Costa Ricans are particularly interested in high-tech uses, such as the production of gaseous fuels and organic chemicals, but these may be too ambitious technologically for a first attempt at using the resource.

We and our Costa Rican colleagues are gathering information relevant to all these issues. We will also test the performance of peat in local cooking stoves and in larger scale combustion and gasification applications. The results, plus detailed information on specific peat sites, economics of harvesting, environmental effects, potential for reduction of oil imports, and development of remote areas, will be used to choose a demonstration peat project. We, as well as the Costa Ricans, look forward to finding a way to make this resource an economic success. ■