gain controls. A multiposition switch and easy-to-read meter constitute the means by which proper performance is ascertained. The antenna-mounted unit is shown in Fig. 10 (right). The transmitter consists of four power transistors in parallel. The largest element in the box is the filter for suppression of spurious and harmonic signals. Anything that is wrong with the transmitted signal can be detected by the NCC at Denver and the sender notified or, in extreme cases, the transmitter turned off by the NCC.

Conclusion

The studies described herein represent some of the most sophisticated social and technical experiments ever attempted in education and health care delivery. It is hoped that the lessons learned from them will bring us much closer to the goal of providing good quality health care and education in areas that are away from metropolitan centers.

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NEWS AND COMMENT

Green Revolution (II): Problems of Adapting a Western Technology

The Green Revolution was conceived by its creators as a primarily technical intervention for increasing food production. Most critiques have focused on the economic impact of the Green Revolution practices (*Science*, 20 December, p. 1093), but the technical nature of the process has also come under strong, if less vociferous, questioning. The package of agricultural practices that constitute the Green Revolution is essentially a Western technology, and its problems—such as dependence on high energy inputs—are if anything more formidable in a Third World setting.

Probably the most serious aspect of the high yielding varieties (HYV's) is that they are genetically more uniform than the native strains they replace, and hence more vulnerable to epidemics. The semidwarf wheats developed at CIMMYT (the International Maize and Wheat Improvement Center in Mexico) are among the varieties that represent "extreme potential genetic vulnerability," says a committee of the National Academy of Sciences (NAS). In the first few years of the Green Revolution, large areas of cropland in India and Pakistan were sown to a few varieties of CIMMYT wheat. What was probably a quite serious risk at that time has been considerably diminished by the introduction of many new varieties of wheat. It is quite unlikely that a single strain of glume blotch, root rot, Karnal smut, or other disease that wheat is heir to would strike down all varieties simultaneously. The only way this could happen is if the dwarfing gene that all the HYV wheats have in common should have linked with it a gene conferring susceptibility to some pathogen. That this should be so is fairly improbable, except that it has already happened once. The epidemic of southern corn blight that destroyed a fifth of the U.S. crop in 1970 was caused by a genetic linkage of this nature. Damage from the southern corn blight was as limited as it was because of the skill and number of American plant breeders.

"If a thing like that should happen in places like India or Nigeria, it would really be a disaster," says J. M. de Wet of the Crops Evolution Laboratory at the University of Illinois. A serious responsibility devolves upon aid givers and promoters of the Green Revolution to see that local research institutions can cope with such a threat: "The outbreak of any major disease which wipes out the harvest of thousands of farmers is far more likely to be blamed on the producers and spreaders of the miracle seed than on Fate," observes Clifton R. Wharton, president of Michigan State University.

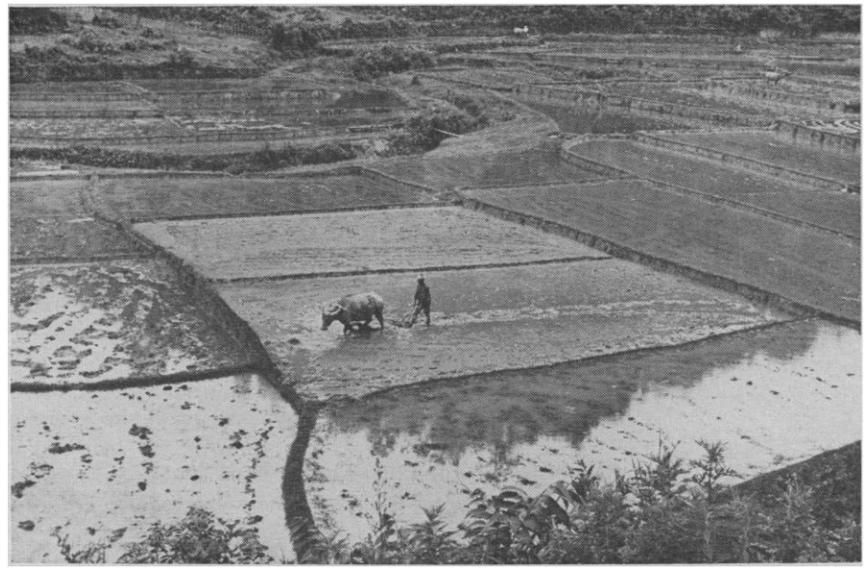
The Green Revolution strains are generally more vulnerable to pests than are traditional varieties. This is partly because of the practice—now largely abandoned—of transplanting HYV's developed in one area of the world to another, without first adapting them to local conditions. "It is futile to think that we in America or Mexico can sit down and put together a strain of cultivated crop that will be equally suitable all over the world," says de Wet: "Local farmers may have good results with it for one or two seasons, but then the introduced variety may become susceptible to disease or insect attack and people are no better off than they were before. The native varieties that have been successful for millennia have survived for very good reason."

The HYV's are also made more susceptible to pests by the recommended growing practices. Close planting, luxuriant foliage, and multiple cropping are all conducive to the buildup of insect pests. According to the NAS

committee on genetic vulnerability, the HYV rices, with their dwarf stature and many leaves, "seem to create an ideal environment for the rapid multiplication of leafhoppers and planthoppers, as well as the sheath blight organism. . . . Other things being equal, the danger of serious crop losses from the attacks of major diseases and insects is greater today than it was in the past." Promoters of the Green Revolution deny that the HYV strains had anything to do with the epidemic of tungro that ravaged the Philippine rice crop in 1970 and 1971, but the NAS committee notes that the outbreaks "have been attributed to large scale introduction of double cropping with rice," a common Green Revolution practice.

Breeders of HYV rice have been skillful at introducing new forms of resistance into their plants, and some of the latest varieties are probably as resistant as the native varieties to many diseases. The trouble is that breeding for resistance tends to be a treadmill from which there is no exit. Resistance often provokes the evolution of new strains of pest. The life expectancy of wheat varieties in the northwest United States is about 5 years. Are the plant breeders and seed suppliers in the less developed countries capable of handling this kind of problem in their HYV's? There is some evidence to suggest they are not.

A quite serious side effect of the Green Revolution is that the rapid spread of HYV's is destroying many local varieties of crop plants. These plants are an irreplaceable source of genetic diversity and their germ plasm is essential for future breeding programs. Seed banks are in theory a reasonable way of halting genetic erosion, but in practice they tend to be underfunded, inadequate, and vulnerable to accidents or carelessness (*Science*, 21 December 1973). A major Peruvian collection of corn germ plasm, one of the largest in South America, was lost when three refrigeration compressors failed. Even at CIMMYT, some of the early and irreplaceable corn collections from the 1940's were found to have been lost when the seed bank was reorganized in the mid-1960's, according to H. Garrison Wilkes, a crop geneticist at the University of Massachusetts. The Rockefeller Foundation has recently increased its funding for genetic conservation which, before 1970, amounted to less than $50,000 a year.



Burmese farmer preparing rice field. The small farmer's first goal is to minimize his risks. Yet Green Revolution technology performs to meet the Western commercial criterion of maximizing profits. [*FAO photo*]

Genetic erosion apart, the ecological consequences of the Green Revolution have been less fearsome than they might have been. The 1967 report by the President's Science Advisory Committee on the world food problem predicted that by 1985 the less developed countries would need to be using 67 million tons of fertilizer and 700,000 tons of pesticide annually. In fact, even before the rise in fertilizer prices, peasant farmers tended to apply much less fertilizer and pesticides than advised.

Nutrition was not one of the qualities stressed in the early HYV breeding programs. The result is that the nutrient content of the HYV's is probably not in general very different from that of the traditional varieties. Unfortunately the HYV's tend to oust more nutritive crops such as pulses (beans, peas, and lentils). In terms of protein production, the greater yields of HYV's are offset by the fact that they contain half as much protein as the pulses they replace —"perhaps in some places resulting in a slight decline, when taking into account that pulse protein is of higher quality than cereal protein," according to World Bank nutrition director Alan Berg. (Pulse acreage in India was shrinking in any case, but introduction of HYV's has hastened the decline.)

Improvement of protein content is now an important goal in HYV breeding programs, but the net effect to date is that, because of population growth and substitution for imports, the Green Revolution has probably not made any great difference to average diets.

An important general criticism of the Green Revolution is that, far from being custom-designed for less developed countries, it is simply American agricultural technology transferred abroad. The most pressing aspect of this criticism is that the Green Revolution package, like American agriculture, is reliant on high energy inputs such as fertilizer, pesticides, and fuel. Probably few realized how prodigal of energy American agriculture had become until David Pimentel and colleagues at the New York State College of Agriculture showed that it took the energy equivalent of 80 gallons of gasoline to raise an acre of corn. The fertilizer and pesticides required by Green Revolution crops are high energy inputs. "With fuel shortages and high prices to come, we wonder if many developing nations will be able to afford the technology of U.S. agriculture," Pimentel observes (*Science*, 2 November 1973, p. 448).

Like almost everyone else, the creators of the Green Revolution failed to foresee the rise in energy prices. ("Undoubtedly the relative cost [of fertilizer] will continue to decrease," one leading revolutionary was saying in 1971: in fact prices have more than doubled). The HYV crops are now hurting badly as a result of the energy crisis, although it is hard to say how much. According to a recent study of the food and energy situation by Ralph W. Cummings of the Rockefeller Foundation, poor countries are likely to find it "extremely difficult" to meet

even their normal demands for fertilizer, and failure to do so "could push agricultural output back towards traditionally low levels of productivity." India is thought to have lost a million tons of her spring crop—about 1 percent—for lack of fuel to pump irrigation water, and fuel and fertilizer shortages may have reduced the summer crop by 10 million tons.

Even without fertilizer the HYV's still do better than most traditional varieties, but they lose much of their advantage. Indian scientists have been considering a return to emphasis on certain traditional varieties which, under minimum amounts of fertilizer, give better yields than do HYV's.

Briefing

Arms Control Groups Qualify Approval

The arms control community appears to be taking the Vladivostok nuclear weapons agreement with, so to speak, a grain of SALT. Three major, Washington-based, private organizations concerned with arms control matters—the Arms Control Association (ACA), the Council for a Livable World (CLW), and the Federation of American Scientists (FAS)—attach similar strong reservations while giving conditional approval to the accord.

The groups question whether the agreement constitutes the "breakthrough" in arms negotiations claimed by Administration officials and share the view expressed in a statement from the ACA that "Ultimately, . . . the value of the Vladivostok accords will depend on what the final agreement itself says, and on its implementation."

President Ford and Soviet Communist Party general secretary Brezhnev on 24 November signed the accord, which amounts to a statement of principles to guide the second round of SALT (strategic arms limitation talks) negotiations next year. Each side for the first time is to be limited to a fixed number (about 2400) of strategic delivery vehicles, including bombers and land- and sea-based missiles. Limits are set on the number of missiles (1320) to be armed with MIRV's (multiple independently targetable warheads), but not, it should be noted, on the number of warheads. The treaty, when signed, is to run to 1985, and is to carry a provision for negotiations by 1980–1981 on further limitations and possible reductions of strategic arms.

The FAS executive committee on 12 November released an analysis and statement which reflected the extent of reservations among its board members and expert advisers by carrying majority and minority views, which is unprecedented for FAS in recent years.

The majority position gave provisional backing to the agreement with the two following qualifications:

"1. The Administration should assert that any build-ups of weapons under the Treaty would be put before the Congress on their merits and not as part of a package deal required by the Treaty.

"2. The Administration should assert that the clause announcing that negotiations will reopen no later than 1981 does not mask any quiet agreement with the Russians not to open negotiations earlier."

In a dissenting view, George M. Rathjens of MIT argued that the Vladivostok agreement is an unacceptable basis for further negotiations on strategic arms because it is likely to actually spur "acquisition of superfluous strategic arms" and is "likely to be a stimulus to nuclear proliferation."

The Council for a Livable World infrequently issues formal statements on issues such as the Vladivostok accord, but staff members said that sentiment among council leaders is generally similar to that expressed by its arms control peer groups.—J.W.

Ethics Commission Holds Its First Meeting

The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, for which there is no pronounceable acronym, met for the first time recently and tried to figure out how to go about its business of recommending guidelines that will affect the course of scientific experimentation for years to come. The commission's most pressing duty, set by law (*Science*, 2 August), is to reach some judgment about the present national moratorium on research on living human fetuses that are the subject of planned abortions. It has until 30 April 1975 to send its recommendations to Health, Education, and Welfare Secretary Caspar Weinberger who must either accept them or tell the public, in writing, why he cannot.

The 11 members of the commission, chosen by an intensely political process from a field of a couple of hundred persons, represent the fields of science, law, and ethics. Following a swearing-in ceremony in which the commissioners promised to uphold the Constitution and defend the country against its enemies, domestic and foreign, Charles U. Lowe, executive director of the staff, told them some of the rules of the game for federal advisory committees. Their meetings and their papers, he said in a room full of at least 50 observers, would be open to the public. The commissioners then launched into a discussion about whether any of them should be allowed to talk to the press outside of the open meetings. Some of the scientists were leary—best not get involved with reporters, they said. The lawyers tended to think any kind of gag rule was silly. In the end, they agreed that each commissioner should act prudently. It seemed the only sensible thing to do.

A considerable portion of the 1½-day meeting was taken up with procedural matters—under whose authority would contracts for studies be let, who has the power to call and adjourn meetings, that sort of thing. But the group did approve one plan to get the work on the fetal research issue started. Jeremiah Mahoney, a pediatrician and geneticist at Yale University, will do a study that will include at least the following things:

1) A search of the literature for all work on living fetuses, with a notation of the purpose for which the work was done.

2) Summaries of the results of that research.

3) Consideration of whether those results could have been obtained by research that did not involve a live fetus—animal experimentation, for example.

For the small farmer, urged by aid givers and extension workers to abandon his tried, traditional methods for an HYV crop, failure to get the fertilizer he requires may not increase his confidence in the wisdom of experts.

Traditional peasant agriculture, like other aspects of primitive societies, is in fact considerably more subtle than it seems at first glance to a Western expert. The yields of a peasant's crop are very low. But so is the risk: his field, in which he usually grows many varieties and several different crops, nearly always produces something, however bad the pests or weather. The peasant farmer's first goal is not to maximize his profits: it is to minimize

Briefing

4) Consideration of the impact of fetal research on fetal medicine and societal needs.

The commission intends to contract out for similar studies of available information in law and ethics as they relate to fetal research.

At the end of business, the commissioners elected Harvard obstetrician Kenneth Ryan as their chairman and set 10 January for their next meeting.—B.J.C.

Edwards Leaving HEW

Charles C. Edwards has resigned as assistant secretary for health in the Department of Health, Education, and Welfare to join a medical supply firm in Rutherford, New Jersey. He will be senior vice president of Becton, Dickinson and Company.

Edwards, who will leave in January, has been thinking about getting out of government for some time.—B.J.C.

Seamans, Zarb, Anders & Company

The Senate has set the stage for the formal dissolution of the Atomic Energy Commission and its reconstitution as the Energy Research and Development Administration (ERDA). On 12 December the Senate confirmed the nominations of Robert C. Seamans, Jr. as the administrator of ERDA and William A. Anders as chairman of the new and autonomous Nuclear Regulatory Commission, to be formed from the regulatory arm of the AEC.

The next day the Senate approved Dixy Lee Ray as Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs. Her departure as AEC chairman and the establishment of ERDA are not expected until early in the new year, however, possibly during February.

In the meantime, the Senate has also confirmed Frank G. Zarb as a replacement for the outgoing chief of the Federal Energy Administration, John C. Sawhill. Zarb, a respected associate director of the Office of Management and Budget and a man of no identifiable ideology, is said to have extracted from President Ford a promise of direct access to the Oval Office, something each of his several predecessors (including Sawhill) initially thought they had, and in the end did not.

The parade of new faces in energy policy continues with four nominations from the White House for seats on the Nuclear Regulatory Commission. They are Richard T. Kennedy, now a National Security Council staffer; Victor Gilinsky, head of RAND Corporation's physical science department in Santa Monica; Edward A. Mason, chairman of the nuclear engineering department at Massachusetts Institute of Technology; and Marcus A. Rowden, until last month the AEC's general counsel.

Finally, the year's end will bring the departure of Alvin M. Weinberg as head of R & D policy for the FEA, a job he has held since retiring as director of Oak Ridge National Laboratory a year ago. Weinberg plans to return to Tennessee for a period of writing and relaxation.—R.G.

Harvard Faculty Says XYY Study Should Continue

The faculty of the Harvard Medical School has decided to allow two of its members to continue screening newborn males for chromosomal abnormalities—particularly XYY and XXY—in spite of the vocal opposition of a few faculty members. It is the culmination of a series of events that have taken place since May when Jonathan Beckwith, of the department of microbiology and molecular genetics, and six colleagues lodged a formal demand that the study be banned. The ensuing debate on the issue has been emotional, often bitter (*Science*, 22 November).

For several years, Stanley Walzer, a psychiatrist, and Park Gerald, a human geneticist, have been screening all baby boys born in the Harvard-affiliated Boston Hospital for Women. They had two purposes in mind: to gather data about the frequency of XYY and XXY chromosome patterns in the population and to follow up any XYY or XXY children to see whether there is any association between the chromosomal abnormalities and antisocial behavior. Walzer and Gerald believe that XYY boys may be predisposed to ill-defined behavioral problems, but they say that the notion that XYY is a "criminal chromosome" is nonsense.

Beckwith and his colleagues took issue with the study, claiming that, by telling parents their boy is an XYY and possibly prone to behaviorial trouble, the doctors create a situation of a "self-fulfilling prophecy."

On 20 November, Harvard's standing committee on medical research, having heard testimony on both sides, concluded that the study should continue. On 13 December, committee chairman Dana Farnsworth presented the group's opinion to the full faculty, which accepted it. He declared that "research on the genetic basis of behavior is important and worthy of pursuit," that the investigators had behaved ethically and sensitively, and that there was no evidence that the study had harmed any of its participants. Farnsworth, speaking for the committee, then cast understated aspersions on Beckwith and his colleagues for the manner in which they conducted their opposition. Beckwith's tactic of going to the press, he said, "was not looked upon with enthusiasm," and Farnsworth went on to suggest that the attacks on the Walzer study might be construed as an infringement on academic freedom.

Beckwith says the report is a "whitewash" and that he intends to keep on trying to block the chromosome study.

—B.J.C.

his risks. Yet Green Revolution crops perform to meet the Western commercial criteria of large production and high profits. They are bred and designed to be grown as monocultures and in monocrops, the whole field being planted to the same single variety of the same crop.

A plant improvement program for small farmers should aim not only at a high mean yield but also at minimum variance, says Richard Levins, a population geneticist at the University of Chicago. Levins considers the development of the HYV's "the result of massive varietal testing and crossing with only negligible use of any insights after Mendel's." He believes that agricultural genetics should be concerned with the genotypes not just of the crop plant, but of the ensemble of plants and pests with which it may interact; yet plant breeders tend to consider a cultivated field as a starch factory, not the complex living system that it is.

Wilkes is another biologist who criticizes the Green Revolution along similar lines. "We should export a stable technology, not one that depends on fossil fuels and phosphate rock. The price for maintaining high yields by monocultural farming is to constantly change the genetic material by breeding for resistance against the latest pest. But monocultures are not a long-term solution for small field agriculture. The technology we should offer to poor countries is a system with lower yields and greater genetic safety," Wilkes says.

The almost total emphasis of the Green Revolution on monocultures and monocropping may be only partly to get the greatest yield. "We have a tendency to impose temperate agriculture on tropical systems," says Vernon E. Gracen, a plant geneticist at Cornell. "Intercropping is usual in the tropics—the monocropping alternative was chosen because most of the scientists working in the area were trained in temperate agriculture technology." Gracen, who believes the HYV plant breeders have done an excellent job so far, considers that the present approach has had the unintentional effect of transforming corn production in less developed countries into a system that is not dissimilar to that in the U.S. corn belt.

Neither the extent nor the impact of monoculture and monocropping introduced by the Green Revolution can yet be assessed. But there is an enormous potential for replacing natural diversity with a handful of HYV's, particularly in countries such as Bangladesh, which at present has some 1200 different traditional varieties of rice, or Indonesia, which has 600. Reduction of diversity is generally only of advantage in a highly commercialized agriculture, where crop uniformity is an aid to mechanized harvesting, packaging, and marketing. For the peasant farmer, reduction in the number of crops or of varieties he plants is a guarantee only of greater risks.

Role of Rockefeller Foundation

Granted that some of the socio-economic and technical criticisms of the Green Revolution may be well founded, what should the creators of the revolution have done differently? The answer generally seems to be: very little. Although many changes in emphasis may now appear desirable, the basic strategy followed hitherto appears to have been unavoidable. When the Rockefeller Foundation first started its corn and wheat program in Mexico, the goal was simply to increase production regardless of the social impact of the new technology. But without such an emphasis, the Green Revolution would probably never have gotten off the ground. Many governments of poor countries are urban dominated, despite their rural majorities, and have not until recently been greatly interested in agriculture. Nor would they have been without the incentive of large production increases and the prospect of saving on imports and scarce foreign exchange. For the same reason, the Rockefeller Foundation need not necessarily be faulted for promoting a product it believed in, despite the backlash produced by its overselling.

Once the economic problems of the Green Revolution began to become apparent, the foundation changed its somewhat laissez-faire strategy and made a concerted effort to package the HYV's for small farmers, instead of letting the techniques "trickle down" to them. The foundation is sometimes criticized for being slow to let social scientists contribute to the direction of the Green Revolution. According to director of information services Henry Romney, social scientists have been admitted perhaps somewhat grudgingly to the team, but "much of the criticism of a few years ago has been accepted. The critics have turned us around. There has been a change from production per se to incorporating the whole life of people who live off the land."

Formal leadership of the Green Revolution has now passed from the Rockefeller and Ford Foundations to an international consortium of nations and foundations known as the Consultative Group on International Agricultural Research. Besides CIMMYT and IRRI (the International Rice Research Institute in the Philippines), the consultative group is now sponsoring six other international research centers. The eight centers together cover most of the major regions and crops of the world.

Further successes, such as those of CIMMYT's wheat and IRRI's rice, are by no means assured. The early high yielding wheats were the product of 30 years' nose-to-ground work by Norman Borlaug. Luck as well as skill enabled IRRI to get a good rice in its first year of testing. The Consultative Group's budget for its eight centers was $34 million in 1974, a sum which, in relation to the dimensions of the world food situation, can only be regarded as risible. Moreover some observers doubt whether the new generation of researchers are acquiring the same familiarity with farmers' needs as Borlaug gained in Mexico. It is still early to expect results from the new centers but, according to one agricultural expert in the World Bank, CIAT has not produced very much so far, and there are disquieting signs at IITA. (CIAT and IITA are research centers for tropical agriculture based in Colombia and Nigeria respectively.) "Building big buildings and paying people high salaries to work in beautiful air-conditioned labs is no substitute for hard thought and muddy boots," the same expert adds.

Whatever the international centers may achieve, the burden of maintaining the momentum of the Green Revolution will fall largely upon national research institutions. Annual investment in agricultural research for all developing countries is estimated to have reached some $240 million by 1970, an outlay that is small but rising. The quality of research seems quite variable. Genetic research in Taiwan, India, and the Philippines has become impressive, but most other Asian countries have lagged behind. Philippine research institutes have produced excellent HYV rices and have often been unfairly overshadowed by IRRI. According to Robert Evenson of Yale University, Indian agricultural productivity was increasing as rapidly

before the Green Revolution was initiated as afterwards.

But even Evenson believes that "we have yet to see a really first rate agricultural research center (comparable to the best U.S. Agricultural Experiment Stations) emerge in a developing country." According to a recent article in *National Journal Reports* by Richard Critchfield, Indian farmers attribute the lower wheat yields harvested this May to bad seed. The Mexican wheats developed by CIMMYT "were the only productive seeds they have received. Seeds introduced in recent years from research institutes in India, they said, were prone to rust or other diseases, vulnerable to insects, or simply low yielding."

The Green Revolution stretches beyond agriculture to touch almost every sphere of life of the countries where it is adopted. Not surprisingly, there are few simple answers to many of the issues it raises. It is in some ways more remarkable as a social than a scientific phenomenon. Miracle crops have swept the world before—for example, sugar cane in the 1920's—but, until the Rockefeller Foundation did so, no one had cared enough to see what modern plant breeding could do for staple food crops. The Green Revolution, in other words, would not have occurred if conditions had not been ripe for it. How far conditions favor its continuance is open to doubt. Some economists believe that the HYV's will never occupy more than half to two-thirds of the wheat and rice areas of less developed countries. The Green Revolution may lose even the momentum it has unless plant breeders can adapt it to other crops, to unirrigated lands, and to the maybe permanent constraints of the energy crisis. These obstacles are probably more likely to be overcome if the Green Revolution can be continued as a native growth, rather than as a Western implant.

—NICHOLAS WADE

Ethiopia: Did Aid Speed an Inevitable Upheaval?

Ethiopia abounds with paradox. A visitor to the capital city of Addis Ababa might encounter cattle skulls lying in the dust of bare unlandscaped parks, and shepherds with their flocks wandering heedless of traffic across wide thoroughfares. Modern, monumental government office buildings are interspersed with ramshackle beer houses. For all its pretensions to modernity—as exemplified by the fabulous Addis Ababa Hilton, financed by the Export-Import Bank, which adorns the road from the airport—Ethiopia has remained firmly entrenched in the 12th century, an African feudal kingdom that has stood as an island of calm while most other sub-Saharan nations have undergone the spasms of post-colonial adjustment.

It has also stood as an island of Coptic Christianity in a Muslim sea. Its mountainous terrain has isolated it geographically from its neighbors, and the unique identity of the ruling Amhara elite, who trace their origins to King Solomon, has helped prevent the formation of culturally or ethnically based foreign alliances. Sitting atop this relatively stagnant society has been Haile Selassie, emperor since 1930, who in the decades since World War II has been free, because of his posture of nonalignment and success at maintaining domestic stability, to travel around the world in the role of Africa's senior statesman. The chief exception to the picture of domestic tranquillity has been the agitations of the Eritrean Liberation Front (ELF). Eritrea, formerly an Italian colony, was federated semiautonomously with Ethiopia after World War II. In 1962 the Ethiopian government dissolved the federal ties and incorporated Eritrea, whose allegiance has always been more with the Italian government than the emperor, as a province. The ensuing rebellions have been simmering ever since and Eritrea's desire for independence has become a central issue in current political developments.

The eventual downfall of the imperial regime has been a foregone conclusion among foreigners and educated Ethiopians for years. The only questions were how it would happen, and when. Most observers thought it would not happen until the emperor's death, but the disastrous 3-year-old drought in the northern provinces of Wollo and Tigre, combined with inflation from rising fuel prices and accompanying social disorders, appears to have hastened the day of reckoning. What began as a fairly subtle takeover, with the military setting itself up as watchdog over a civilian government, turned into a bloody coup on 23 November with the abrupt executions of 59 high government and military officials. The 83-year-old emperor is now a hostage, and what will happen next no one dares guess.

It is worth wondering, though, how American aid has influenced the course of events in what has become an increasingly fragile feudal regime.

In many ways Ethiopia has been an American client state in the sub-Sahara for the past two decades, the most populous (26 million) among the world's 25 poorest nations and the beneficiary of a steady stream of assistance from the U.S. Aid for International Development (AID) programs. Americans have also trained an abundance of Ethiopian military officers and provided an average of $22 million a year of planes, tanks, and other military goods. (Strategically, Ethiopia's prime importance to the United States has been the communications and satellite tracking facility at Kagnew near Asmara. The center is now being phased out, however, its functions having been replaced by communications satellites.) Americans helped launch Ethiopia's Haile Selassie I University in 1952 and have provided quantities of civilian aid, including agricultural assistance to drought-stricken areas. AID funds have remained relatively constant over recent years, averaging $20 million per annum, and, while it may be fruitless to speculate on the extent to which U.S. assistance has contributed to the fall of the government, it seems fair to say that it has helped shape the foundation for the events now being played out.

Because it has never been colonialized, Ethiopia is far less developed

(Continued on page 1225)