and that they could not shift $50 million or even a major fraction of that amount without damaging other programs; a substantial cut they claim, will kill the program. They have strongly urged the Senate to restore all the Pioneer funds, in the hope that the House would agree to go along. Pending final action on the bill, probably later this month, NASA is continuing work on the project, which entails spending at the rate of about $5 million a month in the current fiscal year. Two spacecraft are involved, one to orbit the planet and the other to drop four instrumented probes through the atmosphere of Venus, with the aim of giving a composite picture of atmospheric phenomena which could be compared to weather patterns on Earth.

Loss of the project, if it comes to that, may make for difficult relations not only between space scientists and government, but also between astronomers and planetary scientists. Perhaps with that in mind, several prominent astronomers have written to members of the Senate in support of Pioneer-Venus. For example, Lyman Spitzer, Jr., of Princeton, an outspoken backer of the Large Space Telescope, wrote Senator Proxmire, saying that although he has urged greater emphasis on deep space astronomy, he is opposed to changing priorities in midstream and believes postponement of Pioneer-Venus would be "a serious mistake." A great many planetary scientists would agree.

—ALLEN L. HAMMOND

Agriculture: A New Frontier in Coastal North Carolina

Plymouth, North Carolina. Lying between the famed North Carolina outer banks and this modest county seat is the largely wild and swampy Albemarle-Pamlico peninsula, so named for the major sounds that border it to the north and south. The greater part of the peninsula is still covered by forest and scrub, more typically the latter. Yet, off and on over the past 200 years, this flat, low-lying region of 1634 square miles has given rise to speculation that it might some day become a rich and productive farming area. For, demonstrably, its black soils, which include organic mucks up to 12 feet deep, can produce crops of corn and soybeans as abundant as any in the Midwest.

In fact, this agricultural frontier represents one of the most promising major reserves of potentially rich but unreclaimed land in the eastern United States. Because of the peninsula's high potential, a rapid expansion of farming into the wild lands is now in progress.

Draglines and bulldozers are at work over wide areas, digging drainage canals and ripping up trees and other vegetation, then pushing up the resulting debris into long windrows. A process of irreversible change has been set in motion. In many places where before there was pine or scrub, there is now only cleared land, the fields divided neatly into rectangles by the windrows and grids of canals, field ditches, and farm roads. Much of this land is already greening from new corn or soybeans; some of it, freshly cleared, will be a while yet before being ready for planting.

Now leading this agricultural expansion is First Colony Farms, a $200-million venture begun in 1973 by a free-wheeling, North Carolina–born multimillionaire. First Colony is engaged at its own expense in reclaiming land on a scale comparable to that of many reclamation projects undertaken elsewhere with public funds. Moreover, if First Colony's plans are realized, the peninsula will indeed become an agricultural domain rivaling some famous reclaimed areas, such as Florida's Everglades agricultural area and California's Imperial Valley.

Not a Pristine Wilderness

And, while this development will have a major environmental impact, the land being affected is no pristine wilderness. By the middle of this century, the forests that had once covered this region—pond pine predominating in the higher areas and white cedar in the lower—had nearly all been cut. Since then, some regrowth of the cedar has occurred, but there has been little regeneration of the pine. Because of the seasonal dryness and the combustible peaty soils that mark the pinelands, wildfires have swept over as much as 250,000 acres at a time and resulted in most of the cutover land growing up in thick scrub.

Successful large-scale farming on this peninsula requires lots of capital as well as management savvy, patience, and favorable price trends for the products produced. The drainage, land clearing, and other special preparation required for farming the soft black soils can alone cost as much as $360 an acre. And, at that, in wet weather some of the soils make a hopeless quagmire for even the most modern "high flotation" farm equipment.

Not surprisingly, up until several years ago agricultural development here generally came slowly. Although some outside entrepreneurs drained big Lake Mattamuskeet in the 1920's and began farming its bottom, pump failures and collapsing commodity markets brought this venture to a spectacularly bad end. The waters reclaimed the lake by the mid-1930's and flooded the new community of New Holland.

Since 1970, several major corporations have come here to initiate farming ventures, including American Cyanamid and John Hancock Mutual (in a joint venture) and the Japanese-owned Shima American Corporation. But what these companies have been doing, though impressive, is nothing compared to the First Colony Farms development. First Colony is the personal property and brainchild of Malcolm P. McLean, a shareholder and director of R. J. Reynolds Industries and one of the principals in the Diamondhead Corporation, owner of Pinehurst and other resort properties.

First Colony had its inception in mid-1973 after McLean, who has his offices in New York, saw an ad in the *Wall Street Journal.* Westvaco, formerly known as the West Virginia Pulp and Paper Company, was offering for sale all of its land in the Albemarle-Pamlico region, these holdings consisting of 289,000 acres running in a nearly contiguous tract from the eastern part of the peninsula to the north-central part.

An entrepreneur who is still vigorous at 61, McLean first came into prominence in the 1940's after building a large trucking line, operating out of Winston-Salem. Then, in the 1950's, he pioneered in the containerized shipping business by developing the highly successful Sea Land service for moving truck trailers by sea. Now, in the 1970's, McLean was looking over Westvaco's sales offer and standing at the verge of perhaps his biggest plunge yet. He did not deliberate long.

After only a limited investigation,

McLean made his move, acting on what he says was "strictly intuition." He bought not only the huge Westvaco property but several others as well, including the 40,000-acre Atlantic Farms property which a Midwestern grain company had owned since the mid-1960's and put partly into production. Having assembled 375,000 acres altogether, McLean owned about a third of the entire peninsula. His fiefdom stretched over four counties and embraced the greater part of two of them. In choosing to name his vast new enterprise First Colony Farms, McLean borrowed from a mysterious historical episode—the attempt by Sir Walter Raleigh, in the 1580's, to establish on Roanoke Island (about 60 miles east of here) the first English colony in America. That venture had failed; within 5 years of its founding, the colony vanished without trace.

Plans for an Unrivaled Productivity

Measured simply in terms of total land area, First Colony could never be the nation's largest single agricultural entity. Its acreage, although vast, is not half that of some of the bigger Western ranches, such as the King Ranch in Texas. But, if its plans succeed, First Colony's acreage in row crops and its overall productivity will probably be unrivaled.

The basic aim is to grow huge quantities of feedgrains, roughage, and pasture grasses and convert them to pork and beef, which are to be the primary cash crops. By the conclusion of three "5-year plans," there are supposed to be 150,000 acres in row crops, chiefly corn, soybeans, and winter wheat—a goal which can be seen in better perspective if one notes that, in the big Corn Belt state of Iowa, there is but one farm as large as 5000 acres. Another 50,000 to 100,000 acres would be put into improved pasture. Less than 40,000 acres of cropland and pasture are in production today.

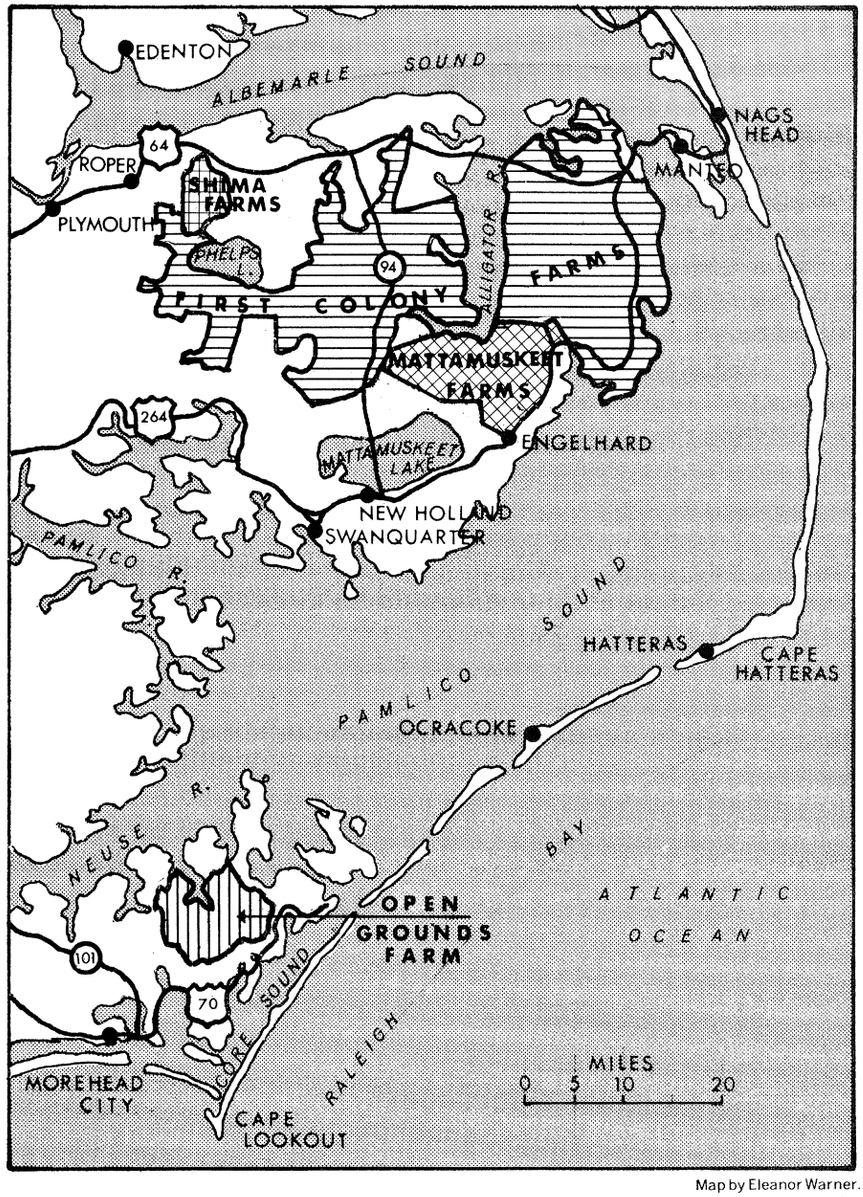
Plans for the livestock operations, and especially the swine operation, are more grandiose still. By 1980 the farm's managers expect to have about 15 exceptionally large and modern "sow units," containing some 25,000 sows altogether and capable of producing up to 400,000 top hogs (210-pounders) each year. Even in the Corn Belt, a 5000-sow operation is a big one.

Today, the farm has 1,200 sows, with a top production potential of 24,000 hogs annually. All wastes from the sow units, now and in the future, are to be collected and sprayed on pastures and crops as fertilizer.

At the moment, plans for expanding the farm's existing cattle herd—consisting of 500 brood cattle, plus 1000 steers and heifers being raised for sale—are in limbo because of an uncertain market and the high cost and difficulty involved in expanding pasturage. But the goal for 1980 has been to have 15,000 brood cattle producing about 12,000 calves annually; this would not be exceptional by cattle industry standards, but the ultimate goals contemplated are several times higher.

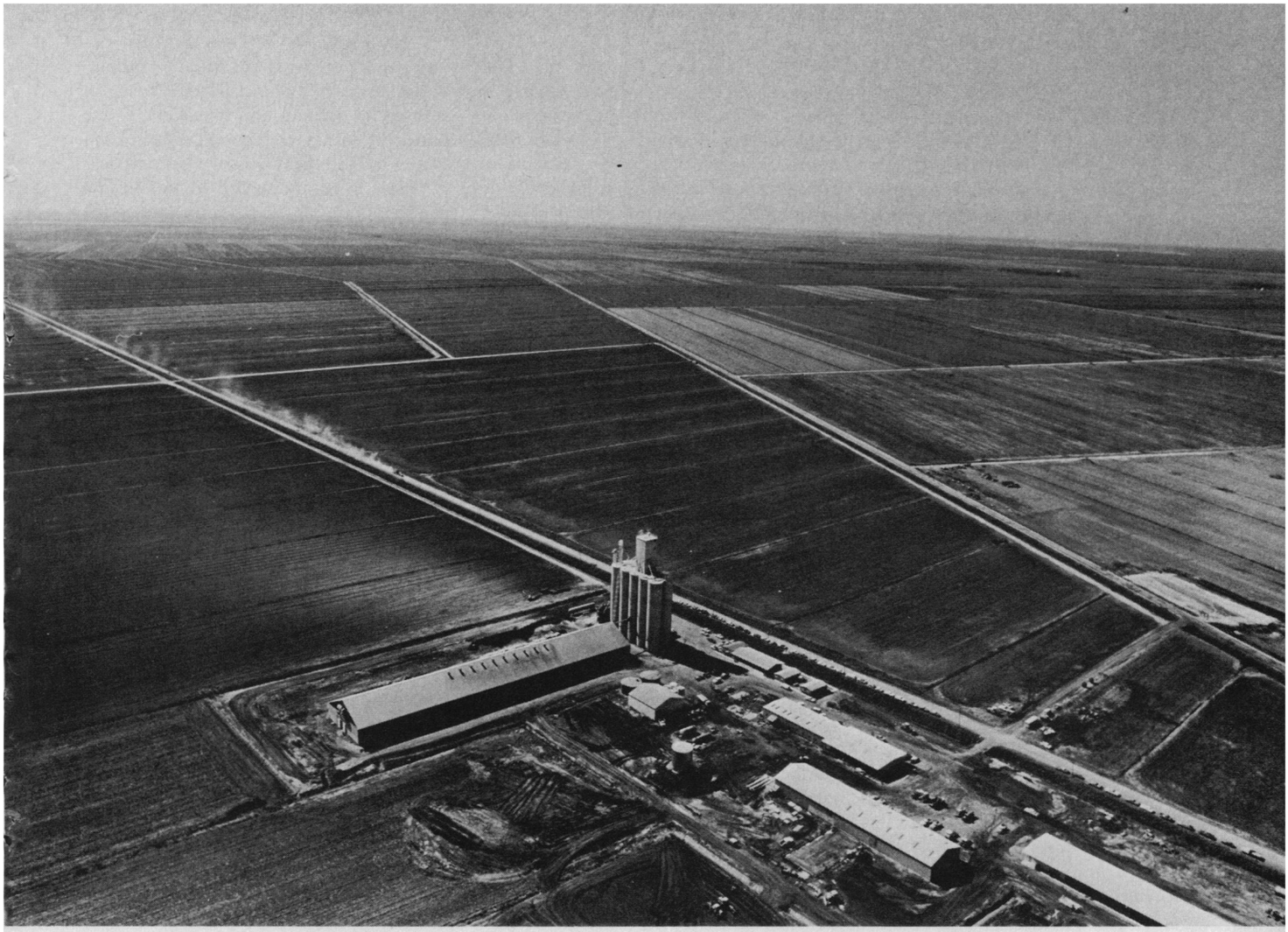
According to McLean's associates here, $100 million already has been spent on First Colony, with well over half that amount paid for the property itself, which included a grain elevator, considerable farming equipment, and about 15,000 acres already under cultivation. On a per-acre basis, the prices would probably have ranged from less than $100 for the least desirable of the uncleared land to usually not more than $400 for land already cleared and in production. The latter figure is a fourth to a third the price of prime farmland in the Midwest, where there are no hurricanes to threaten harvests. Probably at no price could McLean have gone elsewhere and assembled so much potential row-crop land.

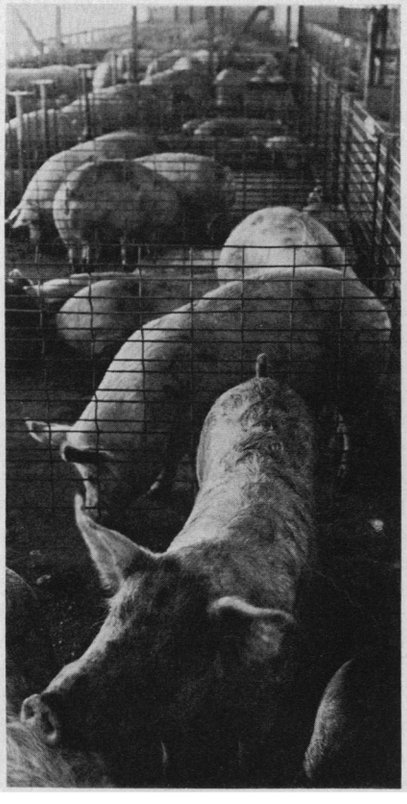
Although McLean would not discuss the matter with *Science*, there is clearly a question whether he will continue much longer as First Colony's personal owner and patron. His associates say that full development will require investment of an additional $100 million—which for McLean would mean doubling his com-



Map by Eleanor Warner.

Map shows four large farms established in coastal North Carolina since 1970: the 375,000-acre First Colony Farms, owned by a New York investor, Malcolm P. McLean; the 35,000-acre Mattamuskeet Farms, a joint venture of John Hancock Mutual and American Cyanamid; the 45,000-acre Open Grounds Farm, owned by Italian interests; and the 7,500-acre farm owned by the Shima American Corporation, a Japanese firm. Shima is now selling to one of the local farmers, some of whom have themselves become large operators.





In the aerial view at top, First Colony Farms resembles more a big Kansas wheat farm than anything North Carolina has seen in the past. At left, breeding pens in a First Colony sow unit. Above, cultivating new corn on land recently reclaimed from swampy scrub; note the field ditch and the windrow of debris. [Top photo by Bill Ray; lower photos by Quintin Bell]

mitment to a project that will not be paying its way before 1980, at best.

Early this year, McLean was approached by officials of the United States Sugar Corporation, which, as one of the giants of corporate farming, grows sugarcane and cattle on tens of thousands of Everglades muck lands in Florida and also has farm holdings in Mississippi. They expressed an interest in possibly buying First Colony, and McLean did not discourage them.

Indeed, U.S. Sugar commissioned the Research Triangle Institute, situated near Chapel Hill, to do a study of First Colony. The study has just been completed and U.S. Sugar had not yet received it when this reporter spoke to S. K. Swayne, the company's vice president of finance. But Swayne said that preliminary findings had been generally favorable. "We think that what they are doing makes sense," he said. The board of U.S. Sugar apparently met on 7 July to consider making McLean an offer, but, at this writing, company officials are treating whatever decision they may have reached as strictly private.

In view of the foregoing, it seems likely that, even if First Colony is sold, the present modus operandi and management will be retained, particularly if McLean is paid for the farm in U.S. Sugar stock and winds up on that company's board.

First Colony's top manager now is Simon B. Rich, Jr., an affable young man of 30 who learned about clearing and cultivating the peninsula's black lands while managing a big farm owned by his father. But Rich and his two younger brothers were running their own real estate business when McLean first appeared on the scene. They brokered all his acquisitions except the big one for the Westvaco land. And, that same year, they brokered the Shima American acquisition and a much bigger one to the south of here by Italian interests.

(A year or so before, all three of the Rich brothers—though born into a Jewish family—had embraced a nondenominational, fundamentalist Christianity. This religious bent, and the brothers' charitable giving, has served them well, Rich believes. "If you give a portion of what you make to the Lord, it's like casting bread upon the waters," he told *Science*. "Oral Roberts [the evangelist] actually sent the Japanese to us.")

Mindful of the pitfalls on this agricultural frontier, Rich and his associate manager, R. N. Campbell, an engineer who has long been active in McLean enterprises, have been stepping gingerly. For one thing, they are trying to keep the operation from becoming bogged down, either literally or figuratively, in the deep organic mucks that cover nearly half the farm. These mucks represent one of the three basic soil types at First Colony; the other two are the mineral soils and the shallow organics.

All three types are suitable for row crops if mineral deficiencies are overcome by adding copper and phosphorus and if excessive acidity is neutralized by applying lime, 5 to 6 tons of it per acre in the case of the more heavily organic soils. But, whereas the mineral and shallow organic soils lend themselves readily to cultivation, the deep mucks can wreck farm machinery and ruin peace of mind. They are unusually "woody," which is to say that stumps, tree trunks, and large limbs occur throughout the soil profile, having been preserved for thousands of years by the soil's acidity. About a fourth of the 24,000 acres cleared last year was of the deep woody type.

Keeping the wood removed from this kind of land to permit row crop farming is an unending battle. Unless corn and soybean prices go sky-high and make the battle worthwhile, all of the deep mucklands that have been cleared in the past, or that may be cleared sometime in the future, will be put into improved pasture, which requires only infrequent disking.

For the First Colony managers the trick is to map the soils carefully and direct land clearing and preparation to the shallow organic and mineral soil areas—and to stay out of the deep muck areas until the farm begins generating a strong cash flow. To help them follow this strategy, Rich and Campbell last year hired Steven Barnes, who had for 9 years led the North Carolina State University (NCSU) extension service's organic soils research.

Earlier this year the managers decided to reduce the pace of land clearing, cutting it from 25,000 acres a year to only half that. In part, this was to compensate for rising costs, which have been caused in no small part by the sharp increase in the price of diesel fuel since 1973. Another consideration was to be able to remove and sell all merchantable timber on land marked for clearing. Also, the slower pace would permit detailed soil mapping to keep ahead of the draglines and bulldozers.

Another major management problem facing First Colony is to make sure that the people who actually till the land and take care of the livestock are conscientious. The absence of a compelling personal interest and motivation on the part of hired employees is said to go far to explain the poor showing of many corporate farms.

First Colony is trying, as some others have tried, to overcome this problem by leasing much of its cropland to local farmers on shares, rather than simply for a fixed cash rent. Other land is farmed by employees who, on top of their regular pay, receive commissions based on output. A similar scheme of incentives is being instituted for the sow-unit managers, whose duties are such as to require the dedication of a monk and the timing of a quarterback. A failure to get the sows bred on schedule can foul things up all down the line, in the buildings used for gestation, farrowing, nursery functions, and finishing.

Environmental Impact

If the environmental impact of the First Colony development should turn out to be worse than expected, the regulatory problems that would ensue could be disastrous for the farm. But, although both state and federal permits are needed for the farm to carry out its essential water management functions, there is not now reason to think that any such permits will be denied.

First Colony is having an environmental assessment of all its proposed operations made by the Coastal Zone Resources Corporation, a consulting firm at Wilmington, North Carolina, known to environmentalists as honest and able. This study could contribute substantially to the environmental impact statement which the Corps of Engineers probably will prepare on First Colony's pending application to enlarge and maintain some existing drainage canals. The warning flag for First Colony and other big farms went up last winter when the Corps of Engineers ordered the Italian-owned Open Grounds Farm to close the gates on its drainage canal and stop the discharge of fresh, turbid waters threatening shellfish in the South River, which normally is clear and brackish.

First Colony has an advantage, however, in that its discharges will be made into two freshwater rivers, the Alligator and the Scuppernong, neither of which falls in the highly restrictive shellfish classification. Moreover, some discharges will be made into swamplands, which can serve as a natural filter.

Nevertheless, with so huge an area to be cleared and farmed, there will necessarily be runoff surges at volumes unknown in the past. The critical question is, will this runoff carry unacceptably large loads of nutrients and pesticides? In this matter, First Colony is perhaps justifiably optimistic. To keep down costs, if for no other reason, pesticides will be applied sparingly. And, with some exceptions, application generally will be made by cultivator instead of by crop-duster because the most frequent targets will be preemergent soil pests. In all cases, the pesticides used will be nonpersistent types such as Sevin, an earworm pesticide which degrades within 24 hours and does minimal harm to beneficial insects.

Substantial applications of nitrogen fer-

tilizer will be made, but, in this case, what might otherwise be a serious pollution problem is expected to be rendered insignificant by a natural process of denitrification. Through this process, the nitrogen would be converted to a harmless gas. According to James W. Gilliam, an associate professor of soil science at NCSU who has conducted studies at experimental plots here, soil conditions are such as to provide both the rich food source and the anaerobic environment needed by the soil microbes responsible for denitrification. The organic material provides the food, and the soils' generally poor internal drainage, even after ditching, makes for a relatively high water table and thus for anaerobic conditions not far below ground surface.

With First Colony expected to have more than 100,000 acres cleared and in production by 1980, a conclusive test of Gilliam's optimistic prediction of no serious pollution cannot be far off. The farm and the state together have installed an elaborate water quality monitoring system. Samples are taken regularly from 23 different stations and sent to Raleigh for measurement of some 30 different things and characteristics, including turbidity, biological oxygen demand, nutrients, trace elements, and heavy metals.

Something else that First Colony will have to conclusively establish is whether, as a practical matter, wastes from the sow-unit and feed-lot operations can be sprayed on pastures and crops without causing pollution. In theory, this method of disposal is workable; but in an operation as large as the one planned here—the wastes generated by the sow-units alone will be equal to the sewage of a sizable city—there will be plenty of opportunities for accidental spills and other problems.

Some subsidence of the organic soils from compaction and biochemical oxidation is inevitable, but, according to Steven Barnes and certain agronomists at NCSU, there are special factors present that mitigate against the kind of marked subsidence that occurs in the Everglades, where up to a foot of soil may be lost in a decade. The natural acidity of the organic soils here, coupled with the relatively high water table expected to be maintained, will confine oxidation to the soils' dry and well-limed top layer. In the Everglades, by contrast, oxidation sometimes occurs throughout the soil profile.

A member of the state Environmental Management Commission, James Wallace, who is also a past president of the North Carolina Conservation Council and a professor of environmental law, recently visited First Colony. He found the management to be "openhanded" and "very sharp." Wallace rates First Colony's chances of complying with applicable environmental standards as reasonably good, provided all procedural requirements of the National Environmental Policy Act and other laws are met.

To relieve environmental concerns further, First Colony could grant conservation easements for some of the wild areas not suitable for farming. Covering up to 175,000 acres, these areas include hardwood swamps along the Alligator River that are a last refuge for the peninsula's diminishing population of black bear.

Caricature of an Agribusiness

Some will raise objection to First Colony on the grounds that it represents yet another big "agribusiness." Indeed, it is virtually a caricature of the agribusiness that gobbles up huge acreages, uses scarce energy in profusion, and seeks profit by converting plant protein that could help feed the hungry into beef and pork for the affluent.

But, as for First Colony's bigness, there is much to be said for it. If there were no large, well-financed operation of this kind here, local farmers perhaps could themselves eventually buy up and clear most of the potentially tillable wild lands. Given the high cost of such development, however, these farmers would be decades in doing what First Colony may accomplish in several years, without government subsidies of any kind.

Furthermore, First Colony employs about 500 persons (including contract workers) and it may ultimately employ 1000. Local officials and most peninsula residents view it as an economic boon to an area long depressed. Tyrrell County, at the very heart of the First Colony development, is the smallest county in North Carolina in population and is next to the lowest in per capita income. At a drainage permit hearing this past April, Ray McClees, speaking for Tyrrell's board of commissioners, said First Colony deserved every support in its effort to put land regarded heretofore as "almost worthless" into productive use.

Even if First Colony should eventually fail, and this is not a possibility to be lightly dismissed, it will nevertheless leave much land drained and cleared and more productive than it was when Malcolm McLean bought it. Environmentalists usually have reason to regard "irreversibility" as a dirty word, but the fact is that much of the land being transformed here today became a brushy wasteland years ago. Indeed, this change which the Albemarle-Pamlico peninsula is now undergoing may be the first that has ever held out a promise of doing much more good than harm.—LUTHER J. CARTER

RECENT DEATHS

William E. Curtis, 57; retired associate professor of biology, Allegheny College; 16 June.

John C. Frazier, 75; professor emeritus of biology, Kansas State University, Manhattan; 6 June.

Elizabeth L. Hazen, 89; former bacteriologist, division of laboratories and research, New York State Department of Health; 24 June.

Hubert Heffner, 44; chairman, applied physics department, Stanford University; 1 April.

Frank J. Hinds, 74; professor emeritus of biology, Western Michigan University; 20 June.

Donald E. Kerr, 59; professor of physics, Johns Hopkins University; 23 May.

Henry W. Knerr, 69; retired associate dean, Graduate School, Pennsylvania State University; 6 June.

Arnold Lazarow, 58; chairman, anatomy department, University of Minnesota; 25 June.

David Lewis, 71; professor emeritus of chemistry, City College, City University of New York; 18 May.

Gennard Matrone, 61; chairman, biochemistry department, North Carolina State University, Raleigh; 2 April.

Charles W. Metz, 86; former chairman, zoology department, University of Pennsylvania; 5 June.

Gerald L. Poor, 68; professor emeritus of education, Central Michigan University; 17 May.

Herbert A. Potratz, 72; professor emeritus of chemistry, Washington University; 28 March.

Edward E. Rall, 99; former president, North Central College; 30 April.

Byron Riegel, 68; former professor of chemistry, Northwestern University; 20 May.

Simon Rodbard, 64; director of cardiology, City of Hope Medical Center; 1 May.

William T. Sanger, 89; chancellor emeritus, Medical College of Virginia; 18 April.

Wilbur W. Swingle, 84; former professor of biology, Princeton University; 20 May.

Richard Wellington, 90; professor emeritus of pomology, Cornell University; 15 June.

J. Frank Whiting, 51; professor of psychology, Catholic University; 23 April.

Clinton E. Williams, 67; former professor of civil engineering, Union College; 30 April.

Edwin B. Williams, 83; provost emeritus, University of Pennsylvania; 28 April.

Roger E. Wilson, 39; associate professor of botany, Miami University; 26 April.