in wilderness. Many potentialities of the earth become manifest only when they have been brought out by human imagination and toil.

Just as the surface of the earth has been transformed into artificial environments, so have these in turn influenced the evolution of human societies. The reciprocal interplay between humankind and the earth can result in a true symbiosis—the word symbiosis being used here in its strong biological sense to mean a relationship of mutualism so intimate that the two components of the system undergo modifications beneficial to both. The reciprocal transformations resulting from the interplay between a given human group and a given geographical area determine the characteristics of the people and of the region, thus creating new social and environmental values.

Symbiotic relationships mean creative partnerships. The earth is to be seen neither as an ecosystem to be preserved unchanged nor as a quarry to be exploited for selfish and short-range economic reasons, but as a garden to be cultivated for the development of its own potentialities of the human adventure. The goal of this relationship is not the maintenance of the status quo, but the emergence of new phenomena and new values. Millennia of experience show that by entering into a symbiotic relationship with nature, humankind can invent and generate futures not predictable from the deterministic order of things, and thus can engage in a continuous process of creation.

NEWS AND COMMENT

Carter as Scientist or Engineer: What Are His Credentials?

Jimmy Carter, if he beats his Republican opponent in November, will become the first American president, at least in recent times, who can lay claim to any significant degree of scientific and technical knowledge. Carter's claims are in fact quite substantial, even if in at least one aspect they appear to be somewhat in excess of what is strictly justified by the record.

In his standard campaign speech Carter used to introduce himself as a "nuclear physicist and peanut farmer." The term "nuclear engineer" is now preferred at the Carter campaign headquarters in Atlanta. "It's a matter of semantics whether you regard there being an important difference between the two words as a pressing matter," a Carter spokesman told *Science*.

In describing himself as a nuclear physicist Carter probably meant simply to imply that he knows a fair amount of nuclear physics, which indeed he does. But the term is misleading insofar as it implies he has a degree in the subject. The nominee's only degree is the Bachelor of Science he got from the Naval Academy at Annapolis in 1946. The program lasted for 4 years, with roughly half the time being devoted to scientific subjects such as mathematics, physics, and engineering, and half to other pursuits such as foreign languages and seamanship. There was no course on nuclear science.

Carter's nuclear expertise stems from the year he spent at the conclusion of his naval career in the atomic submarine program. From November 1952 to October 1953, when he returned home to Plains, Georgia, he was assigned to the Atomic Energy Commission's Division of Reactor Development at Schenectady, New York. His task was to train himself and the prospective crew of the *USS Sea Wolf*, the second nuclear submarine to be built. As senior officer of the crew, Carter says in his biography, he taught the men mathematics, physics, and reactor technology. He also helped General Electric workers construct the prototype power plant for the submarine at a site near the Knolls Atomic Power Laboratory. He and another officer "studied special graduate courses in reactor technology and nuclear physics at Union College."

Does this experience make a "nuclear engineer" of Carter? The "special graduate courses" lasted only one semester. One of the two professors who taught the courses was Kenneth Baker, now dean of faculty at St. Lawrence University in Canton, New York. Baker has lost his course records, cannot remember Carter, and does not know if it was he or the other professor who taught him. The courses, Baker recalls, were introductions to nuclear physics and reactor engineering. They were intermediate between the undergraduate and graduate levels. "No one who took that program could be classed as a nuclear engineer—it was at quite an elementary level," Baker says.

But the term engineer is used in a range of senses. A professional engineer is often understood to be someone who has undergone a 4-year course in a particular engineering specialty, such as electrical, mechanical, or civil. Carter is not an engineer in this sense. But from his course at Union College and the practical work at the Knolls Atomic Power Laboratory he probably picked up as much experience as is possessed by many who call themselves engineers. "The officers in that program participated very directly in the construction process [of the nuclear reactor] and they certainly functioned on board as engineers—anybody who examined the question would say that Carter is an engineer," comments National Science Foundation official Joel Snow, who from 1958 to 1961 used to be an instructor in the nuclear power program that Carter attended. Snow adds that the program, under Hyman Rickover, was a "very rigorous experience" for its participants. "Rickover required phenomenal things from his officers. He required them to be polymaths and to penetrate into every aspect of the problems they were studying," Snow remarks.

The practical expertise acquired by Carter and his team seems to have been in demand outside the navy. "Because of our security clearance and experience in the field," Carter relates in his autobiography, they were asked to help disassemble an experimental nuclear reactor at Chalk River, Canada, which had gone out of control and suffered a meltdown. The radiation intensity, Carter says,

> "meant that each person could spend only about 90 seconds at the hot core location. . . . When it was our time to work, a team of three of us practiced several times on the mock-up to be sure we had the correct tools and knew exactly how to use them. Finally, outfitted with white protective clothes, we descended into the reactor and worked frantically for our alloted time.

For several months afterward, we saved our feces and urine to have them monitored for radioactivity. We had absorbed a year's maximum allowance of radiation in 1 minute and 29 seconds. There were no apparent aftereffects from this exposure—just a lot of doubtful jokes among ourselves about death versus sterility.

Nuclear matters aside, Carter's naval career seems to have called for a certain degree of technical competence. On his first ship after graduating from Annapolis, a test vessel for electronics and gunnery, he was electronics and photography officer. The rest of his naval career was spent on submarines. One of these, the *USS K-1*, conducted experiments on undersea sound transmission and tested new techniques for locating ships by sonar. Carter's command thesis (he became qualified to command a ship but was not senior enough to do so) described "a new technique for determining the distance to a target ship, using information derived from the passive listening equipment only," he says in his autobiography.

Bessel from Fourier

People in the scientific and technical community are already reacting with enthusiasm to the possibility of having one of their own kind in the White House. "It would be unusual to see a president who knows a Bessel function from a Fourier series," says Snow. Others believe that Carter's technical expertise will be of help in making decisions on energy policy. Carter would certainly make a more scientifically literate Chief Executive than either the present incumbent or his predecessor, who once confided to a crowd at Hanford, Washington, that science was one of his poorest subjects and that "I got through it but I had to work too hard." A scientist-engineer in the White House is perhaps the modern age's nearest equivalent to Plato's ideal of the philosopher-king. Carter would doubtless play the former part less disastrously than Hiero, the tyrant of Syracuse upon whom Plato set his hopes, performed the latter.

Carter's descriptions of himself as a nuclear physicist and nuclear engineer may not coincide exactly with what most people would take to be the natural meanings of the terms, but then nor are they barefaced examples of the type of statement that Jimmy has vowed never to make. The point is that he acquired a broad technical competence in the course of his naval career, for which as a shorthand description in a stump speech the term "nuclear engineer" could be regarded as generally apt enough.

—NICHOLAS WADE

New CIA—Research, Anyone?

Mathematica Inc., one of the nation's best known private think tanks, has become a guinea pig for attempts by the Central Intelligence Agency (CIA) to conduct "open" research and resuscitate its languishing relations with the American academic community. Normally, CIA's outside research contracts have been kept secret.

For 2 years, Mathtech, a subsidiary of the corporation, has operated a small consulting group, called the Analytic Support Center, on the outskirts of Washington for the CIA. And although those close to the work of the center are enthusiastic about its activities, perhaps the most interesting thing about the $600,000-per-year effort is that the fact of its existence is public knowledge.

The Analytic Support Center develops methodology for problems of strategic interest; for example, it might model likely coalitions in a multiparty political system. Into such models CIA can then feed the vast amount of information it collects on such problems, in the hope of improving on its individualistic, ad hoc, methods of analyzing them. "Our job is not to conduct the analysis. It's to develop and test the methodology," says Norman Agin, Mathtech's president.

Moreover, the center is meant to be a link between intellectuals and the CIA. The center sponsors university-type seminars at CIA headquarters (which may be attractive partly because the center's private status enables it to pay three times the $100-per-day mandatory government consulting wage). Thomas C. Schelling, professor of political economy at Harvard, who participated in one such seminar, says he finds such arrangements "all right so long as everyone who works for them knows who they're working for. The Mathematica people told me straight away that it was for CIA."

But the experiment with open research has not been totally successful. When word of the impending CIA contract reached other parts of Mathematica, its social scientists objected strongly. Mathematica Policy Research (MPR) does more than half of the corporation's $15-million-per-year business. MPR's reputation as a social science research organization is based on its ability to get unusually high rates of response in questioning poor people such as ghetto dwellers and welfare mothers. The fear was that such people would slam the door in interviewers' faces if Mathematica had a CIA connection.

The dispute was supposedly settled when the CIA contract was let, in November 1974, by making MPR and Mathtech into separate subsidiaries with different governing boards. However, some MPR staffers are still uneasy with the arrangement, although none can cite an actual instance where a survey has actually been hurt by knowledge of Mathematica's CIA contract.

A CIA spokesman denied that the ASC contract signals a new policy of openness in obtaining outside advice. While some contracts have been unclassified, most of the agency's dealings with the academic community remain secret. The CIA has research contracts in approximately a dozen colleges and universities; in nearly all cases, only the investigator and a "senior responsible official" of the university—usually the president—know that CIA is sponsoring the research. Moreover, according to Carl Duckett, who until recently was CIA's long-term chief of research, there are some projects that university records will show the money as coming from another government agency, such as the Department of Defense or the Department of State.

Duckett says that, while CIA usually gets permission for a proposed project from a university official, in keeping with a 1967 presidential order barring covert campus research, there are exceptions. He says that, as of early this year, he knew of one university researcher, who represents "the best brainpower in the United States," who had asked CIA not to tell his superiors that the agency supported him, for fear that he would be fired. The CIA agreed. So, after 2 years of criticism and investigation, the agency now allows an occasional public glimpse of its dealings with intellectuals and scholars. But it is still a long way from opening up such dealings to the sunshine.—DEBORAH SHAPLEY