From Polynesian fishing villages to the streets of Harlem, a visionary scientist yokes the great cycles of Earth and sea into a timeless garden where wilderness and humanity intermingle

INTERVIEW

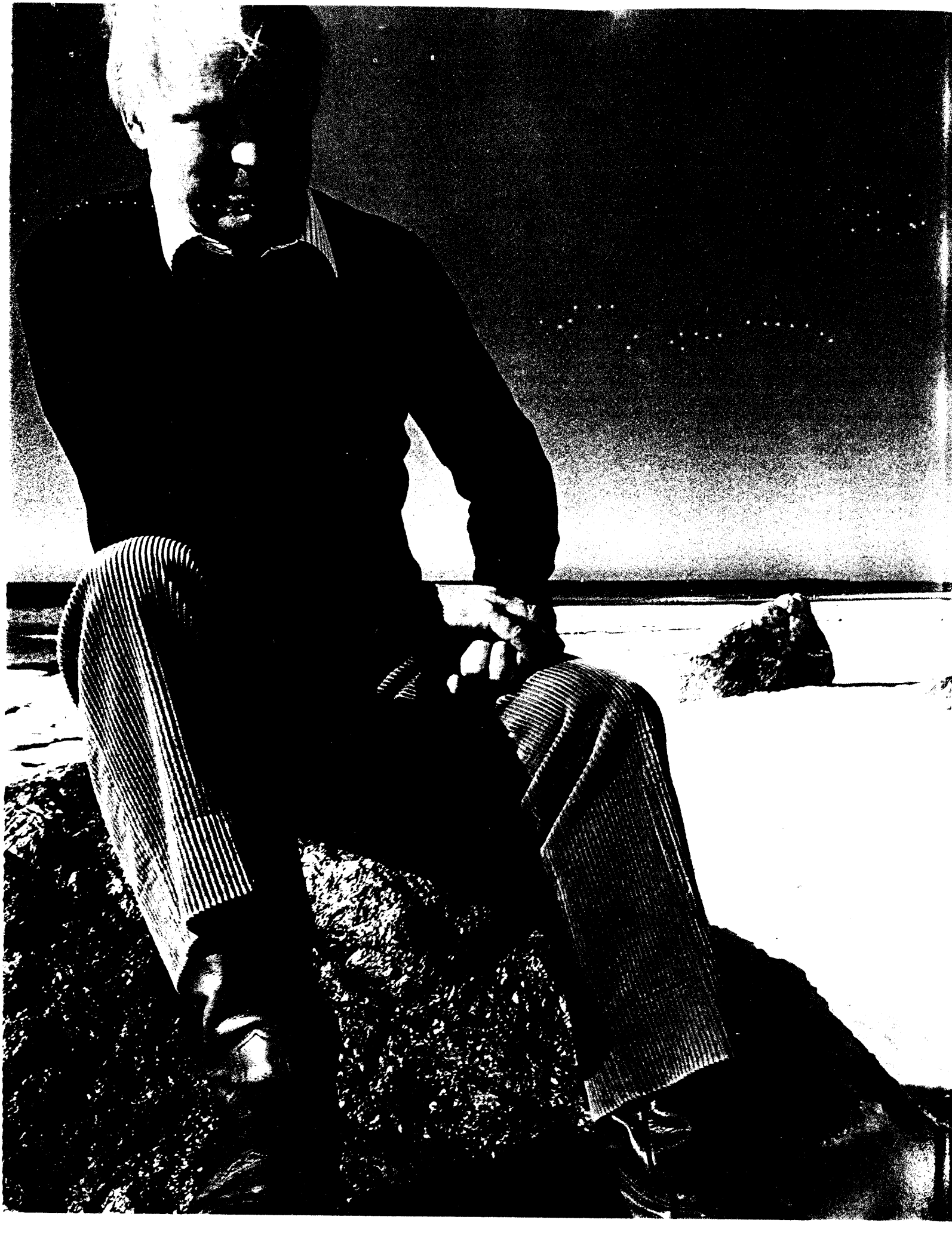
JOHN TODD

South of the border, red is the mark of the devil. So when burly, strawberry-haired John Todd went to a festival in Mexico a few years back, a local crowd attacked him. "They tried to rip out my hair, and they got quite a bit of it," Todd recalls. "My looks were so alien to them. But when I saw the red rocks and the cactus all around me, I entered a state of communion with these inanimate objects, which were so benign and passive. I've tried to use that sense of being an alien as creatively as possible; it's given me the energy to take risks."

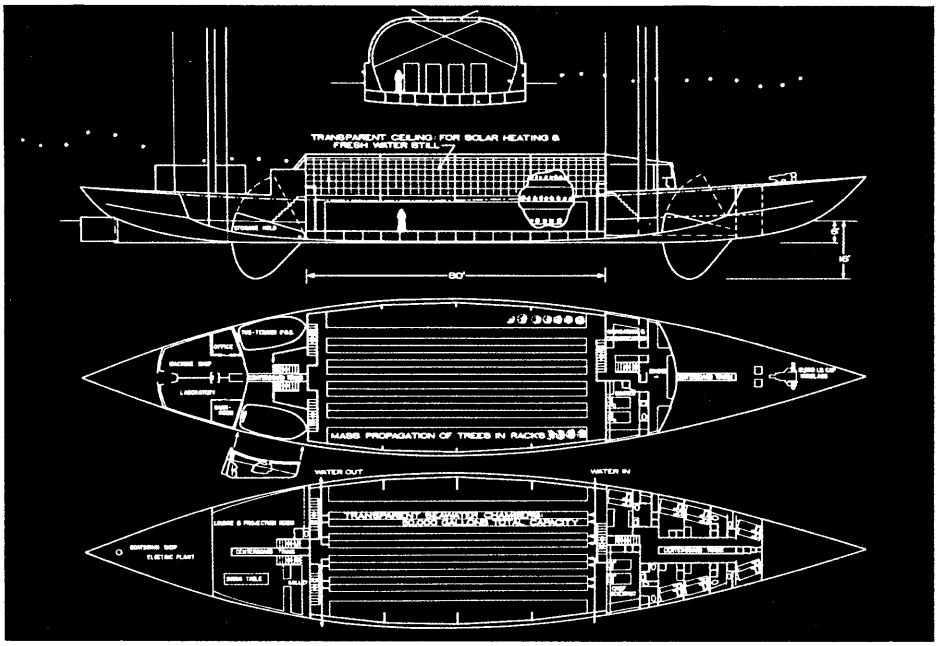
Biologist-ethologist John Todd, forty-five, has taken risks most of his life. Born in Hamilton, Ontario, Canada, he studied agriculture, parasitology, and tropical medicine at McGill University, in Montreal, then earned a Ph.D. in animal behavior from the University of Michigan, in Ann Arbor. By the late Sixties, he was a research scientist at the prestigious Woods Hole Oceanographic Institute, in Massachusetts. Todd was on his way to becoming one of the country's foremost young marine biologists. Then he decided to quit. "It was the thick of the Vietnam War," he explains, "and much of science was being directed toward weaponry. We were spewing poisons, pesticides, herbicides, defoliants, and insecticides all over the place. Yet in all this, there was no institution that would set a different list of values and priorities. We decided it was time to make one."

So in 1969, with the grandiose goals of restoring the lands, protecting the seas, and informing the earth's stewards (its "healers"), scientist-visionary Todd, joined by his wife Nancy Jack Todd and Woods Hole colleague William O. McLarney, founded the New Alchemy Institute. The name, Todd admits, smacked of mysticism and the psychedelic Sixties. But, he insists, it helped him hone his ideas. Ancient alchemy, after all,

PHOTOGRAPHS BY DAN McCOY



"Everybody likes to roar around on something, whether it's a motorcycle or an Ocean Pick-up."



demanded a precise knowledge of the natural world. And the natural world was what Todd hoped to emulate.

Working with a dedicated group of colleagues, most of whom were paid little or nothing, he built a series of bioshelters. Structures within geodesic domes, bioshelters house fish and plants and run nearly self-sufficiently on sun and wind, the power of photosynthesis, and the great cycles of land and sea. By studying and varying these domed environments, dubbed *arks*, Todd was able to develop potential agricultural units that could be productive and profitable *without* relying on fossil fuels or costly chemical fertilizer.

Todd had built a number of ark systems when, in the early Seventies, anthropologist Margaret Mead encouraged him to use his methods to transform the town and city as well as the farm. Soon John and Nancy Todd had spawned a plan that included trees to purify the air, water hyacinths to process sewage, aquaculture minifarms at every bus stop, and vast lakes that would modify urban climate.

Todd hopes he can soon begin to implement some of his ideas on the largest Gothic structure in the world, New York's Cathedral of St. John the Divine, in Harlem. His plan is to replace the copper sheathing on part of the 600-foot-long roof with glass. This solar greenhouse will at once trap warm air to heat the cathedral and will house hundreds of fruit, nut, and ornamental trees. The hope, according to Todd, is that the church might use these trees to reforest the city en masse. Burnham Wood comes to Harlem.

But Todd is not content to wield the wisdom of biology in the Western world alone. In recent years, spurred by the realization that our profligate, energy-intensive ways will inevitably oppress those in the impoverished Third World, he and Nancy established Ocean Arks, International. Their primary purpose: to build sailing ships that would replace the energy-intensive, petroleum-run fishing vessels in use today. Todd, who comes from three generations of naval architects, has already collaborated with designer Richard Newick to create five versions of the Ocean Pick-up, a boat with three parallel hulls connected by crosspieces. This space-age sailing craft—"It's half-bird and half-boat," Todd says—is speedy, sturdy, and reliable. It can be built from local trees with a manufacturing process accessible to low-technology Third World cultures. Should Todd have his way, production will begin in Guyana and Costa Rica sometime soon.

If John Todd has proposed radical designs for people around the world, a visit to his Cape Cod home reveals those concepts implemented with a vengeance. Driving past lush, windswept stretches of Massachusetts coast, one comes to a culde-sac without a name. There, just as Todd promises, is a house you can't miss. Its sloping glass face reveals a garden of leaves and eight-foot-tall cylinders filled with iridescent green. Each vat, Todd explains, is an ecosystem all its own. Emerald algae photosynthesize carbon dioxide and water into protein, sustaining fish ranging in species from the ancient tilapia to the Chinese amur. The fish, in turn, often provide dinners for the Todds.

In back of the house, meanwhile, a picture window looks out on the Todds' *other* garden, a natural area complete with wildlife and a pond. "There's a muskrat building his nest," Todd points out. "He really wants a female. Last year his nest wasn't good enough to attract one, but this year he might do better."

The eye, though, is drawn not to the animal but to a rickety shack on stilts in the middle of the pond. Its only approach: planks that emerge out of foot-deep water and seem to miss the door by a yard. "I go in there afternoons to write," Todd explains. But when asked for a tour of the facility, he declines. "It's pretty private and raunchy in there," he says. "Besides, you'd probably fall. I have to wade over with thigh-high boots myself.

"We're going through changes as dramatic as those of the Renaissance," he says, returning to the subject of his life's work. "As a culture, we have not really learned yet to work *with* the planet, with total fascination and respect. We've always superimposed our totally fascinating technology on the natural systems of the planet. And our chemistry is so alluring to us that we impose it in drugs on our own bodies. The exploration of the self and the willingness to work with the planet, not just to use it, are two world views hitched to the same star."

John and Nancy Todd describe their years of research in a new book, *Bioshelters, Ocean Arks, City Farming: Ecology as the Basis of Design* (Sierra Club Books, 1984). Todd was interviewed at their Cape Cod home and at the New Alchemy Institute by *Omni* senior editor Pamela Weintraub. The discussion that follows was added to sections from a previous interview conducted by anthropologist John Grossinger and writer Lindy Hough.

Omni: What convinced you to leave hard-boiled research and an academic career to found the New Alchemy Institute?

Todd: In a way, my path was cyclical. From the time I was a teenager, I was fascinated by the idea of agriculture and farming as the mother of culture. I read the works of Louis Bromfield, Sir Albert Howard, and others studying the relationship between man and Earth. They chronicled the fall of many civilizations that had turned their backs on the natural world, suggesting that agriculture and culture were twin souls. I was inspired and went out to study agri-

A seagoing bioshelter, the ocean ark Margaret Mead *(above) has a solar desalination plant, tree farm, and continuous filtering of seawater.*

culture myself. I soon discovered, though, that as perceived by present-day professionals, it was mostly a technological venture. It wasn't anything like what I had read about. I wanted to understand how the living world worked, and eventually I did a doctorate in ethology, the study of creatures in their natural habitat.

By the Sixties, in fact, I had become an animal behaviorist trying to decode some of the ways creatures in the sea and freshwater lakes communicated. I worked with a species of catfish whose social behavior was so highly organized that two individuals could remember a single conflict four months after it had occurred. For four months I would separate the participants in a conflict situation. Then I would simply place the water from the winner's tank into the loser's tank. The loser would immediately change color, flee, and quiver as if it were about to be clobbered. When I did the opposite, transferring the water from the loser's tank into that of the winner, the unique behavior pattern of aggression and challenge would occur.

Don't forget, in the Sixties, when we founded the New Alchemy, we were in the midst of the flower-child era. You turned on the radio and heard Malvina Reynolds singing "Ticky-tacky," and everywhere was the sense that society had just become too materialistic and insensitive to deeper aspirations, whatever they might be. We simply wanted science to serve culture in a way that wouldn't lead to atomic bombs. We thought we could best accomplish that goal with an institute of our own. When I told my father that we decided to name it New Alchemy, he said, "You've really blown it there, fella." But the name helped us formulate our ideas. It helped us differentiate between what we perceived as old science as opposed to the new.

Omni: What were some of your goals in those early days?

Todd: The stated goals were to restore the lands, protect the seas, and inform the earth's stewards—those individuals who would help us tend the earth. More specifically, we thought we'd like to create a little food-growing entity that would be highly productive and operate as much as possible on natural cycles, without the need for fossil fuels or a lot of land.

We asked ourselves one basic question: What takes care of itself by itself? There was one obvious answer: The earth. So we said, okay, let's design a miniature earth. Then we set out to learn just how the earth works. Earthly life exists, we realized, because of the atmosphere—a transparent, translucent body of gases that captures solar energy. The architectural form that would simulate the function of the atmosphere best suited to the capture of sunlight, we decided, was the geodesic dome, developed by Buckminster Fuller. As the sun marches across the sky, no matter what its position, the dome has facets facing it directly. But the atmosphere alone doesn't cause life to exist. We need another element to store the energy that has been captured. Land is a very poor storer of energy, as anyone who's been in the desert at night can attest. Captured sunlight is stored mainly in the oceans, which make up seventy percent of Earth's surface.

So within our artificial atmosphere—a plastic geodesic dome—we placed a pond. Because most of our small farm was water, we thought that most of the foods grown would be based on aquatic cycles. Thus, first we seeded our ocean with a wide variety of tiny plants, the plankton that convert sunlight and carbon dioxide into oxygen and protein. Then we needed to stock our pond with fish that would eat the plankton. The fish we finally chose to play the role of the great blue whale or the sardine—the filler-feeding fish that eat the ocean's green soup—was an African creature called tilapia, or St. Peter's fish. That fish, ironically enough, was the fish associated with the loaves and fishes tale in the Bible and was in the Sea of Galilee at the time of Christ.

The tilapia has been associated with humans for a long time. There are drawings of it on the tombs of the pharaohs, and we liked it because it could be cultured without exploiting the environment. Then there were other aspects of the ocean that we simulated as well. To reproduce currents, which cause pond nutrients to roll over and circulate, we introduced the highly muscular and active mirror carp from Israel. And to emulate the nutrition that highly fertile seas get from rivers, we used a Chinese creature called the white amur. These fish are delighted to feed almost exclusively on plant matter from the land; so we gave them hay, marigold leaves, and weeds from the garden. They have a rather uncanny digestive ability—what comes out of their rear ends, in short, are things you might find in a river.

Finally we began to design the other thirty percent of our bioshelters. Plants were irrigated and fertilized with pond water enriched by fish waste. The plants, in turn, sent their wastes back to the pond. The whole system was a constant.

Omni: You've built many other enclosed ecosystems—you call them arks—since then, haven't you?

Todd: We have subsequently improved and varied that original strategy, but the thinking still holds. Nature provides the information that will allow us to succeed in our larger goal—creating equality between the world's peoples. As long as things cost money or require a lot of capital, as long as agriculture requires the importation of heavy amounts of petroleum-based fertilizer, you can't have equality, because some people can afford it, and some people can't. So we were looking for a currency applicable to all peoples, no matter how rich or poor. The one currency available to everyone, we found, is nature and the information inherent in how it works. There may be more intrinsic resources in any given region; I'm not denying that. Each

area has its own latent possibility; learning that is like watching a flower unfold in the spring. Even during periods of scarcity, nature provides enormous potential.

Omni: Could you give an example?

Todd: Well, we were in the Indian Ocean, visiting a beautiful island whose primary crop was coconut. But the fate of the population was threatened because the sole source of fresh water, apart from what people caught on their roofs, was the freshwater lens underneath the island. The lens was nearly depleted; so the island would have to be abandoned in a matter of years. Here was a real tragedy in the making. Well, the one solution to the problem would be to somehow make bowllike basins on the surface, thereby catching the rain during the rainy season. The island's coral soil was as porous as sand, and water poured into it disappeared.

But I remembered the research of a couple of Russian scientists who had discovered a process, little known in nature, whereby, in the absence of oxygen, organic matter could combine with certain kinds of bacteria to form the biological equivalent of plastic. They discovered this process at the bottom of tiny, rubble-filled lakes that wouldn't ordinarily hold water. So I wondered if it would be possible to simulate the process by making a living plastic on an excavated lake. Well, that's just what I did. First we excavated a large pond. Then we went in search of organic matter with a lot of carbon in it. It turned out that husks, which are rejected from the coconut, were appropriate. We ground them up and layered them over this pond floor.

Then we went into the jungle and found a papaya plant with real sexy enzymes, which acted like witches' brew. With that we created another six-inch layer and then pressed sand down over all of it. We added enough water to start the process, waited for the rainy season, and now there's a lake on the island. This was an important experiment, because over-grazing and deforestation have caused most of the soils of the world to lose surface. Those areas of the world where there are seasonal rains can be brought back to life again.

It may sound arrogant to say that I can revive the ecology in wasted places. But I know it can be done. There is a vitality and tough organizing principle to nature. Even when you take a bulldozer and scrape the side of a road, you notice how it reorganizes itself. You see types of organisms that absolutely love a good scraping!

Omni: What part did Margaret Mead play in influencing your thinking, that is, to embrace communities rather than buildings?

Todd: In 1976 we went to the town in Indonesia where she and Gregory Bateson had once observed the balance and connectedness between religious practice and music, art, and architecture. We hoped to think on a larger scale about villages and towns. The result was the bioshelter. It has become the main tool within which water can be desalinated passively; inside the structure, trees, plants, and soils, as well as water and marine life, are cultivated.

In desert regions, for example, this desalination facility looks like an encampment of tepees: a number of fifty- to eighty-foot-diameter geodesic climatic envelopes. These bioshelters are placed in a large circle. During the day seawater is pumped into a large solar silo within each bioshelter. The evaporation and condensation of the seawater produces fresh water at the silo's base. Marine organisms grow inside the bioshelters. At night, with colder weather outside, the whole building begins to weep, and water runs down its periphery. This enables us to establish the ring of trees immediately beyond the structures. Within two years the trees—their root systems and soils—are established, and the geodesic bioshelters are lifted off and taken to a new site to repeat the cycle. The cluster of trees and vegetation eventually traps its own moisture, preparing the way for permanent agriculture. The whole collective structure acts as a catch basin for wild pollen, leaves, and pine needles that fall after the domes have gone on to the next place.

"If we connect a primeval woods from the Hudson River to Manhattan by adding tentacles of soil, we'd create a direct link to all the creatures that don't come into the city."

Omni: Are you more concerned with bioshelters than the technology of land-restoration projects?

Todd: We're concerned with different combinations of plants, of predator-prey relationships, soil enhancements—all the ecological elements. There are very few ecologists who have a great interest in technology. On the other hand, we have to bring in biologists who know just what combination of plants will allow a Greek island that is now nothing but rock and sand to flower with springs from the ground and a forest floor. To regenerate an ecology of ten thousand years ago and return a thousand years of its topsoil in a decade, you need people who understand Mediterranean plants and can carry out this symphonic ecology. You can't just plant trees and pray to Pan it'll work.

Omni: How would you evaluate the present state of desert restoration?

Todd: I was fascinated by the early, very sophisticated ecology that grew out of Israel. The rediscovering of the flow of water and of seeds that can germinate with a few days of moisture, get roots down, and survive to produce a crop of trees that can do the same thing. This superb ecology was patterned on the historical methods of the flowering of the desert.

But the pressures from the shadow side, from the militarization of the country, have had their effect. A tremendous amount of walnuts and oranges have to be produced to feed Europe and keep money flowing for weaponry. Israel is no longer adapting trees to the desert. They're adapting the desert to the trees.

They've found primordial aquifers deep within the great organs of the earth, and they're pumping up this water to use on crops in a desert not unlike Death Valley. One effect is the salting up of the surface. Look at the Tigris-Euphrates Valley. It's become one white, glistening desert from salt deposits created by humans trying to grow crops with imported water. That desert's been dead since 2500 B.C. Before, it was a lush valley. There is scientific evidence that tampering with these great organs could have untold consequences.

Omni: Does anything remain of those early years of agriculture in Israel?

Todd: I would guess that in the rush for bucks from Europe, the addiction to petroleum has reached nearly everyone. The early ecological agriculture wasn't so involved in oil to fuel every machine. It depended on waterworks and canals to take advantage of the runoff after a flood and allowed that few minutes of rain to produce a whole crop. The Israelis weren't quite as good at it as the Hopi or the Papago, but they were good. Now the bucks are needed because of the weapons. Israel is almost the world in miniature. The moment you develop an addiction to a particular input other than the sun, you start playing by a different set of rules. Israel absolutely must have petroleum.

Omni: So the rules of the game you're playing have to do with technologies that will work indefinitely?

Todd: That's the basic rule. In designing around natural infusions of energy, you soon discover that you're dealing with pulses instead of steady states, such as those of a power station or an electrical generator going twenty-four hours a day. Pulses open your field to a whole variety of interacting relationships.

Ten years ago I designed a wind-powered fish farm: three connecting pools with the bottom pool enclosed by a greenhouse. Water flows from the top to the middle pool and down to the bottom pool, the biggest. The windmill chugs it back up to the top. Everyone said, "The water won't flow all the time. You're going to ruin productivity." I said, "Perhaps, but I'll see what happens." We put fish in the upper ponds but not in the lower, so that when the wind wasn't blowing, a whole variety of microorganisms were busy proliferating. There were hundreds of rotifers and daphnia. The

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windmill started after a few days and pumped these organisms up to the fish, which ate them, but without destroying the population that was growing exponentially in one compartment. So our fish had a source of free food that wouldn't have existed if water constantly circulated. Then there would have been continual predation. The pulsing of the wind and the segregating of elements of the ecosystems functioned as two interacting principles.

Omni: How can your ideas help us revamp the center of industry, the city itself?

Todd: Okay, let's start with an existing city. First, I'd like to see greater use of living processes within the city itself. Cities have always tended to be exclusive to humans and pets. Other than parks, there's been a real rejection of nature. The biological knowledge gathered at New Alchemy, on the other hand, shows that while nature can be miniaturized, it has to be whole. To make the city whole so that it can take care of itself, much as the earth does, you've got to link it up to the essential cycles of nature. The first cycle to consider would be the purification cycle. The secret agenda behind this scheme is to purify the water by reinstating the original marsh plants that once flourished where buildings have now displaced them. There are plants that extract toxic materials from the air. Such plants could be used everywhere—inside buildings, on the streets, in workplaces. Another cycle is the food cycle. Foods can be grown in cities and should be grown in cities, because people who grow food in the city just won't tolerate pollution.

Perhaps the most orthodox city agriculture would be greenhouse gardens on the rooftops. But equally challenging is a funny idea I call bus-stop aquaculture. It is possible and cost-effective to grow fish and shellfish in small spaces, using relatively little water. Translucent cylinders of fiberglass seeded with algae and filter-feeding fish could be placed in almost any spot that receives direct sun, from bus stops to street corners. People could make good livings selling the fish.

A third extremely important area is the whole question of wastes. I propose the very radical idea of building a solar sewage wall right through the heart of the neighborhood. The wall—a long, thin, greenhouselike structure filled with a beautiful display of water hyacinths—would run parallel to the sidewalk, shielding pedestrians from cars and the street. Human waste would enter the system, and as it traveled through the chambers, hyacinth roots would filter out all particulate matter. By the time the water had passed through, it would be crystal clear. At the very end of the process, you would zap it with ozone to kill any remaining viruses or pathogens. The result would be the purest drinking water you could find. Finally, you could compost the hyacinths to make fertilizer!

One of our ideas for the Cathedral of St. John the Divine was to produce literally millions of fruit trees, which would be made available to parishioners and would also be used for the reforestation of urban areas. There is no question that everything planted on the street would get vandalized initially. But in their minds, people would start to own the trees and take care of them. And the trees might lead to the protection of the neighborhoods. It might take several waves of trees out in the streets. It would be nice to give or sell peach trees so that the street would accept them when they are bearing fruit. It's harder to violate a peach tree when it has a big peach on it. Steal the peach but not the tree.

Omni: You have another scheme—building lakes throughout the city.

Todd: To set up these lakes, you excavate an area eight feet deep and one block long. I'd like to see one lake about every four blocks, staggered in a pattern that wouldn't screw up the movement of the city. Café societies could spring up along the banks. The lakes would serve as gigantic swimming pools; the only life they'd contain would be human. Since the lakes would be heated with solar energy, they'd be warm enough for swimming in the late spring and throughout the fall. In the winter the lakes would be drained to a few inches in depth. Whenever there was a cooler-than-frost night, a fine mist of water would freeze over it, and you'd have a beautiful rink for ice skating. It would be like Elizabethan England on the Thames.

"To regenerate an environment of 10,000 years ago, you need people who can carry out this symphonic ecology. You can't just plant trees and pray to Pan it'll work."

On the side of the lake, exposed to the southern sun, would be a channel perhaps three feet deep. The water would leave one end of the block and be pumped through the channel, which would be covered by a transparent vault. As the water comes through the channel, it gets warmer and warmer so that by the time it goes out the other end, you've got warmish water. That would give you swimming temperatures in the later spring and throughout the fall. And in the lake, there would simply be a wall of photovoltaic cells for solar heating. Every time the sun would shine, the water would pass through the channel, getting warm and being purified.

On cloudy and gloomy days, people are less prone to swim; so there are going to be fewer kids peeing in the water. So it's a perfect connection between the sun and the purifying cycle and the fact that all kids pee in swimming pools. During the summer, the lakes would absorb excess heat, cooling the city. In late fall they would release that heat to the air, thus warming the surrounding area.

Omni: Any other schemes for the biologically based city of the future?

Todd: Yes. I think it would be good to have fingers of true, unbroken wilderness from the country—say, from the Hudson River Valley—permeating all the way down into the very center of the city, right down to lower Manhattan. These would be like tentacles; so the wildness that makes up our cells, that makes up us, would be reflected in the wildness inherent in nature. The word *wildness* makes most people think of creatures like tarantulas. They don't realize that *wildness* simply means *without domestication*. If we connect, say, a primeval woods from the Hudson to Manhattan by adding strips of soil, we'd create a direct link to all of the creatures that don't come into the city.

Another thing I would do in the city is rethink light from the ground up. Future generations are going to see our notions of light in the twentieth century as savage and cruel. There is nothing in our architecture that allows us to be conscious of the sun's position in the sky or the degree of cloud cover. Yet all other things in nature respond to those elements, as do we whenever we're out in the environment. This is one reason why so many people seek out the wilderness experience. They know deep down they're missing something that the architecture of the city prevents them from getting at. But buildings could be designed with shapes and structures that would reflect some of this, and I know the effect would be powerful, since I myself have slept out under the sky.

Finally, I would design the city to change our notion of school. I didn't like going to school. None of my kids did, either. My youngest daughter, who is now fourteen, hasn't been to school for two years. Our oldest daughter and our son didn't go to school until they went to university. They get a bunch of books, and there were always knowledgeable people coming in and out of this house, and we gave them advice when they needed it.

Omni: Do they feel at a loss because they're not with a peer group?

Todd: No. Susannah, our youngest, is a dancer; she spends three or four hours a day with other people. Anyway, what I'm driving at is light. I cannot be in a building without being sick. That was true in high school, and it's true with my son Jonathan, and it's true with Rebecca, the oldest daughter. Ordinary commercial light makes us sick and gives us headaches. And I feel

funny in department stores. I think we need to have rooms with many different grades of light to reflect different states of being, different environments; and I can apply the concept to education as well.

In the ideal city, you might enter, say, a medical center for some kind of checkup. But at that point, you may also find yourself in the middle of a farm. The medical center would be inside the farm, and inside the farm, you would have a school. Right now, schools are prisons that reinforce the distinctions between indoor and outdoor, between wildness and domestic. My ideal school within the ideal society is quite a bit different from what exists. I'm putting together millions of known elements that have never been put together, postulating radical combinations and constellations. It's like cooking; you start out with a dish and a few things and end up with a bouillabaisse. A hell of a lot takes place between one and the other.

Omni: Getting back to the schools, theory has it that if you put people in a well-lighted room and eliminate distractions, they'll think and learn more easily.

Todd: Maybe it's just the opposite. If you're in the most natural environment, with that bird winking at you, you'll feel so totally comfortable and natural you'll learn more. Moreover, how can you know about old age if there isn't somebody very old on the corner, which may also be your school or the senator's office. Why shouldn't a senator look out from his office and see not another senator but a child? And a bum?

It could be that the story of man's expulsion from the Garden of Eden has deep roots in his relationship to nature. As we weave all the large cycles of the earth back into human culture, Eden will rise up around us again. The need for this deep connection is evident in something as simple as having a pet. The blueprint for human life is so similar to the instructions that compel the rest of earthly life that we are in many ways linked to all the other species. Our need for a dog may actually be the result of an ancient biological memory.

I have the feeling that wherever the forests were protected, wherever peoples were able to live within the complete constellation of light, there were gods. Wherever there was massive environmental destruction and loss of habitat, you start having the monotheistic religions like Islam, Judaism, and Christianity. The seat of monotheism, the Middle East, is a place where the gods have disappeared. As the elements of nature are destroyed, the gods become silent, one by one. For the ancients, the world was alive in a spiritual sense; it still is in places like Bali.

Omni: This connection to nature brings to mind the Gaia hypothesis, which suggests that the earth is a single, thinking being.

Todd: Although the myriad life forms, processes, and natural cycles of the earth have been thoroughly studied and documented, the question of a pattern of patterns, or metapattern, that would make the entirety of life comprehensible continues to elude us. The most far-reaching yet credible theory to date comes from the brilliant research of Lynn Margulis, of Boston University, and James Lovelock, an independent British researcher. In their Gaia hypothesis, named after the Greek goddess of the earth, they say that the entire range of living matter on the planet, from whales to viruses and from oaks to algae, could be regarded as a single living being. Earth hangs in the blackness of space like a great, luminous, pulsating cell endowed with powers of maintenance, regulation, and intelligence far beyond those of its constituent parts.

If this hypothesis is proved true, it will erode man's sense that he's separate from, and more important than, the rest of the world. If we accept Gaia, then destroying the environment would be like cutting a wrist. In a Gaia culture, we would honor the earth, just as the early Americans did when they placed rocks on the ground.

"A greenhouse filled with water hyacinths will run parallel to the sidewalk and shield pedestrians from cars. Human wastes will enter the system; the hyacinths will filter out the particulates."

Omni: How do you think that people born and bred on Western culture will come to accept this hypothesis?

Todd: They may have to. Already there's significant evidence to support the idea. For instance, the earth's oxygen level has always provided a habitable environment, despite the odds against it. The sun's output of radiation has increased enormously over the aeons, and such an increase should have altered the level of oxygen. Yet the current oxygen atmosphere has altered very little since the beginning of life. The oxygen level is twenty-one percent right now. If it went down to sixteen percent, combustion couldn't occur, and there would be no fires.

If it went up to twenty-four percent, just three or four percent above where it is now, the planet would spontaneously burst into flame and burn itself out. We've stayed within the habitable range, despite the increase in radiation, because myriad other factors—some might say the forces of Gaia—have come into play. Analysis of atmospheric carbon dioxide and nitrogen reveal planetary self-regulation as well.

Omni: Speaking of stewardship, you've changed the direction of yours. After yea of designing model farms and bioshelte at New Alchemy, you've founded an o ganization called Ocean Arks, Intern tional, which designs ships for the Thi World. Why?

Todd: Whether I liked it or not, I was b coming an entrenched old alchemist, st going into areas that were beautiful but als basically my own. It was time to take greate and more mature risks. I have always fe obliged to test myself in ways I wouldn think of testing other people. I sensed th many years ago at that festival in Mexic In Mexico red hair is considered the sig of the devil. Maybe red is a sign of th devil, but another devil, one who has bee long enough in exile from a false heaver Now it's time for him to break the idols an show us ourselves and our planet. Any way, that sense of being an alien in a cu ture, yet part of a larger culture, gives m energy to do work that entails risk.

Omni: And you took this sort of risk wit Ocean Arks?

Todd: I saw a tremendous need to hel Third World peoples with growing tech nological problems. What we call a reces sion in the United States is total tragedy i many parts of the world. The spinoff fror First World economies into the backwater is really devastating.

We have elected to design commercia fishing craft that are sail powered rathe than diesel powered. Why? Becaus throughout the world there are millions o watercraft people who use small boats t get around and do their work, the way w use cars and pickup trucks. Formerly the boats were built of slow-growing, nobl woods like mahogany and teak. But mos of those trees have been cut down; so i the Fifties, Sixties, and Seventies, thes watercraft people began buying steel, and aluminum, and fiberglass boats. They threw their sails away and put outboards or die sels in. That worked all right for a time, bu they had to cut the forest down like crazy to pay for the spare parts and the fuel. This forest was their birthright and their only liv ing resource. During the next few years country after country went bankrupt—a Guyanan dollar buys nothing outside Guy ana. Because the debts exceed the gross national product, many countries can't ge hard currency. So the boat people have no way to buy fuel or spare parts. Their net works are breaking down.

I knew I couldn't go back to traditiona methods. But through my association with marine engineers and naval architects, realized we could put together three tech nologies that are just emerging and build high-performance sailing craft using fast-growing, scrubby trees that could be re-planted quickly. Ocean Arks is now doing the replanting experiments in Costa Rica and Central America. We plan to take the most advanced epoxy materials and mass-production techniques, deindustrializing as much as possible for a Third World vil-lage. We can make high-performance

lightweight, sail-powered working craft that are as fast as the motor boats they're supposed to replace. And they don't require spare parts. We call them Ocean Pick-ups. They are relatively inexpensive, and only ten percent of the materials must be imported. They're analogous to four-wheel-drive pickups. The aerodynamics and hydrodynamics engineered into the Ocean Pick-up are of the caliber of a Concorde or the most advanced jet. The exciting thing is that you can use high-tech information in a rural setting and come up with a really exquisite, usable, nonexploitative solution.

That first Ocean Pick-up was able to carry one and a half tons of fish. Now, though, a smaller model has been designed for fishermen who catch less. And larger pickups can go out to sea. In fact, we've already created four and produced some ideas on a fifth, and we hope to start production in places like Costa Rica and Guyana as soon as possible.

Omni: How would you distribute them?

Todd: We're trying to change the rules of the big multinational corporations. Instead of making something somewhere to sell to somebody, we're trying to send the *information* to develop the manufacturing capability. We'd like Ocean Pick-up factories to be indigenously owned. We're also trying to set it up so that boat people begin to see the relationship between these boats, which give them economic freedom, and the need for reforestation. After all, they'll be building the boats with wood that they grow from scratch.

Our Western technology is fascinating to everyone. I'm hoping we can develop as sexy a technology for the Third World as the Western one that doesn't work for them. Everybody likes to roar around on something, whether that means riding a racehorse, a motorcycle, or a one-ton Ocean Pick-up.

Omni: How do you come by funding?

Todd: Whatever we get comes primarily from small U.S. foundations and the Canadian National Development Agency.

Omni: The government isn't interested?

Todd: The United States Agency for International Development would rather invest in a big industrial process that employs Southern U.S. shipyards that can sell products to the Third World at a profit. A lot of pioneering is very hard. The orthodox channels of support are closed to you.

Omni: Speaking of support, what was your work with Marlon Brando?

Todd: In the winter of 1980, I spent four weeks with him on his island, designing gardens, a waste-treatment plant, a fish farm, and aquaculture networks. The island was to be an example for the rest of the Pacific. We tried not to impose engineering solutions on top of creatures, but to find subtle ecological solutions. Brando had been tracking my work for a number of years, but he hasn't yet decided to get further involved. He is absolutely fascinated by the ideas, but he is frightened of pioneering—of technical failure and its attendant ridicule. In the end, Marlon turned his back on it, despite the fact that one of the Ocean Pick-ups on his atoll could pay for itself in a year. It saddened me, but the project certainly wasn't a waste.

I loved the whole notion of a tropical island, where the scale is so reduced. The alkalinity of the soil doesn't allow vegetables to grow. Islands don't have surface water in most cases. So you change a few things, and you begin to attract pollen, birds, dust. In the Seychelles, I built a lake, using a biological seal on porous coral soils. Now birds that have never been seen there before are landing on the islands. It was a real breakthrough in biotechnical restoration. When you get a sense of what could be done, you have to make a start. It's like putting a seed in the ground and seeing it grow.

Omni: What about planting your ideas? Does your radical approach make publication in scientific journals difficult?

Todd: I've never had problems publishing; I've published in all the prestigious journals. But these days, I don't even try to publish scientific papers. The idea of writing a scientific paper that reaches an audience of only a thousand is something I don't have time for. It would be misplaced concreteness. I'm not against it. It's just that there isn't time. I'd much rather produce a sequence of books. Right now I'm thinking about the *Ecological Cookbook*. Turn to page seventeen, put in so many sprinkles of this and dots of that, and end up with a forest. I also want to do one on the Ocean Pick-up that will be equal parts adventure, Third World development, and, for want of a better word, *quest*.

Omni: Do you think there is an overriding symbol that pervades our culture?

Todd: Yes, the notion of a rocket leaving the earth and moving into outer space as some kind of transcendence. I would like to propose another kind of symbol—the biological hope ship—in an attempt to bring the power of symbolism back to Earth. We would see the great sailing ships, beautiful things that are also greenhouses and that also function like whales, bringing the sea into them and through them, supporting millions of life forms that are also extraordinarily beautiful.

It really doesn't matter whether your work is interstellar communication or trying to restore the ecology of a hillside. The attitude behind the practice is what's important. To view space exploration as the only possible next frontier, with its funding and societal weight being greater, is wrong. Every civilization has a kind of rip-roaring, next-frontier sensibility, a sort of what's-next mentality that might be easier for humans than standing in a desert and thinking how to bend the forces of the world to care about restoring land here and now. While this language turns off technologists, most great scientists harbor a sense of the divine. That implies getting your cues from the natural world and not imposing short-term desires on a natural cycle.