Journal of the New Alchemists 2

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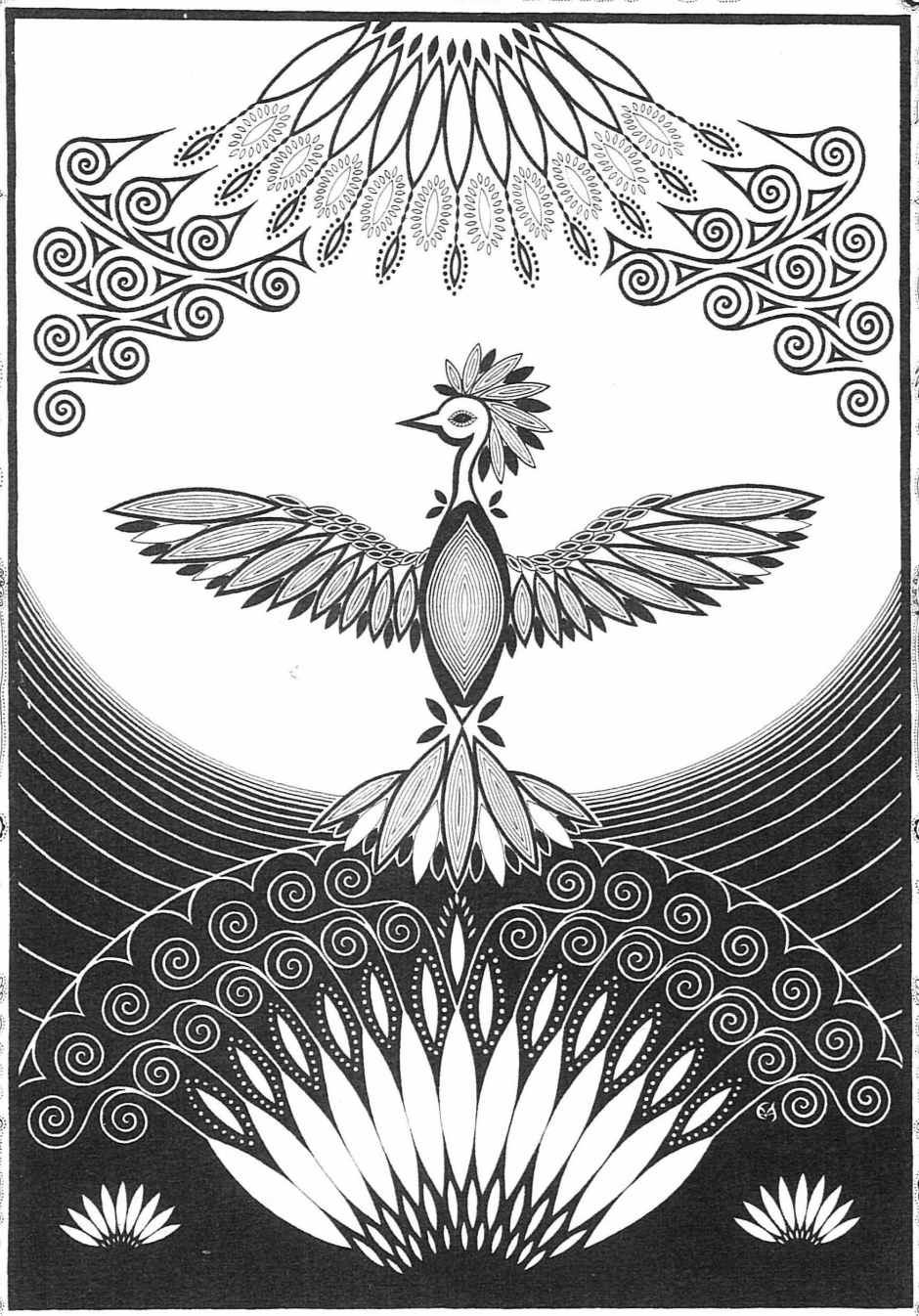

The New Alchemists

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To Restore the Lands, Protect the Seas, And Inform the Earth's Stewards

The New Alchemy Institute is a small, international organization for research and education on behalf of man and the planet. We seek solutions that can be used by individuals or small groups who are trying to create a greener, kinder world. It is our belief that ecological and social transformations must take place at the lowest functional levels of society if mankind is to direct his course towards a saner tomorrow.

Among our major tasks is the creation of ecologically derived forms of energy, agriculture, aquaculture, housing and landscapes, that will permit a revitalization and repopulation of the countryside. The Institute has centers existing, or planned, for a wide range of climates in several countries, in order that our research and experience can be used by large numbers of people in diverse regions of the world.

The Institute is non-profit and tax-exempt, and derives its support from private contributions and research grants. Because we are concerned with ecological and social tools useful to small groups or individuals, many orthodox channels of support are not available. The success of the Institute will depend upon our ability to address ourselves to the genuine needs of people working on behalf of themselves and the earth, and to the realization by all our friends that financial support of our research is necessary if the task ahead is to be realized.

The New Alchemy Institute has an Associate Membership ($25.00 per annum, tax-deductible) which is available to anyone with an interest in our goals. Associate members receive our periodic publications which deal with theoretical and practical aspects of new world planning. Associates are also provided with information and guidance from New Alchemy Institute scientists and other individuals with relevant skills. Associate Membership can involve a close dialogue with the Institute, and Associates contribute their talents and work with us on problems of mutual interest.

ASSOCIATE MEMBERSHIP	*$25 per annum*
Contributions of large amounts are very much needed and, if you can afford more, that would be beautiful.	
SUSTAINING MEMBERSHIP:	*$100 or greater*
PATRONS OF THE INSTITUTE:	*$1,000 or greater*

We invite you to join us as members of The New Alchemy Institute. A company of individuals, addressing themselves to the future, can perhaps make a difference during these years when there is waning reason to have hope in the course of human history.

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Woods Hole, Massachusetts 02543 U. S. A.

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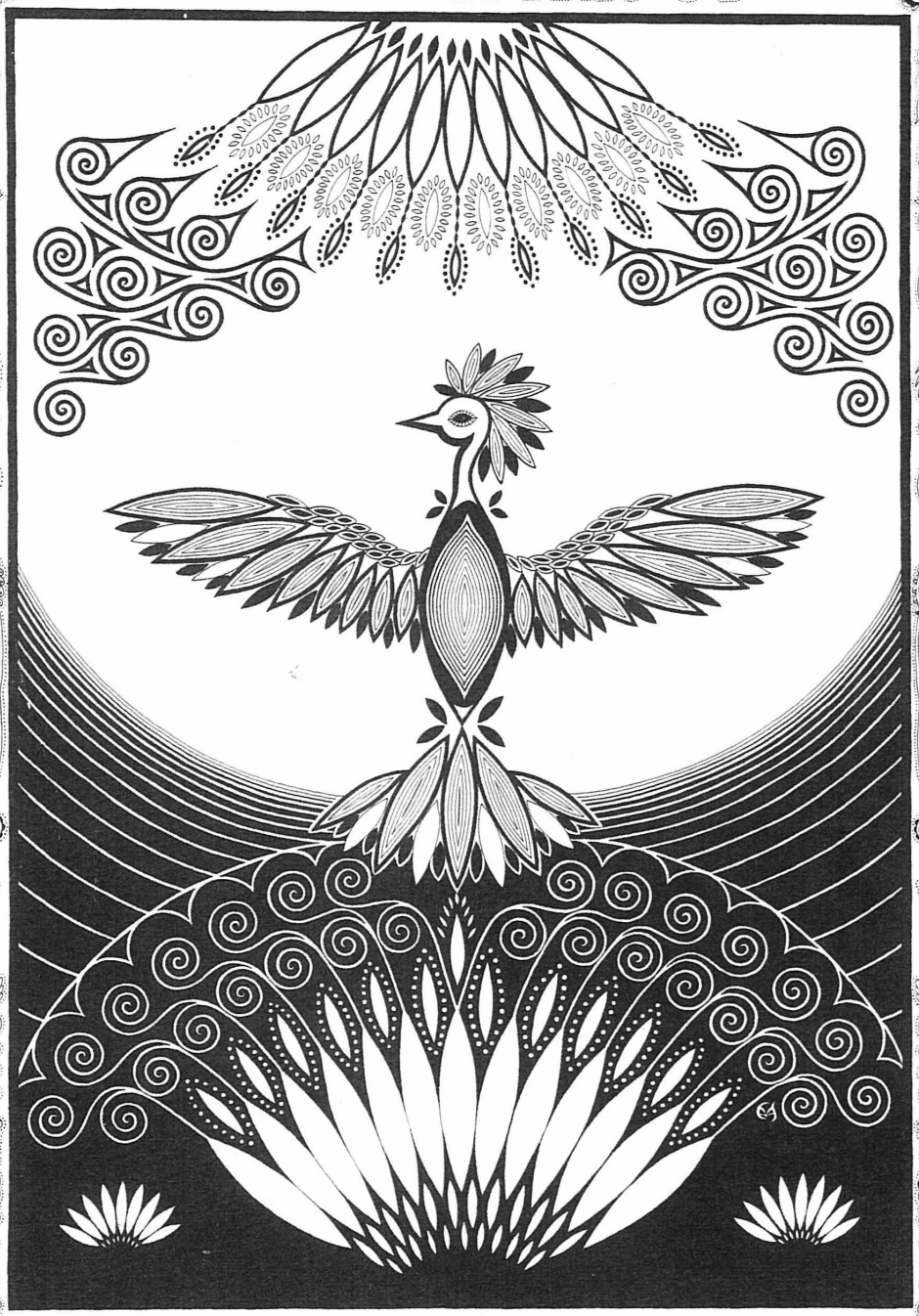

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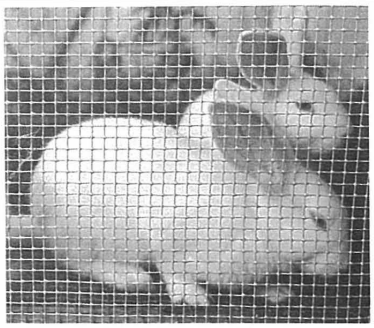
We dedicate this Journal to the memory of MARSTON BATES

Born, July 23, 1906 Died, April 4, 1974

Marston, a brilliant ecologist, was a friend and teacher. The miniature tropical "rainforest" in his Ann Arbor house inspired New Alchemy's Backyard Fish Farms and Arks.

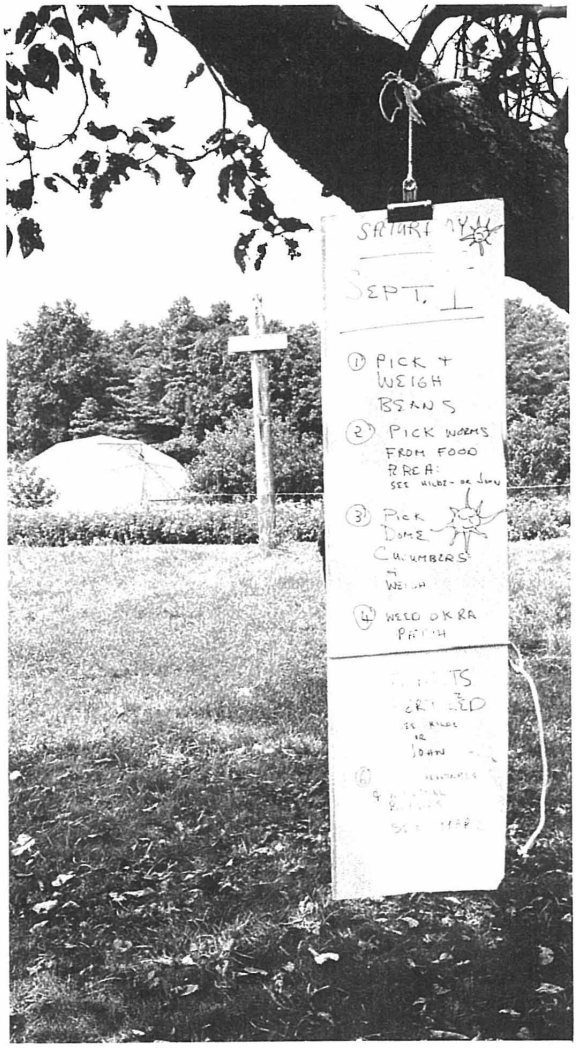
HIS BOOKS:

The Natural History of Mosquitoes...1949
The Nature of Natural History...1950
Where Winter Never Comes...1952
The Prevalence of People...1955
The Darwin Reader...1957
Coral Island...1958
The Forest and the Sea...1960
Animal Worlds...1963
The Land and Wildlife of South America...1964
Gluttons and Libertines...1968
A Jungle in the House...1970



This second issue of the Journal was planned, outlined, even partially written, as a description of the work of last summer. It was to have been a glowing account of fruitful gardens, fast-growing fish, August sun, brown tousled children, and a happy sense of slowly building the kind of alternative that eventually could be shared in a very broad sense, both ecologically and socially. Of course, we were aware of the Watergate issue being played like second-rate cloak-and-dagger across the nation's television screens, but, to most of us, long disenchanted with power politics, it was far more black humour than tragedy. So we went on cultivating our gardens and left Mr. Nixon to his plumbers and his tapes.

Then, in the fall, as we harvested our last vegetables, came the news of the resumption of the Arab-Israeli war, and Russia and the U. S. again picked up their nuclear toys. With the signing of the cease-fire and a temporary lull in the nuclear nightmare, another of the shadows hovering over this hulking technocracy took shape in the form of the energy crisis, staged for our benefit by Big Oil and resulting, so they chose to have us believe, from the Arabs' oil embargo. While all this activity was taking place on the national and international fronts, John Todd met with friends at an Ecology Conference organized by Murray Bookchin



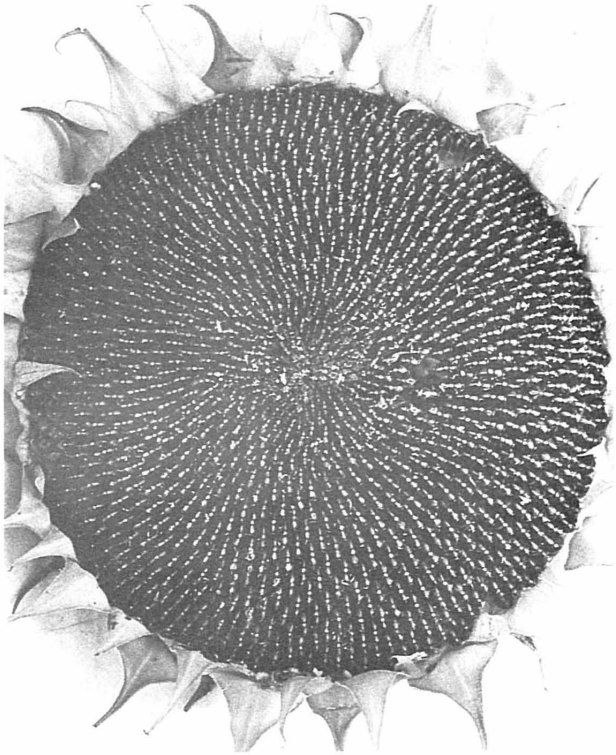
at Goddard College in Vermont and came away with new insights, based on the work of ecologist Howard Odum, that shook us and strengthened our sense of urgency. It was not that we had been unaware of the dangers inherent in our present economic system, but we had hoped that there would be more time for working out solutions to basic problems of, in Gary Snyder's phrase, "living lightly on the earth" and to developing a technology that would be, as Robin Clarke said, "valid for all men for all time."

In Explorations, in the article entitled "The Dilemma Beyond Tomorrow", John Todd discusses the Odum report, leaving one in little doubt as to the magnitude of the real energy crisis and, at the same time, making quite clear the factors that led to our decision to slant this issue of the Journal towards a more crisis-oriented approach. To this end, we have collected such articles as "Towards a Self Sustaining Agriculture" by Richard Merrill, and the one mentioned above by John Todd, while postponing others we liked equally but seemed less immediately applicable.

From last summer's work on the farm comes Hilde Atema's description of her experiment researching insect resistance in cabbages, Bill McLarney's papers on irrigating with fish metabolites and midge culture, and the collective aquaculture manual entitled "Walton Two, A Compleat Guide to Backyard Fish Farming." Complete instructions and diagrams of the water-pumping windmill that Marcus Sherman built last summer are followed by a thorough discussion of windmill electronics by Frederick Archibald.

The summer's work, some of the rest of which is touched on in the New Alchemy section, seems, with the economic and political oscillations of the intervening months, if anything, more relevant than it did at the time.

— Nancy Todd



Photos by Alan L. Pearlman

Photo by John Cressey

New Alchemy

Photos by Alan L. Pearlman and John Cressey

Photo by John Cressey

It was a summer of sunflowers, marigolds and cabbages, tilapia and midges, weeding and picking, video, film and the press, intense women's caucuses in the kitchen, and swimming, feasting and music by sun or firelight.

Clear spring days of planting were followed by a warm June. Then, came an overcast, wet July with wheat unripened on the stalk and sullen green tomatoes on the vine. August was hot and sunny and people, plants and fish bloomed. Then, as perfection never lasts, the summer people drifted away, the children were herded back into schools, it became a little cool to swim and summer slowly became fall, gently, as it does on the Cape, with a gradual transition from green to rust and copper, and a quiet folding away of the summer's brightness.

— NJT

The Gardens

The work on last summer's garden really began in February when Hilde, armed with a variety of gardening manuals and innumerable seed catalogues, sat down to do the planning. To have some basic goal or guideline, we had agreed to plan a garden that would provide vegetables for twenty people for a year, preserving as much as possible. In addition there would be Saturday lunches and other less predictable feasts. Plotting all this was incredibly complicated. The previous year we had had Yedida and Rich Merrill from New Alchemy-West to guide us. Last spring Hilde and Earle had to find a way to estimate how to stagger planting times to avoid total inundation by all the green beans, for example, maturing at once. They had to learn what each crop required in terms of sun, shade and moisture, and which plants would be best near each other. We did experiment with planting several lines of pole beans and corn side by side with the idea that the beans could climb the corn stalks for support. This was definitely not successful. The corn was slow in germinating, and the beans uncooperatively took off without it.

The immediate outcome of all the reading and research was a giant chart that ran the length of one kitchen wall. With accompanying maps of the garden, it was designed so that anyone who wanted to help with the planting could check the chart under the appropriate date, find the list of seeds to be planted and locate on the map in which line, in which garden plot to plant them. The chart was a monument to clear thinking in two ways. Dealing as we do with large numbers of people who stop by and want to help, the chart made it possible for people to understand very quickly what they could do; even more gratifying were the beautiful gardens and the full harvest.

All the gardens were surrounded by what grew to be young hedges of marigolds. Judging by this summer's experience, the marigold, alleged to be a repellent, is at best a decoy or trap plant, attracting pests away from other crops. At times during July there seemed to be a Japanese beetle for every marigold blossom. We were almost completely free of aphids which had been a great nuisance the previous summer; still our motive in planting them in such abundance had been as much for their aesthetic as their utilitarian virtues, and there is no question as to the beauty and colour they brought to the garden.

In a productive, healthy garden where diversity is considered fundamental, there is the beginning of an agricultural ecosystem which can harbor, on some crops at least, a fair insect population. The garden was bountiful yet the insects got their fair share..... for example, it seemed the beans would be overwhelmed, first by the Japanese beetle and later by the bean bug, but they kept producing and we had

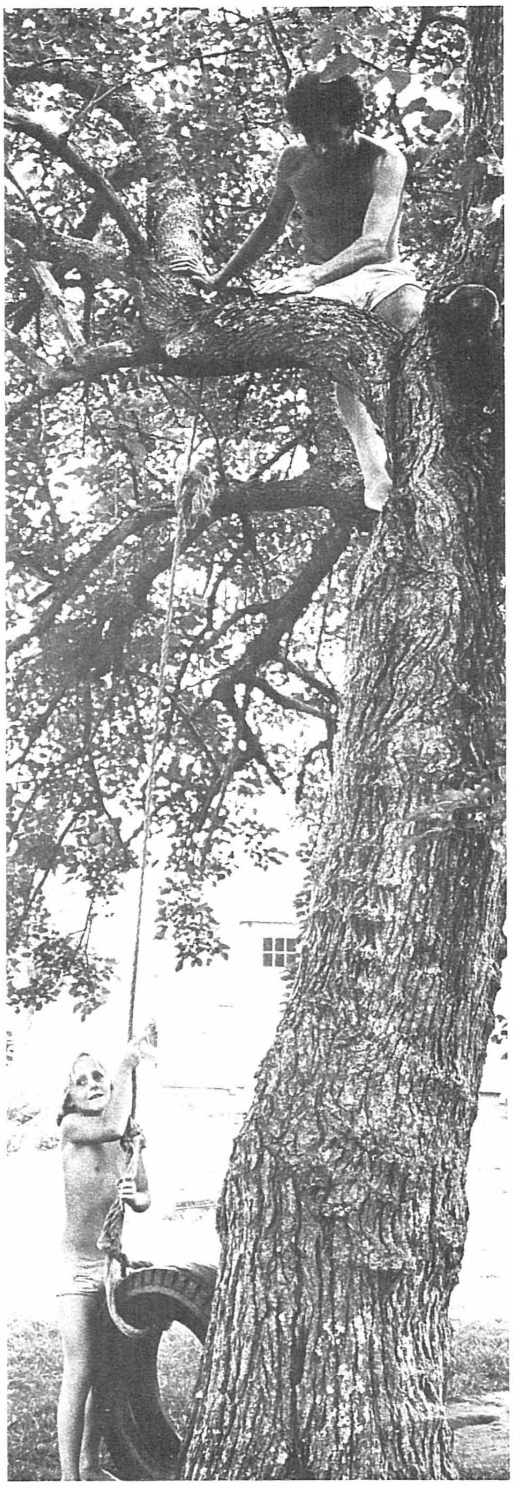


Photo by John Cressey

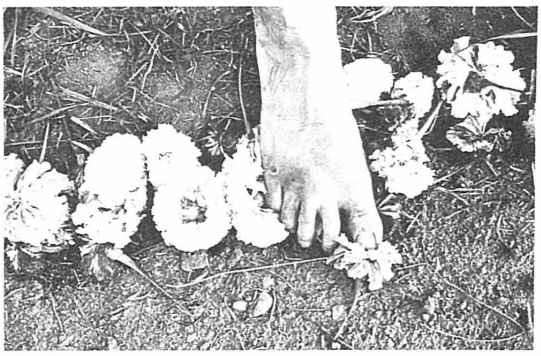


Photo by John Cressey

more than our wildest expectations. This was true of a number of crops. In our diversified garden no single crop was significantly reduced by pests, not even by the Japanese beetle. We did routinely pick the beetles from the grapes and young trees where damage seemed greatest. Perhaps it's a kind of tithing. Or perhaps to quote Gary Snyder again with this kind of sharing, "how can the Harvest fail?"

We tried one method of insect control which should perhaps be mentioned, although it would only be of use to groups with large populations of children. We tried paying the kids a 'penny a pest' for every creature they destroyed. The kids killed hoards of insects and were making fortunes until Bob Angevine ventured that he felt that the project was based on faulty economics, and that we couldn't afford it.

The other major garden experiment last summer in a season of happy experiments was in the use of fish pond water as a fertilizer. It worked. This is discussed by Bill McLarney in *Land and Its Use.*

In addition to the basic food garden which included a good many vegetables and herbs I have not mentioned, we undertook growing, in a largely experimental way, several other crops. Along the perimeters of the vegetable garden, we planted strawberries, blueberries and grapes. The grapes were planted to see whether there would be varieties of wine grapes particularly suited to the Cape. Next to the fence between the garden and the woods we planted rosa rugosa, but many of them did not survive Similarly, the sweet peas we had hoped would swarm over the fences failed to do much, and we have decided it was a good lesson in listening to your land and letting it guide you. It seems that marigolds belong with us here whereas sweet peas do not, at least until our land is more fertile.

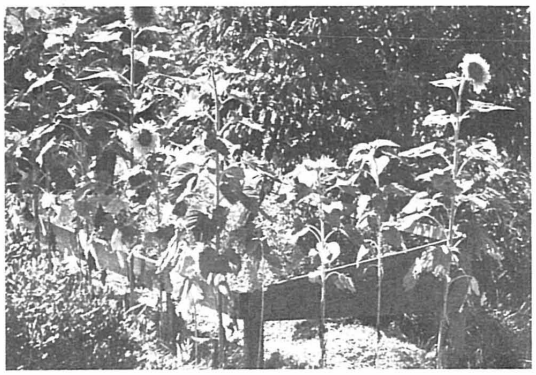


Photo by Alan L. Pearlman

We grew a magnificent field of sunflowers that stretched to 14 feet in height. From the windy spring day when the Shanti school helped us plant them, they puttered along slowly. One June Saturday, it was difficult, when weeding, to distinguish sunflowers from weeds. Then suddenly, in beanstalk fashion, they shot up. By August there was a jungle where one could lose oneself, green and shaded, on the sunniest day. Then Earle with his machete decapitated them one by one and our forest was gone. The seeds will feed rabbits, chickens and people. We also had a very successful soy bean crop. They will be used as a supplementary protein for the tilapia, as well as food for ourselves.

Again, largely as an experiment, we decided to try growing wheat, although the day when one can think of merely experimenting with a crop may be drawing to an end. The wheat was nothing if not an adventure. It is said that wheat had not been grown on the Cape for a hundred years. Nothing daunted, we decided to try. Getting the seed was the first obstacle, costing Bob Angevine endless phone calls, letters and arguments, and thoroughly trying his equable disposition. We did eventually acquire the seed and it was planted in late May. During succeeding weeks the wheat grew well, although the weeds offered some competition, and held its own until a flood, due to heavy rains, just as it was heading stalled it and there it sat, water logged, so that in late July, we had a fine field of a little waving wheat, somewhat dominated by the waving weeds. We chose to be pleased and consider it not a bad effort for the first time. But then, having grown it, we were faced with a problem we had not until then considered. What were we to do with it? Obviously it had to be harvested. We certainly couldn't waste it. We settled after much pondering on the plan of waiting for Saturday when there would be lots of people and - - - picking it.

The first hour was great fun, sitting or standing in the field, gathering tottering armloads and staggering to the edge with the enormous sheaves. There was considerable theorizing as to whether it was more efficient to pick one or several stalks at a time, avoiding taking weeds or to pluck great handfuls and then separate wheat and weed. Rival schools sprang up, each determinedly advocating its own method. By the second hour, one was beginning to wonder why the picked area had grown so little in relation to the vast amount that surrounded it. By the third, conversations began to lag and

the crowd had thinned perceptibly as we began to remember other equally urgent jobs. By the end of the day, we had picked a ragged little pocket handkerchief in the great expanse and were definitely discouraged.

The next day, being Sunday, we devoted to other things and by Monday morning Bob had somehow unearthed an ancient cutter that moved through the field chopping weeds and wheat indisciminately, but doing so quickly and easily. Once cut, the field was raked, and then the task of separating the wheat and weeds was finally accomplished by putting everything through a shredder/grinder which had had its bottom plates replaced by bars.

Having come so far there yet remained the winnowing of the wheat from the chaff. Earle, who rarely fails to rise to a challenge, pondered various means. One method involved a vacuum cleaner connected to a large tube. The vacuum forced air upward through the tube where Earle at the other end was dropping in the wheat. The chaff was at once blown off while the wheat hovered in the upsurge of air until the vacuum was turned off and it could be collected. It was not an unpleasant job and it was certainly an interesting-looking apparatus, but as the wheat could be processed only a cup at a time, Earle rejected the method as too slow and technology and ingenuity notwithstanding, settled on traditional winnowing, tossing the wheat in the air and relying on wind power for the rest.

If the project did cost a great deal of time, it was valuable in that it gave us the confidence that wheat could be grown, if necessary, in what would generally be considered an inhospitable area and that the problems of harvesting and processing could be solved without recourse to either expensive equipment or herculean physical labour. Bob, who is in charge of the field crops, is going to try wheat again as he feels our problems may be eliminated by planting a couple of weeks earlier, giving the wheat a better jump on the weeds.

Photo by Alan L. Pearlman

Squash Flowers

Each forest
is proud of its trees but places its trust
in underbrush. The sleek, striped animals
run for cover.

Here are the tall men
and here the heavy women. The bees assault
the men, hum-humming
then back awkwardly out on sweet knees.
The women wait
twisting their kerchiefs tight.
Their short necks stiffen.

But the gold cups of the men incline
their gold thrones teeter
generous to the wind, the bees, the final requests.
By dawn they've even given
their weight in gold to the ground.

The covered animals listen.
Down among trunks
the kerchiefs bright as brass locks
slide open and in them drop
the favors of the dead.

Each cradle in the forest
rocks with gold.
Each hidden animal
receives a coin
from its mother's practical hand.

– Meredith Fuller-Luyten

October Squash

1.
The vines that shot off
like startled snakes
that curved down
like snakes from trees
that tightened
like hunting snakes
that grew as green
as garden snakes
and made fruit
pale as the snake's belly
lie as stiff and thin
as snakes on a spring day.

2.
The Epeira climbs
the wasting plants.
Her web breathes.
Her flies are tucked away
as softly as her eggs.
Her black body
her jointed legs
her gold-leafed back
center themselves in cold air.

– Meredith Fuller-Luyten

PRESERVATION OF FOOD; PRESERVATION OF SELF

Another major aspect of the summer's work was the preserving of food, an activity that one appreciates all the more with rising food prices and hard frozen ground. We did try either to freeze or to can as much of the summer's vegetables as we possibly could. There was some spoilage when we lacked either the time or the courage to tackle the vegetables soon enough, but between feeding the rabbits and composting anything that had gotten past its prime, very little was actually wasted. Mary Lou Macilvane, who spent the summer with us, was vital throughout this process. Not only was she ready to tackle any pickling, canning or jam-making that had to be done, but she was cheerful about it.

The food-processing, and predictably the housekeeping, are the areas where the difficulties of sex roles are most readily apparent, and equally predictably, it is the women who are least pleased with their lot. More than one visitor to the farm has commented that our roles with some exceptions are, in the main, still structured along traditional lines. The reasons for this are obvious. If, as a group, we have agreed on certain goals and projects we feel to be important, then it seems efficient for all of us to do what we do best. For example, I don't know how to make a windmill. It would take me some time to learn, as mechanics is not a field in which I shine. Granted, I could probably eventually master it, but while I am off apprenticing to Earle or Marc, my share of the garden work would not be done, vegetables would be stock-piling in the kitchen and correspondence lying unanswered in my box. Although all of us, as women, do not wish to emerge from our domestic cocoons and stretch our wings only to turn to housekeeping and cooking for a larger crowd than before, there are not many jobs that we could hold "out there" in the system as it exists in which we would not feel in some way compromised. Our idealistic and political selves are happy with the group. Obviously we are in a fine double bind.

There is no simple answer. The solution so far in our case and in many others I think must be to work with men whose consciousness has been sufficiently raised to understand how thoroughly sexist has been all of our backgrounds. If we are to work in groups with both sexes, I do see a transition, perhaps on the slow side for our taste, coming about in which the jobs, particularly those that we as women find most psychically oppressive, are being shared on an equal basis. It is certainly starting to happen with us. Several of the men cook. A gratifying number crowd the kitchen after Saturday lunch to do the dishes; yet I still have a memory of a hot afternoon, a sticky kitchen, stacks of vegetables threatening to molder and an all-female and very resentful crew. Dave Engstrom said once that transitions are always hard, and so they are..... as long as they keep happening, I guess.

The Media

Well, no man is an island, of course, and we have always wanted to share our ideas as broadly as possible. At the same time we are well aware that one of the fastest ways to be co-opted in this culture is to become, in any way, a darling of the media. So our attitude, when approached, is always distinctly schizophrenic. Bill McLarney can be relied upon to growl at almost any overtures. With the rest of us, our response tends to vary depending on how closely the views of the person or publication interested in us tally with our own.

Early press coverage posed no problem. Only like-minded magazines contacted us and we were glad to cooperate with ORGANIC GARDENING AND FARMING, MOTHER EARTH and LIFESTYLE and with a number of small underground or independent publications which shared many of our ideas and ways of viewing the world. The same applied to Stephanie Mills when she came to interview us for CLEAR CREEK. We wrote an article for THE CAPE COD NATURALIST because we felt it might explain our ideas to people in our own region and indicate a common bond in the area we both loved.

When Peter Jones from the B. B. C. arrived a year ago, we were somewhat surprised to be approached by the major leagues, but felt so supportive of his ideas that we agreed to work with him. The resulting film, *Science is Dead, Long Live Science,* caused a great stir in England we were told. Although a visiting English friend assured us that 'the movement liked it', most of the scientific establishment emphatically did not and while we were aware of the hornets' nest it had stirred up, it happened so far away, none of us have seen the film and so it has had little reality for us.

The past spring and summer the scenario (you see how even the vocabulary infiltrates) shifted when we faced the Great NEW YORK TIMES Tilapia Challenge and The National Film Board of Canada.

* * * * *

John Hess, who is the Food Editor of THE NEW YORK TIMES, had advised us of his arrival one August Saturday. We knew from his writing that he was sympathetic with ideas of ecology and soft technology. What we didn't know and were delighted to discover was the depth and range of the knowledge that he and Karen, his wife, had of food. Not only were they familiar with the most cultivated French cooking, both Hesses had a profound interest in poor peoples' food. Mrs. Hess, who knew more about food than anyone I have ever known, knew innumerable ways of using every scrap and bone of meat or fish, how to make palatable tough, over-age vegetables and an amazing variety of ways of coping with beans. She said memorably "we have forgotten how to be poor." The Hesses are working together on a collection of recipes, traditional to a variety of peoples, that make use of inexpensive, nutritious foods. This type of contribution would rank, I think, with a book like *Diet for a Small Planet* as enormously useful to all those who for ecological, economic or political reasons have rejected the refined, prepared and packaged foods that are regrettably still the norm.

The Hesses talked to a variety of people, toured the farm, worked with us in the garden and in the kitchen and altogether were part of a very pleasant farm Saturday. Then, just before he rose to go, John Hess flung down his gauntlet. "Granted, growing inexpensive, high-quality protein is useful, even necessary. But how do your tilapia taste?" We were taken aback. People don't very often ask that. Bill McLarney, who has eaten tilapia frequently, wasn't there for the moment, so after a slight hesitation I leapt into the pause and declared with forced heartiness that they were delicious, definitely delicious. I remembered that various people had had them in Costa Rica and pronounced them excellent, but I had sampled them rather uncritically which had left me with an unclear memory. And growing conditions on Cape Cod are not, after all, identical to those in Costa Rica.

John Hess went on to say that he would very much like to try one for himself, and if Karen would consent to do the cooking, could they come back and taste the tilapia? We had planned a feast for the following week, and although we should have preferred to check out the tilapia in a less exposed way, we rose to the challenge. The next Tuesday, nets and fishing lines in hand, Bill, Earle and most of the kids went fishing for tilapia. To our enormous delight, a largely neglected pond netted fourteen fish, some of which had grown to over half a pound in ten weeks. So far so good. The taste was still an unknown, but we certainly could grow 'em. Mrs. Hess instructed Bill, who with an enthusiastic, if unskilled staff of small boys, was in charge of the cleaning, that the heads were to be left on. Then, the cleaning done, Mrs. Hess took over. We had decided, after much debate, not to use any of the more exotic recipes that people had sent us, but to cook them simply to evaluate, critically, the taste of the tilapia *per se.* Mrs. Hess chose to fry some, dipping them first in flour, seasoning them only with salt and pepper. The others were baked in tin foil in the oven, again seasoned with salt and pepper, with parsley and lemon added just before serving. Mrs. Hess worked with breathtaking speed, chopping, oiling, frying, while I hovered about ostensibly being helpful.

Then, after a suitably suspenseful lull came the triumphal bearing of the platters of tilapia to the picnic table. Anxious moments..... cautious, tasting sounds, and then in tones ranging from surprise to relief and en-

thusiasm, "It's good, it really *is* good!" And McLarney was heard to mutter, "I told you so."

As for the Hesses, both of them said that the tilapia had far exceeded their expectations and were unquestionably superior to any hatchery-raised fish they had tried. But the best moment of all came one morning a week or so later when we opened THE NEW YORK TIMES and came upon the article describing the affair under a headline that read "Farm-Raised Fish: A Triumph for the Sensualist and the Ecologist."

* * * * *

Our other major media experience was with The National Film Board of Canada. Perhaps because the Canadian Government has lavished less of its resources in the recent past in making the world safe for democracy, while not, of course, denying some of its citizens the basic freedom to make a handsome profit in arms manufacture, it has had the money to provide for a number of useful organizations, among them, The National Film Board. The Film Board has released many beautiful, informative and useful films. When we were contacted by them, we were doubly susceptible, in the first place because of our respect for the Film Board's work, and secondly, because the producer of the proposed film was to be John Todd's sister, Dorothy Todd Hénaut. Her plan was to make a film that would be interesting to a number of specific audiences "ranging from small farmers to middeclass back-to-the-land freaks, to government people at federal, provincial and municipal levels, to schools both in terms of the old agricultural departments and the new departments of the environment, and to frustrated housewives and bankers looking for ways of reducing their alienation and getting some kind of concrete grip on their lives."

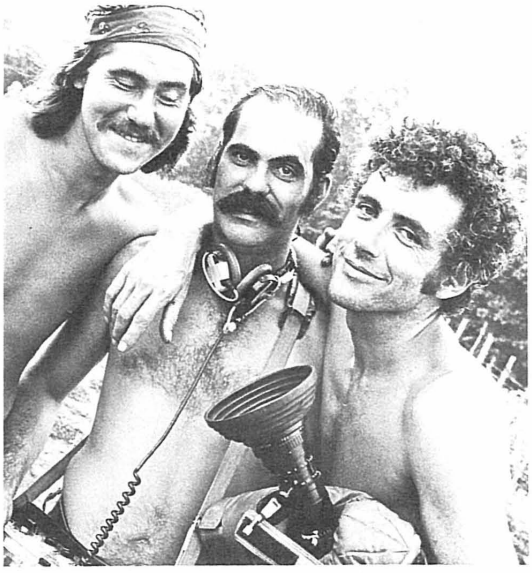


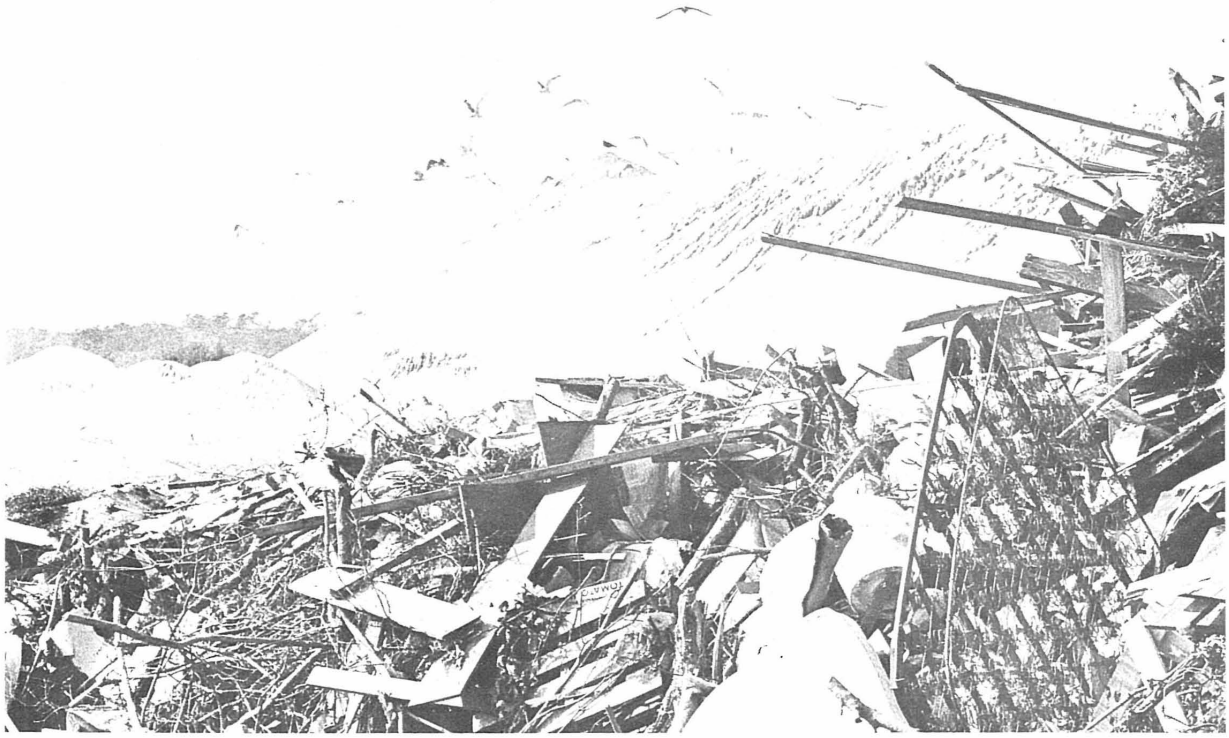
Photo by John Cressey

National Film Board films are distributed to public libraries across Canada, where they are available to any citizen or group. Outside Canada, the Film Board has offices in many foreign countries. The ready availability of the film and its complete dissociation from anything that smacked of commercialism convinced us that beyond our own publishing program, this might be another vehicle for the dissemination of our ideas, particularly as the main film, which had to be somewhat general and descriptive, was to be backed up by satellites on the windmills or fish ponds, giving considerable technical detail.

Dorothy arrived in early May to do a pilot video film. The video was a marvellous toy for us. We would work for the morning, and then at lunch play the morning back. It does extraordinary things to one's concept of time. It is also useful as a communications tool, forcing one to define and clarify ideas to oneself and others.

Dorothy left with her completed tape, acquired permission in Ottawa to do the film, and returned in late August with a crew of inspired clowns who were, at the same time, first-rate film-makers. Then, for the benefit of the cameras, as they say, we explained ourselves endlessly and tried to look spontaneous as we repeated a conversation for the third time or carried the same load of garbage to the compost heap, pretending that we hadn't just done it.

There are now coiled in boxes on the floor of a film editor's office in Montreal ten hours of film on The New Alchemy Farm. Most of it will eventually be cut and a film lasting from half an hour to an hour will emerge. We are discussing the possibilities of wider American distribution with Film Board people, feeling it may be a timely tool - Dorothy likes to think of it as a sort of celluloid earth gypsy – hopefully providing something of a catalyst in people's lives, by suggesting the possibility of alternatives in technology, food, and energy production open to them.



The Dump: *as Resource and Allegory*

High on our list as a supplier of resources is the Falmouth Dump. The announcement of a dump run is usually greeted with clamouring cheers from the children and general scrambling for position on the truck. Earle even has for such an occasion a dump hat in the style of latter day Sergeant Pepper. The dump, luckily for us, is "conveniently located" and a short drive takes one to an area which has been cleared of its scrub oak and pine to expose gravelly mounds and hills reminiscent of parts of Southern California. There one can scavenge among objects declared obsolete by society and emerge with clothes and toys in fine condition. Earle found one of Susannah's favorite dolls and her most princessly dress there. In a more prosaic line it has provided a major source of lumber, electrical cable, motors and other parts for machinery. We have found fish barrels, which make excellent containers or planters, and an ice cream freezer, vacuum cleaners, carpeting and innumerable containers of all kinds, not to mention discarded leaves that we brought back for composting .

Photos by John Cressey

Most of us probably have our own horror stories of the waste and extravagance that are our civilization's legacy to its children. Earle was a part of one this fall. In need of lumber for some new rabbit hutches, Earle drove to the dump to discover an unexpected windfall of newly abandoned wood. With lumber prices soaring and many other projects planned, he decided to load the truck as full as possible and then come back again for the rest of it. At the exit he was stopped. "NO", the man said, "it's illegal to take anything from the dump. I can't let you do it." Earle, having defied the law in this way countless times before, explained and argued. The man was quite nice about it, but firm, in a resigned way. He was, he explained, acting on a Higher Authority than his own. Even in his anger, Earle knew that this man could not be held accountable for such absurdity, that new trees would be cut and that people would be forced to pay higher prices for lumber that might well be no better than that that was being scrapped. Bound by a law that defies all common sense, yet somehow provides a neat metaphor of our present economic system, he put the truck in reverse, turned it around and replaced the lumber to see it buried under several tons of gravel.

What, I wonder, will future archeologists speculate happened.

The New Truck

or *howwekeptontrucking*

We have been, in the main, uncannily lucky, not only in having people help us, but frequently in having them do so in the most appropriate way at the most timely moment.

Our old truck had been doing a valiant job, but it was at the expense of an inordinate amount of time and attention from Bob, Earle and Marcus, all of whom were feeling that their energy could be more creatively used elsewhere. As it became increasingly obvious that the old truck was due for imminent retirement, Nancy Willis, who works with us in the summer, ventured that she had a friend who might be willing to donate a truck. The only trouble was that the would-be donor and his truck were in Colorado. The distance between Colorado and Cape Cod might normally loom as prohibitive, but again providence was with us. Bob Angevine was about to fly to California to visit New Alchemy-West and was perfectly willing, on his return, to fly as far as Colorado, meet Frank Bacon, Nancy's friend, pick up the truck and drive it back to the Cape. He did. Now, thanks to Frank and Nancy, to whom we are extremely grateful, not to mention Bob, we have the truck that is indispensible to us for compost and dump runs, construction work and the innumerable errands that we do.

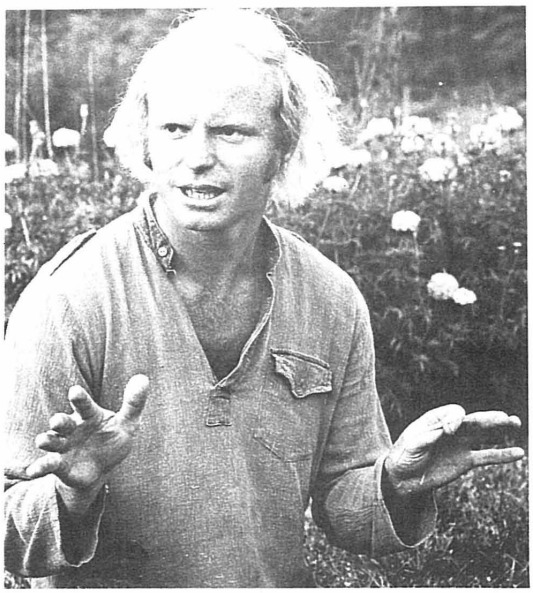


Photo by John Cressey

Foundation Support

It is extremely difficult for a small research and education institute not affiliated with universities or government to survive economically. We live on a fiscal razor's edge. The Stern Family Fund and the Point Foundation have provided us with the support to pay salaries, maintain the center and carry out the research. In short, our survival has depended upon their assistance and we thank them for it.

A Further Note to Associates

Perhaps many Associates don't realize just how instrumental are their contributions to the running of the institute. I have been reading recently of the Findhorn Community in Northern Scotland and how their needs (which are carefully distinguished from desires) are almost always provided for in some unforeseen way.

For us, it is frequently our Associates who are fairy godmothers, sending in a flurry of memberships just as a project seems to be in danger of faltering. We are as grateful for their good faith and optimism as for their generosity.

We mentioned in Journal 1 that we planned to publish a list of the names and addresses of our Associates. We have since reconsidered because we are afraid that, with our wider circulation, the mailing list could be picked up by advertisers, and our Associates would be subjected to the same annoying paper pollution via the mail by which we are plagued.

We would offer instead to Associates interested in the possibility of locating fellow travelers in their area that you write to us and we shall gladly check our files and let you know of others within a useful communicating distance.

Mail - and the Journal

As it has become fashionable, if not downright satisfying, to blame one's problems on the energy crisis, perhaps we could say that, due to the energy crisis, we have had a quantum jump in our mail: Incoming, that is. The reason we can choose to trace this leap back to the energy crisis is that it is probably the reason that a variety of magazines, most of which we've never seen, have dropped our name, usually in connection with alternative energy programs. As a result, we are subject to a flood of letters referring to articles we hadn't known existed. Marc Sherman responded on one such occasion, on the eve of his departure for India, with his windmill bibliography which guides people to most of the available sources on wind power. Using a printed bibliography rather than writing the hundreds of letters that would have been required otherwise did save considerable time, but still took a fair effort. Even this did little better than make a dint in the mail. So, in order to make our information available as widely as possible, we have decided to make the Journal our major organ of communication. Though less personal than answering letters, we shall try to be as sensitive as possible to the bulk of questions directed at us and to plan issues around them. We hope, in this way, to be more useful in that we will make more information available to more people and to do so in greater detail than would be possible through individual letters.

– Nancy Todd

Photo by John Cressey

Last *But Not Least*

Please note the change of address for New Alchemy West:

New Alchemy Institute West
Box 376
Pescadero, California 94060

Photo by Alan L. Pearlman

Book Reviews

Rudolf P. Hommel, *China at Work,* MIT Press, 1969 – $3.95 (first edition, 1937).

Hans E. Wulff, *The Traditional Crafts of Persia,* MIT Press, 1969 – $7.95.

Peter van Dresser, *A Landscape for Humans,* 1972, Biotechnic Press, P. O. Box 26081, Albuquerque, New Mexico 87125 - $3.00)

These are valuable books for people wanting to get back to the land and live simply and self-sufficiently. Modern Americans having been brought up, as they have, with everything treated as commodities and prepackaged for them, lack knowledge and skills for producing basic necessities of shelter, clothing and food. These two books help fill this awesome gap with necessary information describing techniques that have been used by the Chinese and the Persians for thousands of years.

Rudolf Hommel spent eight years in China in the 1920's doing research for *China at Work*; the result is a careful recording, illustrated with hundreds of fine photographs, of the hand tools and simple machinery used for centuries by Chinese peasants in their daily tasks. The text explains the methods for using these tools and gives clear directions for such techniques and crafts as pise de terre (rammed earth) walls; house heating with limited fuel supply; cart, sled, and boat building; hand spinning, weaving, potting, and metalwork; carpentry, brick and tile making and much more.

Of special interest is the chapter on farming. For people who want to produce their own rice and other grains on a small scale by hand, this chapter provides basic information on plowing, planting, irrigation techniques, fertilization, harrowing, tilling, threshing, winnowing, hulling and grinding. Also there are detailed descriptions and pictures of tools and processes for making soybean curd (to-fu); vegetable oil pressing; brewing and distilling, salt mining, fishing and more.

China at Work is part of a growing literature on the traditional ingenuity of the Chinese. Such books as F. H. King, *Farmers of Forty Centuries,* J. Needham, *Science and Civilization in China,* and Li Chi'iao Ping, *The Chemical Arts of Old China* have amply demonstrated the ingenuity of the Chinese in producing, for thousands of years, the necessities of a good life from the simplest of tools and materials.

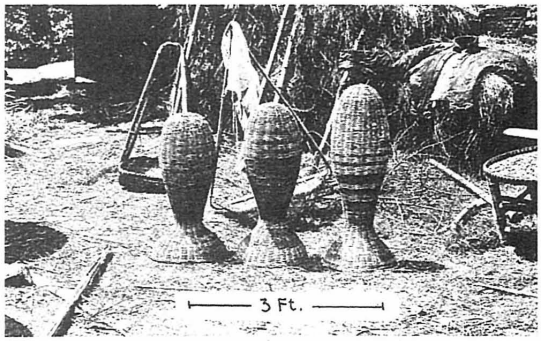
Hans Wulff began research for *The Traditional Crafts of Persia* in 1937 when as principal of The Technical College at Shiraz he was asked by the then Shah of Iran to incorporate "the great tradition of Persian craftsmanship" into the curriculum of the College. The result of his work is a comprehensive source book on traditional crafts which have survived in Persia since ancient times. The book is divided into sections on metalworking, woodworking, building and ceramics, textile and leather, agriculture and food treatment. It is amply illustrated with photographs and diagrams. The text never loses sight of the historical antecedents of present-day Persian crafts. In one volume Wulff combines the excellent qualities of both Hommel's and Needham's books on China. For instance, after discussing contemporary blacksmithing, he lists the ancient classifications of steel made by the philosopher-scientist Al-Kindi in the 12th Century. He introduces the woodworking section by listing about 200 species of trees with their Persian, Latin and English names and most important properties.

Like *China at Work,* this book is extremely useful for us today: there are pictures, diagrams and descriptions, for example of simple spinning wheels and recipes for natural dyes, a portable wood-turning lathe used by wandering gypsy craftsmen (to turn out, among other things, the parts of spinning wheels); Persian house domes and roof-vaulting systems; metal-working techniques, glassmaking, and many more.

The hand working farm methods of the Persians, strikingly similar to those of the Chinese, are clearly described. Especially important for people living in dry climates such as the American Southwest is the information on dry land farming and ancient Persian methods for conserving and distributing water.

China at Work and *The Traditional Crafts of Persia* are two inspiring books, invaluable sources of information, that one may turn to again and again in the effort to learn survival without "benefit" of modern technology. We are fortunate to have them available.

The current "energy crisis" with resulting shortages of basic commodities is making clearer to growing



Eel Cages or Baskets to Keep Alive Captured Eels.
– from *China at Work*

numbers of people the deep-rooted weaknesses of our highly-centralized, capital intensive, urban-industrial economic system. In the United States and other Western nations, this system is proving itself quite incapable of providing any assurance of the necessities of a good life, but seems rather to be leading us to economic and ecological break-down. The major existing alternative to the capitalistic system, state-controlled socialism, is experiencing, with industrialization, similar socio-ecological problems.

However, early in this century in India the failings of both economic systems were clearly foreseen, and a truly viable alternative proposed in the "social ecology" of Radhakamal Mukerjee (*The Foundation of Indian Economics,* 1916, and *Regional Sociology,* 1926) and in the "villagism" of Bharatan Kumarappa (*Capitalism, Socialism, or Villagism?,* 1946), among others. This alternative was put into practice to some extent by the Gandhi movement. In the West little has been done, the main exception in America being the Decentralist movement of the 1930's, which has been pretty well forgotten, in spite of the potential ecological crisis of the present day. Peter van Dresser took an active part in the Decentralist movement. In *A Landscape for Humans* (1972) he presents clear proposals for small-scale ecologically sound economic development founded upon a harmonious balance of local resource potential and human needs within the specific region.

Like Mukerjee, van Dresser realizes that essential to an economic development that is human-based yet ecological is the concept of regional self-sufficiency. Only when economics are based solely upon the natural resources and human needs of a particular region can a healthy, self-sufficient, and ecologically sound way of life develop. Our current system treats a region, its natural resources and inhabitants, as a one-way commodity, to be used until no longer profitable. The present ecology and energy crises result from the practice of mindlessly consuming the resources of region after region. Should a labor-intensive and resource-conserving economic system be allowed to develop, it would still be possible to live a fulfilling and harmonious life in this day of crises and shortages. Peter van Dresser shows the way in a region that he knows well.

A Landscape for Humans is an in-depth study of the northern New Mexico uplands. Van Dresser begins with a detailed description of the region: its geography; the history of Spanish, Indian and Anglo settlement; traditional practices; present means of livelihood; population figures; and natural resources. He then discusses the current trend toward resource depletion and rural depopulation. He shows clearly that this is in no way "inevitable", as its proponents maintain, but is rather based upon the dictates of our economic system. By the criteria of this system the northern New Mexico uplands are "uneconomic" because their resources are not conducive to profitable or large-scale exploitation. The only value of the region, from this point of view, is the potential human labor which can best be utilized as an urban labor pool, resulting in rural depopulation and the growth of increasingly parasitic urban groups. This need not happen. Van Dresser points to the history of the region. The Spanish settlers, mostly small farmers, were for hundreds of years virtually self-sufficient, producing almost all necessities of life locally. With careful resource management this region could again provide the basic needs of its inhabitants and, in fact, support a larger population.

Van Dresser discusses four areas or "potentials" for productive socio-ecological development: I) "A full complement of region-supplying primary industries" developed upon the basis of traditional skills and local resource availability. This would foster a truly regionally-centered industrial development providing employment and basic commodities for local use without destroying the environment; II) "Land- and skill-intensive agriculture and husbandry." The land in northern New Mexico is "uneconomic" in agri-business terms due to small holdings and limited water resources, but it is more than ample for providing food - vegetables, fruit, meat and dairy products - for the whole region; III) "Deep functional involvement of the community in soil and biotic conservation." This is the key to long-term regional self-sufficiency. The local people themselves must learn to conserve such natural resources as water, timber and soil, which are the true sources of a healthy productive life for generations to come; IV) "Enriched village-community economic, social and cultural life." The strengthening of local organizations is necessary for community control of resources and for guidance in planning and development within the region. Further, such organizations can provide, as they did traditionally, local social and cultural centers to counterbalance the lure of the "big city.".

These four "potentials" for socio-ecological development, and the possibilities and means of their implementation, are explored in great depth by van Dresser. The result is a study of immense value to northern New Mexico, and, with modification, provides guidelines for sensible small-scale development in any region. The problems of northern New Mexico are world-wide and the time has come for people to stay home and develop a new regionally centered and self-sufficient economy and way of life. We can no longer depend upon distant, potentially unstable, sources for our basic needs as most Americans do at present, leaving themselves extremely vulnerable to the effects of scarcity. *A Landscape for Humans* indicates a path from vulnerability to self-sufficiency, from weakness to strength. It is to be hoped that concerned people everywhere will read this book and put what they learn from it into action, in the task of developing strong and independent communities throughout the country.

— William Wroth, Box 3, Amalia, New Mexico 87512

Energy

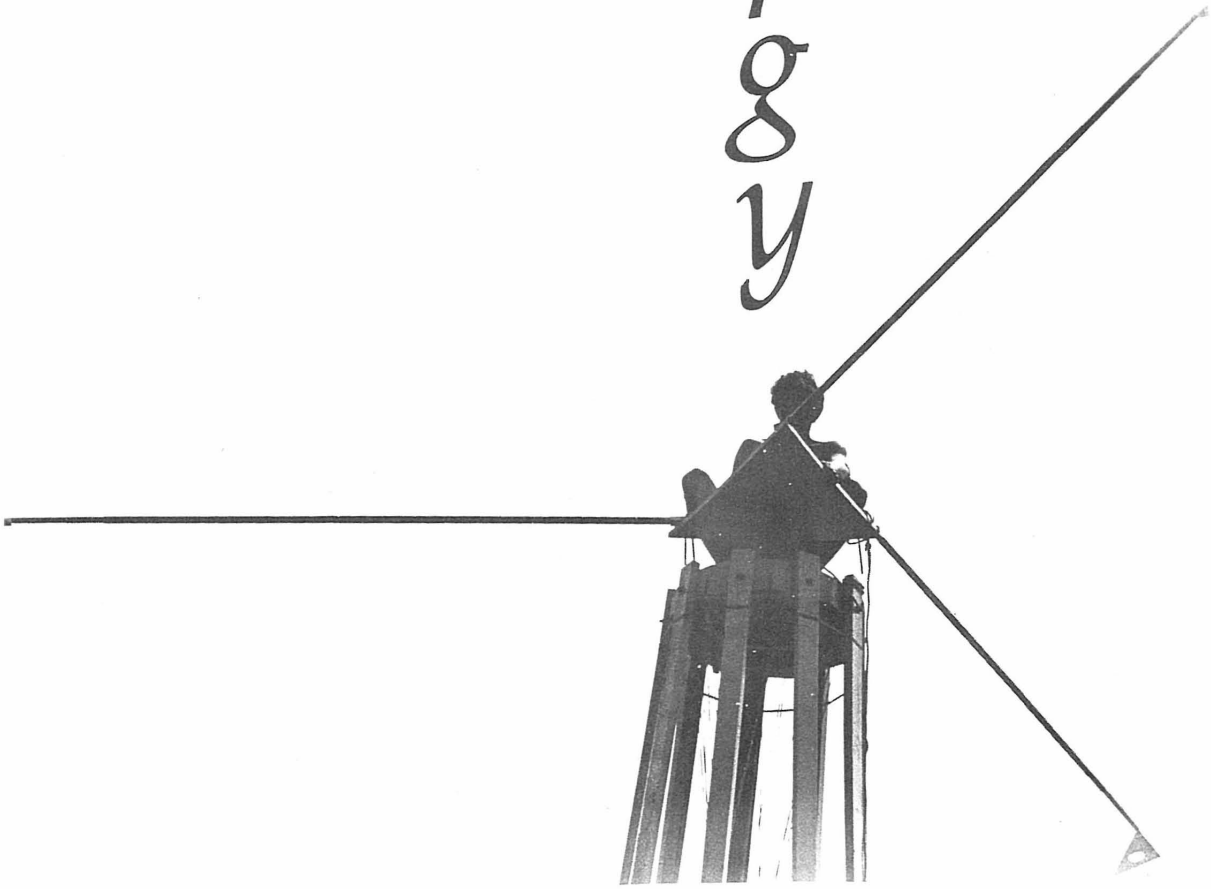
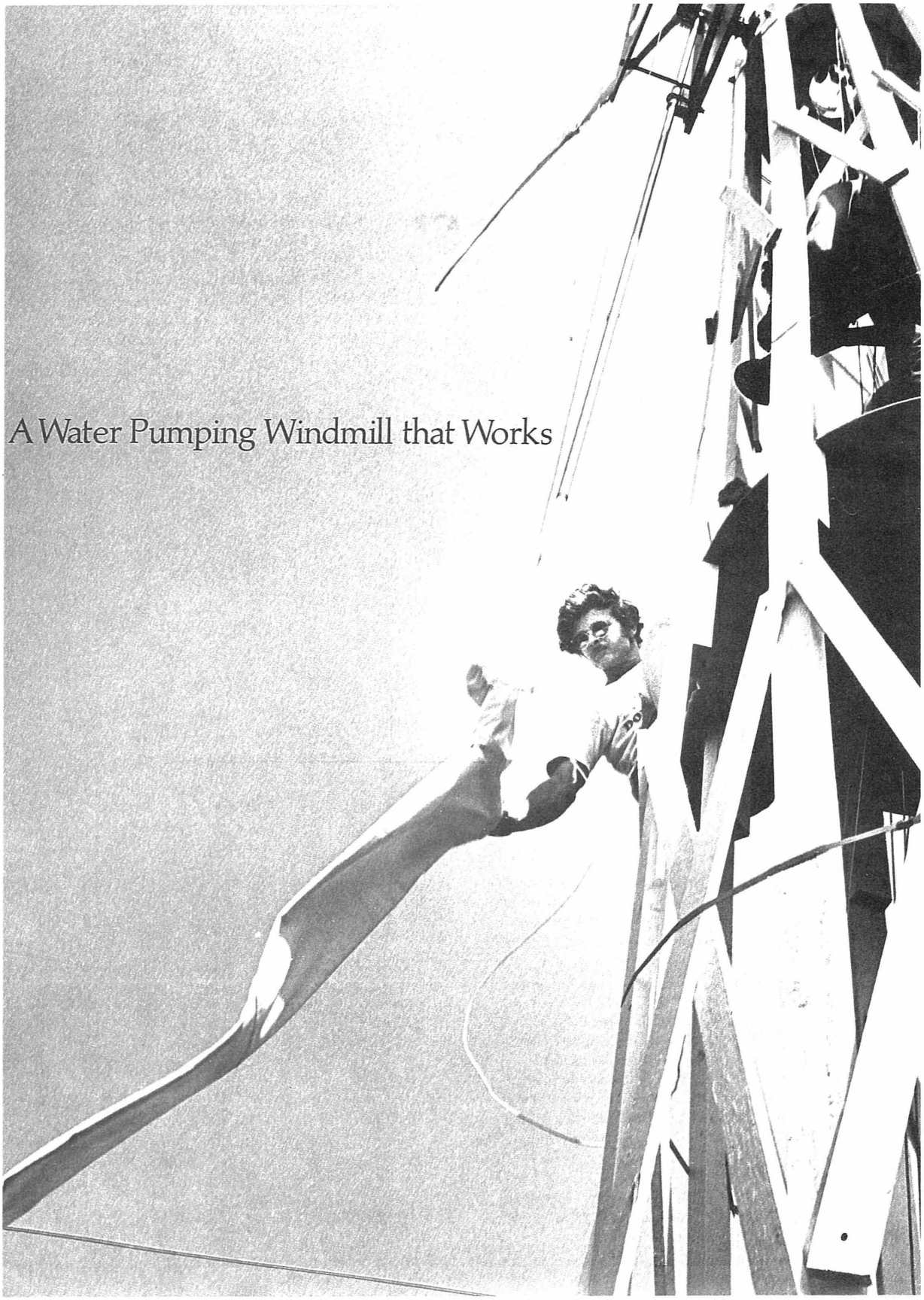


Photo by Alan L. Pearlman

We little thought, when we chose the title "Energy" for this section of the Journal, of how many shadings of meaning the word could be understood to have. I have seen it used to describe the positive force that believers in a New Age feel is growing swiftly now and will take us forward in an Aquarian Era of serenity and heightened awareness. Energy is spoken of to describe the impact of a personality or a group; of one's power to influence the people and events around one. It is still an apt term for what children have limitless amounts of.

We are still using it, in this section of the Journal, in a more traditional sense of the capacity to do work. At the same time, in doing so, we are deeply committed to working with as opposed to taking from nature, and, as this implies a contemplative approach of learning to listen to the wind and the sun and to growing things, then, perhaps when we chose "Energy" to describe our work, we half-intended some of the more subtle meanings to be understood as well.

— NJT



A Water Pumping Windmill that Works

Photo by Alan L. Pearlman

This windmill consists of three cloth sails attached to three tubular steel masts which are fastened to a triangular plywood hub. The center of the hub is bolted to the end of an automobile crankshaft which spins in bearings mounted on top of a steel ball-bearing turntable. The bearing turntable unit, which allows the windmill to rotate so that the sails are always perpendicular to the wind, is mounted at the top of an eight-legged tower which is firmly guyed and braced. A piston rod connected to the crankshaft transfers power through a reciprocating vertical steel pipe which runs from the top to the bottom of the tower where it operates a high capacity piston-type water pump.

The tower legs are bolted at the base to eight telephone pole sections which are firmly buried in the ground to prevent the tower from blowing over in heavy winds. This windmill is designed to remain operational and to withstand storm conditions. Ideally the cloth sails should be removed if severe wind conditions are anticipated. Our windmill was built to supply circulating water to a series of twenty experimental aquaculture ponds. It was required that the water in each pool be replaced once each day. Water pumping trials showed a yield of 250 gallons per hour in a 6 mph wind with 18' diameter blades applying power to a 3" diameter pump through a 3½" stroke.

$$\begin{array}{l} 7.481 \text{ gallons/ft}^3 \\ \underline{250 \text{ gph}} \\ 7.5 \text{ g/ft}^3 \quad = 33.3 \text{ ft}^3\text{/hr} \end{array}$$

$33.3 \text{ ft}^3\text{/hr} \times 8 \text{ hr} = 266.4 \text{ ft}^3$ in 8 hr.

This figure is lower than the calculated pumping capacity of the windmill.

Because of this we recommend that a crankshaft with a greater stroke or a pump of a larger diameter piston be used. A new mill that we have just completed uses 2 No. 350 cast iron pumps mounted in tandem (Mid-West Well Supply Co., Huntley, Illinois).

Parts

PARTS SHOWN ARE NOT DRAWN TO SCALE

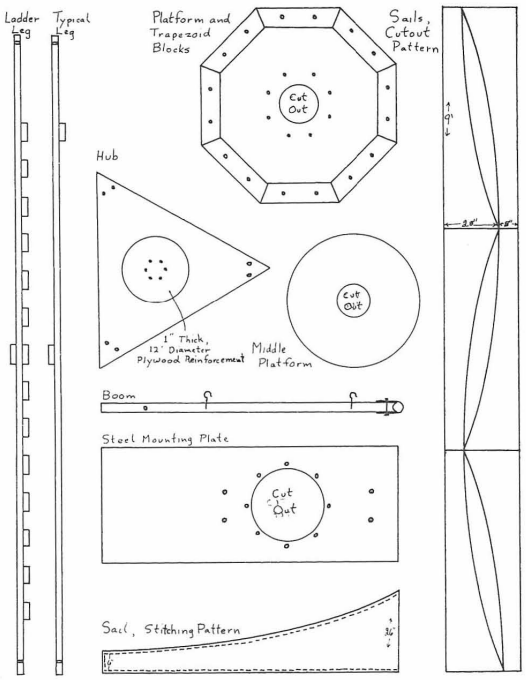
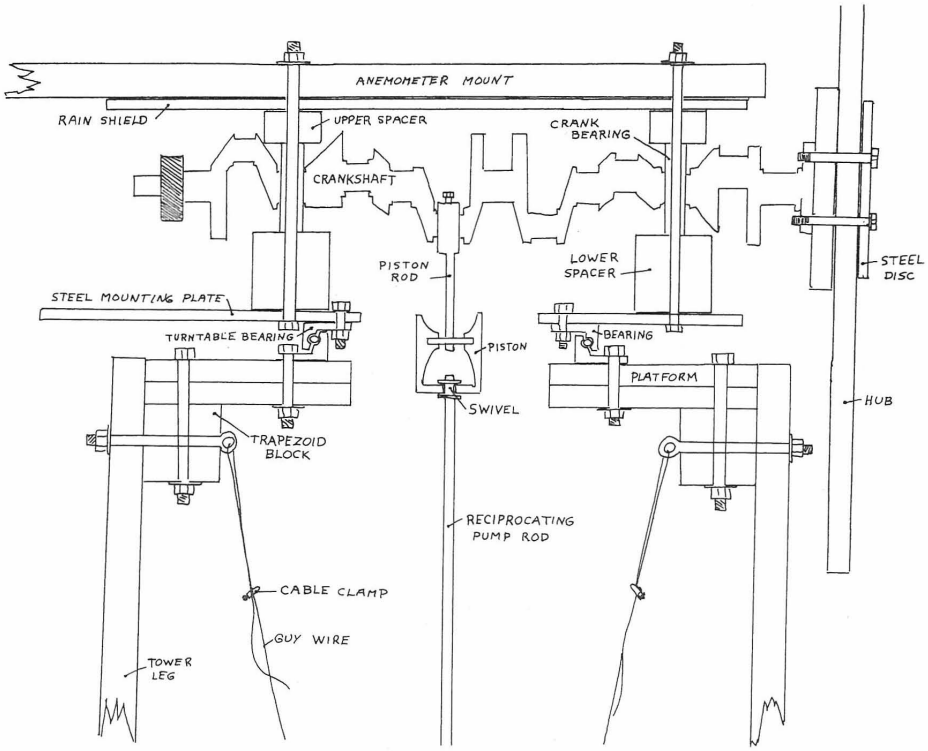
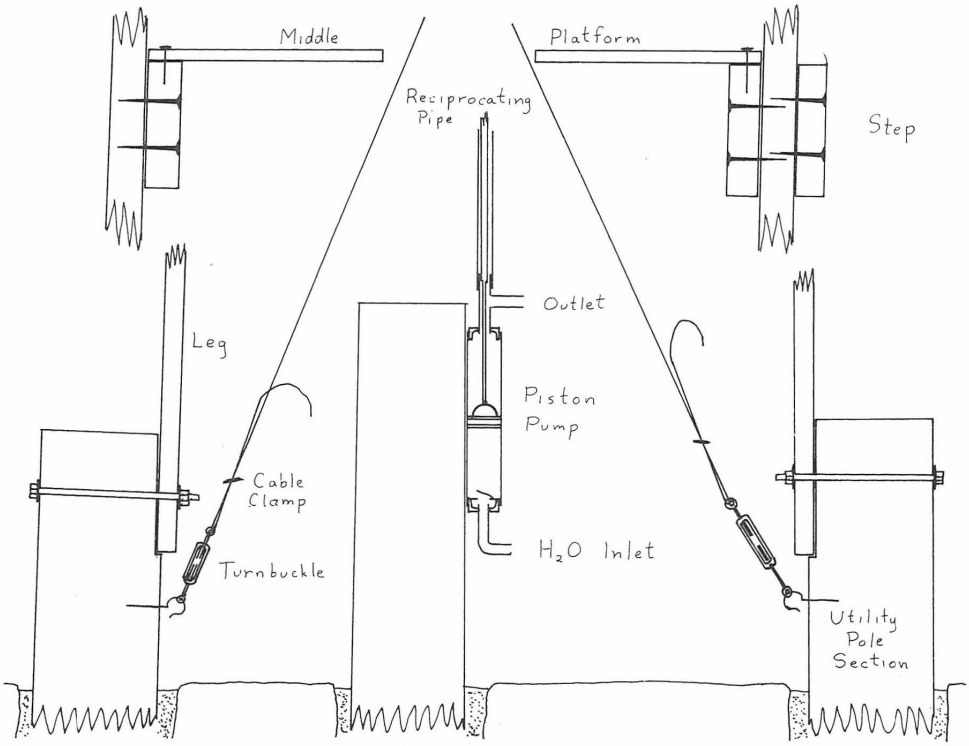


Photo by Alan L. Pearlman


ANEMOMETER MOUNT
RAIN SHIELD
UPPER SPACER
CRANK BEARING
CRANKSHAFT
PISTON ROD
LOWER SPACER
STEEL DISC
STEEL MOUNTING PLATE
TURNTABLE BEARING
PISTON
BEARING
PLATFORM
HUB
SWIVEL
TRAPEZOID BLOCK
RECIPROCATING PUMP ROD
CABLE CLAMP
GUY WIRE
TOWER LEG


Middle
Platform
Reciprocating Pipe
Step
Outlet
Leg
Piston Pump
Cable Clamp
H_2O Inlet
Turnbuckle
Utility Pole Section

Materials in Order of Assembly:

BASE

8 - 6' sections utility pole (or railroad ties), concrete optional depending on hole depth
8 - 12"x ½" galvanized machine bolts, 8 nuts, 16 washers
8 heavy galvanized screw hooks to secure turnbuckles to base

TOWER AND TOP PLATFORM

8 - 26' x 2" x 4" spruce for tower legs
8 - 8" pieces 2" x 4" spruce to secure middle platform to inside of legs
16 - 8" pieces 2" x 4" spruce for ladder steps on outside of one leg
8 - 8" pieces 2" x 4" spruce for foot holds around top of tower
½ gross 2½" No. 10 galvanized wood screws
2 - 1" thick, 28" wide plywood octagons for top platform
1 - 10' x 3½" x 3½" spruce for making 8 wooden trapezoid blocks to secure platform to legs
16 - 7" x ½" galvanized machine bolts, 16 nuts, 32 washers, to secure trapezoid blocks to platform
8 - 6" x ½" galvanized eye bolts, 8 nuts, 16 washers, to secure top of tower legs to trapezoid blocks and to provide attachment for top of guy wires
16 - 27' lengths of t-v antennae guy wire for internal guying of tower
32 cable clamps to form loops at ends of guy wires
Several strong persons and 100' strong rope required to set tower in place, gin pole helpful
1 - 48" diameter ½" plywood disc for middle platform
16 guy wire turnbuckles
16 - 56" pieces 1" x 3" spruce for lower bracing of tower
1 - 8' piece ½" nylon rope with eye splices and safety clips (for safety line)
At least one capable person who is not afraid of heights
16 - 40" pieces 1" x 3" spruce for upper bracing of tower
1 gross 12 penny galvanized screw nails to fasten bracing to tower legs

TURNTABLE AND DRIVELINE UNIT

1 - Model No. M4-12P4 series 1000 Econotrak bearing (9" inside diameter) from Rotek Inc., 220 West Main Street, Ravenna, Ohio 44266 (about $129.00) with 6 holes (½" diameter) bored equidistantly in both top and bottom bearing ring segments
1 - 36" x 14" x ½" steel plate for mounting crankshaft on top of turntable bearing. A hole approximately 9" in diameter must be made in this plate through which the piston rod extends to connect with reciprocating rod
6 - 1¼" x ½" galvanized machine bolts, 6 nuts, 6 spring lock washers to secure steel mounting plate to top of turntable bearing
1 large stroke auto or truck crankshaft with 4 of its bearing retainers. An 8 cylinder crankshaft is preferable.
2 - 6" x 3½" x 3½" spruce blocks for lower bearing spacers
2 - 8" x 1½" x 3½" spruce blocks for upper spacers
1 - 36" x 14" x ½" plywood for rain shield
1 - 8' x 1½" x 3½" spruce for anemometer mount
4 - 12" x ½" galvanized machine bolts to secure anemometer mount, rain shield, upper spacer crankshaft, bearings and lower spacer to the steel mounting plate, 4 nuts, 4 washers and 4 lock washers
6 - 3" x ½" galvanized machine bolts to secure bottom of bearing to platform, 6 nuts, 6 washers, 6 spring lock washers
1 piston and piston rod unit to connect crankshaft to vertically-reciprocating pipe
1 - 20' length ½" galvanized pipe to connect piston at top to pump at bottom
4 - ½" pipe thread screw collars and 2 - ½" inside diameter heavy polyethylene washers to secure top of pipe in hole in head of piston for swivel mount
1 adaptor to connect ½" pipe threads to 3/8" machine threads on pump rod

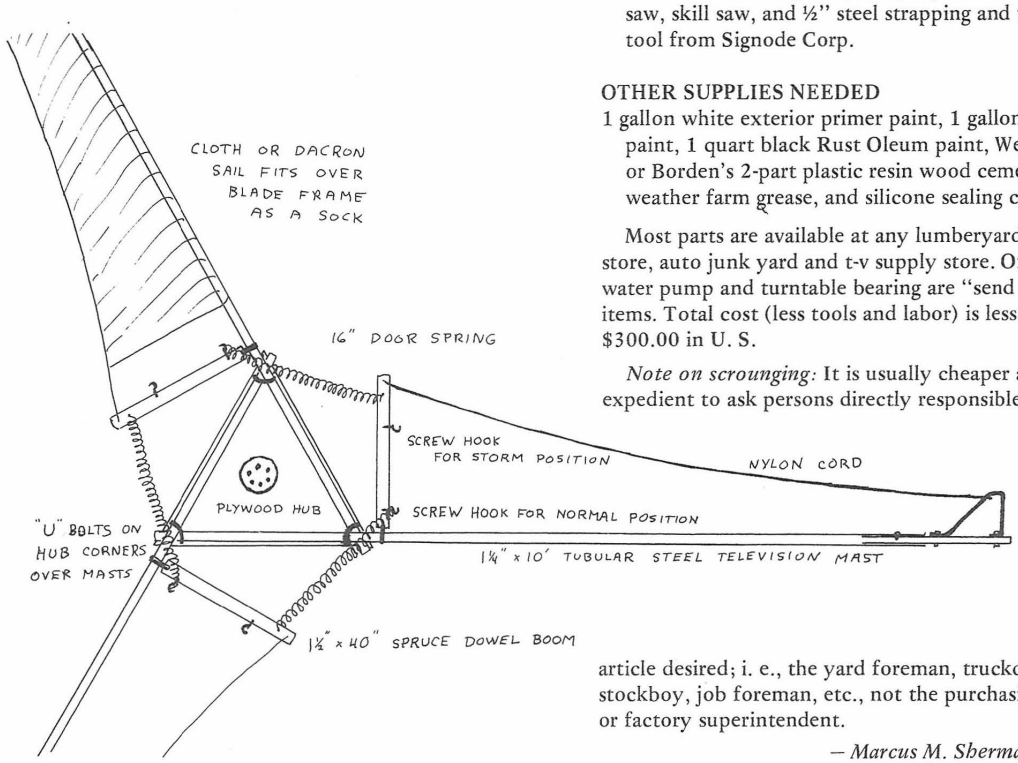
PUMP UNIT

1 - 8' section utility pole (or railroad tie) set in ground off center of line of travel of vertically-reciprocating pipe (pump cylinder is mounted on this)
1 Model No. 81 brass-lined pump cylinder No. 380-1-3021 from Demster Industries Inc., P. O. Box 848, Beatrice, Nebraska 68310 (about $45.00), or any large diameter piston pump or Model No. 350 Shallow Well Cast Iron Cylinder from Mid-West Well Supply Co., Huntley, Illinois (about $18.50).
1 "T" joint for outlet of pump
1 - 1¼" check valve for bottom of intake pipe
Adequate 1¼" plastic piping for inlet and outlet of water

HUB-BLADE UNIT

1 - 1" thick plywood equilateral triangle 30" on each edge for hub
1 - 12" diameter 1" thick plywood circle to reinforce center of hub
1 - 9" diameter ½" thick steel disc to reinforce center of hub (from hole in steel mounting plate)
3 - 10' long 1¼" tubular steel t-v antennae masts for windmill masts (arms)
3 - 1½" spread "U" bolts made from 3/8" threaded rod to secure masts at hub corners
3 - 1½" inside diameter galvanized steel pipe sections 6" long to prevent "U" bolts from crushing masts

6 wooden wedges 12" long, 1½" wide, 1" thick at fat end to adjust coning angle of masts to prevent collision with tower
3 - 2' x 1" steel tubing for mast extensions
3 - ¼" thick, 1" wide 21" steel straps for tip of mast extensions



12 - 1½" x 3/8" machine bolts to attach steel straps to tip of mast extensions, 12 nuts, 12 spring lock washers
3 - 2" cotter pins to secure mast extensions within masts
3 - 32" pieces 1" spruce dowel for booms at base of masts
3 - 1" x 8" medium gauge galvanized sheet metal strips to secure booms to masts
3 - 16" door springs for automatic pitch control
9 medium screw hooks to secure door springs to booms
3 - 12' long pieces nylon cord to form trailing edges of sail blade frames
9 yards muslin, cotton or dacron sail material

OPTIONAL ITEMS
1 anemometer (recording)
1 water meter
Water storage tank(s)

TOOLS NEEDED
Bit brace, chisel, cross-cut wood saw, hammer, level, open-end wrench set, paint brushes, post-hole digger, screwdrivers, sewing machine, shovel, socket wrench set, 9/16" wood bit, and wood clamps; *Optional:* electric drill (heavy duty), high speed drill set, jig saw, skill saw, and ½" steel strapping and tensioning tool from Signode Corp.

OTHER SUPPLIES NEEDED
1 gallon white exterior primer paint, 1 gallon exterior paint, 1 quart black Rust Oleum paint, Weldwood or Borden's 2-part plastic resin wood cement, all-weather farm grease, and silicone sealing compound

Most parts are available at any lumberyard, hardware store, auto junk yard and t-v supply store. Only the water pump and turntable bearing are "send away for" items. Total cost (less tools and labor) is less than $300.00 in U. S.

Note on scrounging: It is usually cheaper and more expedient to ask persons directly responsible for the article desired; i. e., the yard foreman, truckdriver, stockboy, job foreman, etc., not the purchasing agent or factory superintendent.

— Marcus M. Sherman

POSTSCRIPT

Testing of the mill: Since the article was prepared we have had an opportunity to test the sailwing windmill for ruggedness and pumping ability.

The windmill, with the cotton sail blades of 18' diameter, did indeed pump 250 gallons per hour in 6 mph winds. The water was pumped up 14' from a lake below the windmill. Our calculations and direct observations indicated that our pump was considerably undersized for the windmill. A larger stroke or a larger diameter piston pump would have been desirable. Our latest sailwing windmill, with sails designed by Merrill Hall, has two pumps mounted side by side (see drawing of advanced backyard fish farm mill) and we may yet add additional pumps.

Cotton versus dacron sails: During the winter trials the cotton sails did not stand up to continuous operation through storms and high winds. We decided to try dacron sails as dacron is a much longer-lived material, holds its shape better, does not absorb water during rains and is much stronger and lighter than cotton.

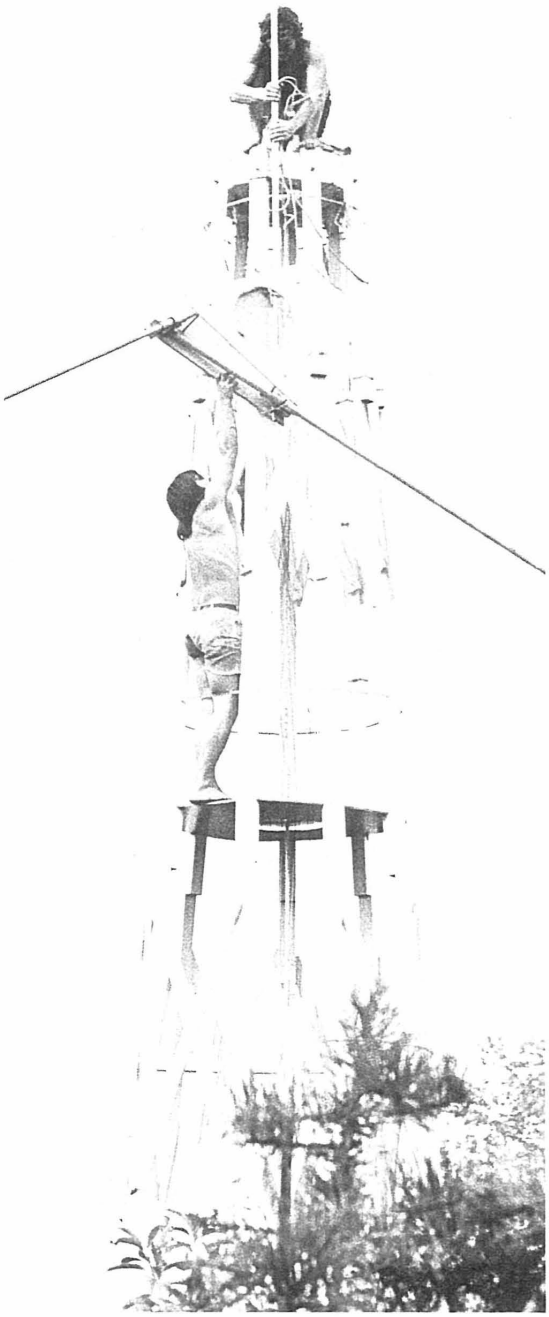


Photo by Alan L. Pearlman

Photo by Alan L. Pearlman

These are important factors when it comes to the design of large sailwings.

Merrill Hall made us a set of 3.8 oz. dacron sails to Marcus Sherman's design. From visual observations they seem to perform better than the cotton sails did. They are steadier and have a better configuration while driving in heavy winds.

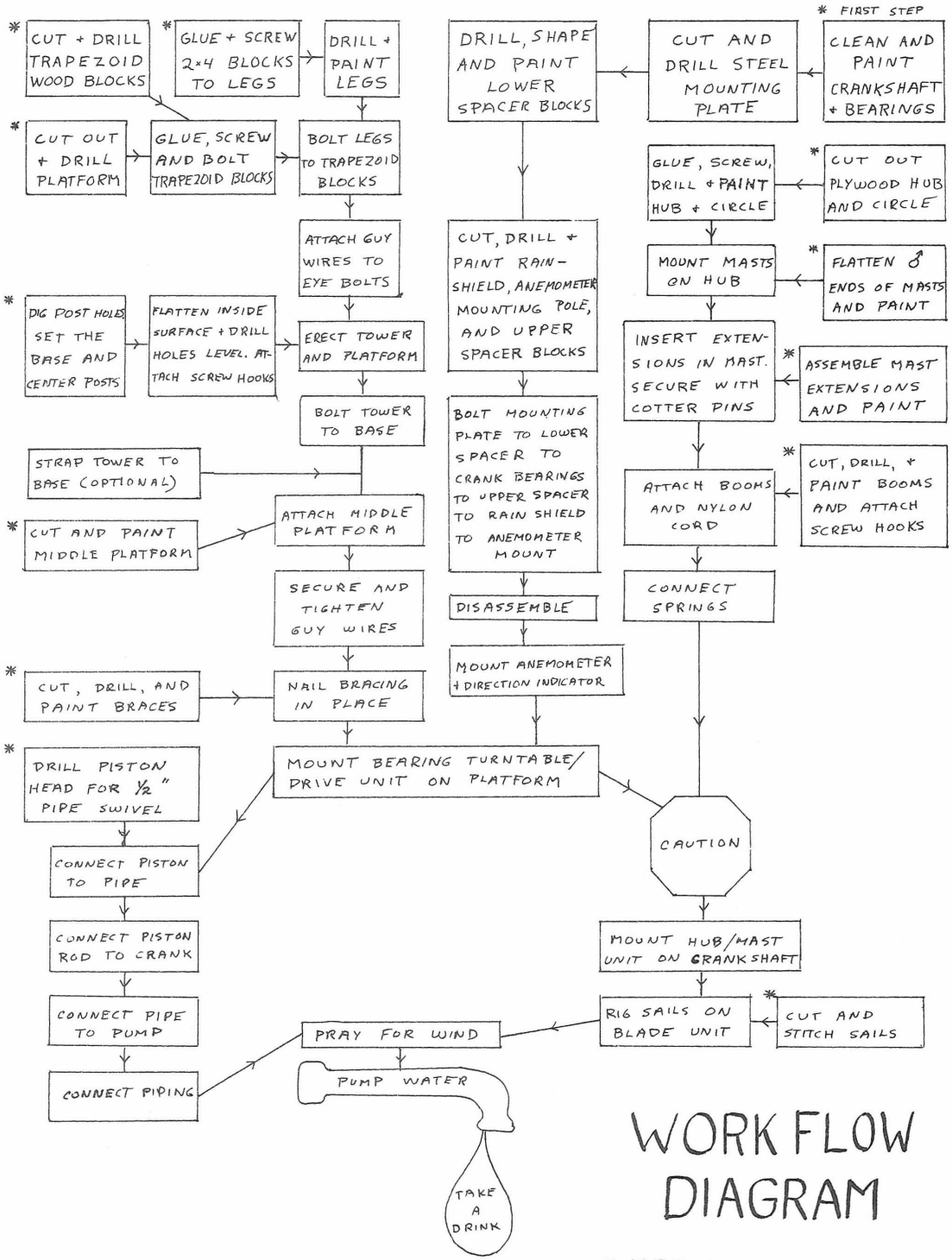
It was not long before we had a chance to test the dacron sails. With the feathering springs set in their storm position (see sailwing diagram) the mill came through a force nine gale (40 knots-plus winds) and continued to pump throughout the storm. The next gale arrived a few days later accompanied by freezing rain. This time we decided to leave the feathering springs in their full working position. The mill, to our great pleasure, was still pumping when the storm abated. The strong sails and Marc's spring feathering system have vindicated themselves, and since the last gale, a number of severe storms have been weathered.

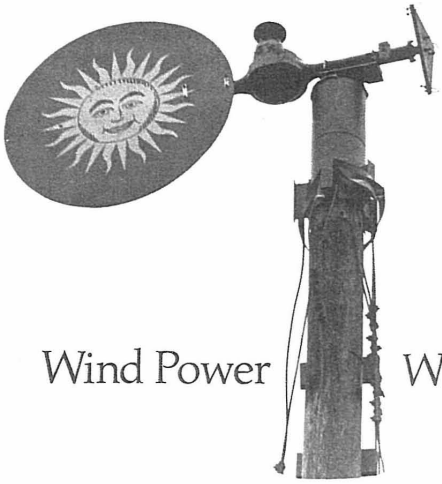
Post Postscript

We have recently learned that dacron is not superior to cotton for use in tropical areas, although coloured dacron has proved more durable than white.

Problems: During high winds, bolts and screws, including those on the end of the crankshaft, shake themselves loose. We replaced the hub bolts with longer ones so that lock washers and nuts could be placed on the crankshaft side of the hub. If you plan to have your windmill operate during high winds, we advise that you do not skimp; get quality materials and build it to last a long time, perhaps even a lifetime.

The windmill as accomplice and ally: Our sailwing windmill with its bright red sails has brought us an immense amount of satisfaction. Having it around makes us feel better, and there is something almost magic about working with the wind. At the bottom of the tower with the wind passing through the rigging, one is carried off to the plains of Crete and to distant shores where men first used the wind to drive their vessels and embark upon the unknown.


* FIRST STEP
* CUT + DRILL TRAPEZOID WOOD BLOCKS
* GLUE + SCREW 2×4 BLOCKS TO LEGS
DRILL + PAINT LEGS
DRILL, SHAPE AND PAINT LOWER SPACER BLOCKS
CUT AND DRILL STEEL MOUNTING PLATE
CLEAN AND PAINT CRANKSHAFT + BEARINGS
* CUT OUT + DRILL PLATFORM
GLUE, SCREW AND BOLT TRAPEZOID BLOCKS
BOLT LEGS TO TRAPEZOID BLOCKS
GLUE, SCREW, DRILL + PAINT HUB + CIRCLE
* CUT OUT PLYWOOD HUB AND CIRCLE
ATTACH GUY WIRES TO EYE BOLTS
CUT, DRILL + PAINT RAIN-SHIELD, ANEMOMETER MOUNTING POLE, AND UPPER SPACER BLOCKS
MOUNT MASTS ON HUB
* FLATTEN ♂ ENDS OF MASTS AND PAINT
* DIG POST HOLES SET THE BASE AND CENTER POSTS
FLATTEN INSIDE SURFACE + DRILL HOLES LEVEL. ATTACH SCREW HOOKS
ERECT TOWER AND PLATFORM
INSERT EXTENSIONS IN MAST. SECURE WITH COTTER PINS
* ASSEMBLE MAST EXTENSIONS AND PAINT
BOLT TOWER TO BASE
BOLT MOUNTING PLATE TO LOWER SPACER TO CRANK BEARINGS TO UPPER SPACER TO RAIN SHIELD TO ANEMOMETER MOUNT
STRAP TOWER TO BASE (OPTIONAL)
ATTACH BOOMS AND NYLON CORD
* CUT, DRILL, + PAINT BOOMS AND ATTACH SCREW HOOKS
* CUT AND PAINT MIDDLE PLATFORM
ATTACH MIDDLE PLATFORM
SECURE AND TIGHTEN GUY WIRES
DISASSEMBLE
CONNECT SPRINGS
* CUT, DRILL, AND PAINT BRACES
NAIL BRACING IN PLACE
MOUNT ANEMOMETER + DIRECTION INDICATOR
* DRILL PISTON HEAD FOR 1/2" PIPE SWIVEL
MOUNT BEARING TURNTABLE/DRIVE UNIT ON PLATFORM
CAUTION
CONNECT PISTON TO PIPE
CONNECT PISTON ROD TO CRANK
MOUNT HUB/MAST UNIT ON CRANKSHAFT
CONNECT PIPE TO PUMP
PRAY FOR WIND
RIG SAILS ON BLADE UNIT
* CUT AND STITCH SAILS
CONNECT PIPING
PUMP WATER
TAKE A DRINK
WORK FLOW DIAGRAM
* JOBS ARE FIRST IN SEQUENCE



Wind Power Windmill Electronics

Photo by Alan L. Pearlman

In Journal 1, we introduced the design of a home-built windgenerator made of recycled automobile parts, with details of the tower, swivel, transmission, and other mechanical parts. In the following article by Fred Archibald, we continue the development of the windmill by discussing the electrical system. The following diagrams and excellent technical advice allow the basic mechanical windmill to be adapted to several power ranges to suit the needs and situations of the builder. Equally valuable information is given concerning batteries and storage.

January 6, 1974

Dear New Alchemists:

I have been following your work with interest, and a little sense of participation, as I came up with the idea for the automotive differential-wheel spindle basis for a wind generator. Marc Sherman and I spent a long time discussing the system, both in the fall of '72 when the thing was started and this last Christmas. I have investigated the problem a bit further and hope that the following information, mainly on the electrics of the thing, will be of some use to you or your readers.

There are a number of problems associated with producing useful amounts of electric power from the wind for any length of time, if money is a consideration.

1. A constant voltage must be produced from a mechanical energy source (the propeller) varying from a few RPM to several hundred RPM.

2. A constant AC frequency of 60 CPS must also be produced from this variable speed source if standard appliances are to be used, and AC power frequency depends on AC generator speed.

3. The system must be able to withstand extremes of vibration, temperature, water and ice, corrosive salt spray and hundreds of thousands of revolutions with little maintenance.

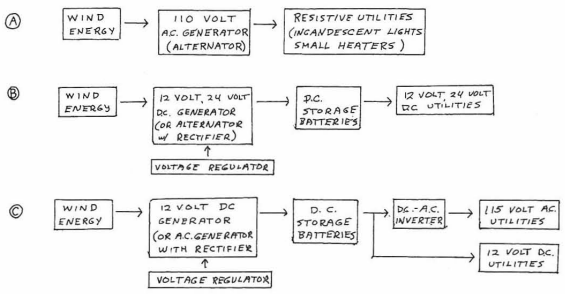
4. It must be designed to extract as much energy from the wind as possible and transfer it efficiently to the utilities to be run.

5. As wind conditions, terrain, facilities, and power requirements will be different with nearly every installation, blade size and design, tower height, and the generator:propeller mechanical ratio will be more or less specific for the site.

6. The components must be fairly cheap, very rugged, and widely available.

Cutting corners on Nos. 3, 4 and 5 will make the whole project a great waste of effort. Really, if you don't have the time or facilities to do this thing right, it will only be a toy.

There are many possible generation systems, but the three thought most practical for a small home-type system are:



System (A) is the simplest, but an AC generator run off the wind will have widely varying frequency and voltage which would damage most appliances. Only resistive heaters and incandescent bulbs would be usable, and these would flicker on and off with the wind.

System (B) is the simplest system with storage capacity. A number of commercial wind systems use this. DC power is available at a regulated level, usually 12 or 24 V, even when the wind isn't blowing, and can be used for a wide variety of lights, motors, small heaters, and radios. Many of these things can be bought or scrounged from old cars (12 V) or ordered from automotive or marine supply houses. A small 12V DC refrigerator is even made for marine use. However, the low voltage means high currents and therefore very heavy wire is needed. For instance, Edison calculated that it would take several *tons* of copper to light the houses in a city block using 10-volt bulbs in a 10-volt system. Therefore unless a great deal of heavy cable (like auto starter or 200 AMP arc-welder cable) is available, only small devices (< 50 watts) or ones very near the generator are feasible.

System (C), while the most complex, is the only one providing reliable power compatible with all the utilities in use commonly. The DC storage provides constant power whether the wind is blowing or not, and in turn allows the capture of wind energy when the electrical devices are not being used, which in a system without storage ability would go to waste. Both 12V DC and 115V AC utilities can be run directly and even European 230V AC ones with the simple addition of a transformer. The only limitations on this system are the *amount* of power produced daily, and the current or wattage rating of the inverter. Such a 115V AC system could be plugged directly into a house by pulling out the main circuit breaker or block of cartridge fuses and connecting the inverter directly to the house side of the circuit.

There are infinite variations on these three, depending on what's available, like 28V DC surplus aircraft generators, arc-welding generators, etc., but these are the basic alternatives open.

I won't discuss System (A), because it is the simplest to construct (electrically anyway) and is fairly useless except for heat production, and as even small heat-producing appliances like an iron or toaster use 750-1500 watts each, a very large generator and propeller would be needed to heat even a small building or fish pool.

The 115V AC system is just the 12V DC system with the inverters added, so it might be feasible to start with the 12 V system and later add the inverters. The solid state ones are around 70% efficient, i. e., 1000 watts of 12-volt DC power (83 AMPS) will produce 700 watts of 115V AC (about 6 AMPS).

The reliability needed in a fairly complex system like this is only possible with a really rugged well-designed generating system, and unless you have considerable engineering and technical facilities available to you, the best thing to do is adopt an entire system from another application. The only such system available and meeting the ruggedness, cheapness, and availability requirements is the modern automotive one. Only the automotive one is temperature-compensated to work from -40° to 260°F, go thousands of hours maintenance-free, and resist water, dirt, grease and exposure. If this doesn't sound like the generating system in your old car, it's because there have been some very significant improvements in the system since 1969, mainly the integrated circuit (IC) regulator.

These new systems employ an alternator (AC generator) with an internal rectifier bridge to produce DC and an IC regulator, often also within the alternator unit itself (on '72—'74 units). These alternators come in a number of power (wattage or amperage) ratings, and for the wind generator, the higher the better. Sixty AMPS is the largest common size on big American cars and the best for this application. Sixty AMPS at a nominal 12 volts is 720 watts (generators actually put out 13-14 volts). This is the peak continuous output of 1 unit. As can be seen in the accompanying diagrams, 1, 2, 3 or 4 of these can be accommodated by the design, giving peak outputs of 720, 1440, 2160 and 2880 watts. In assessing the amount of power you need, it is very important *not* to compare directly the wattage ratings of the utilities to be used to these peak output values. The important figure is the *average* power output of the wind generator through 24 hours of the day. If optimal propeller and generator design will only produce 400 watts average (actually quite a good figure), then whether the peak potential power is 2160 or 2880 watts is not very significant, unless your area alternates between calm and very strong winds to get this average. To obtain a good average output, proper blade design, gear ratio, tower, and generator cut-in speed are all-important. The power capability of the system depends on the *length of time* used, at least as much as amperes consumed by

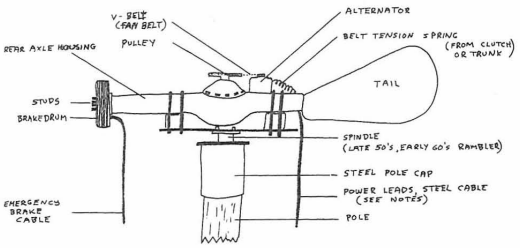
utilities, and the storage capacity of the batteries. Even the average power produced is wasted if there is not sufficient storage capacity to hold it and few utilities are being used. In other words, a system producing only 100 watts average output would have stored 2.4 kilowatt-hours a day, if the battery system is adequate, easily enough to run a stove once or twice a day. Actually this would take a large DC-AC inverter, and so such large heating jobs should better be left to DC or other energy sources. The principle, though, is important; a small, continuous power input to a good set of batteries will provide adequate power for high consumption occasionally, say for morning pumping, coffee percolating and evening lights, radio, etc. Perhaps it would make us more aware of electricity's value to us also.

The accompanying diagrams will explain the outline of a feasible electrical system for a wind generator. It doesn't include blade design (which I know very little about) or the over-all ratio between the blade speed and the alternator rotor speed. A high-speed 2-bladed propeller might have an over-all ratio of 8-10 revolutions of the rotor to one of the propeller, and a slower sail type or 3 or 4-bladed type perhaps 20-25:1 ratio. The ratio is determined by selecting an auto rear end with a proper ratio. They vary from about 2.7:1 in big cars with automatics to 4.6:1 for trucks and many small standard shift cars (Datsun, Toyota, British cars, etc.) On top of this, the ratio of the diameters of the pulleys on the pinion shaft and alternators is added; i. e., 2" alternator pulley to 10" pinion pulley. A wide selection of these aluminum pulleys can be found at any hardware store.

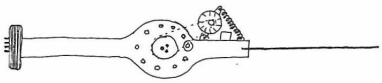
You'll probably read in the other papers about wind systems that pulleys, belts and gears all waste some of the wind's power. It's quite true, but the only way around it is to get a very slow-speed generator directly driven. It must have a very heavy shaft, heavy case and super bearings to take the propeller directly; and the only ones I know of are the ones custom-made for wind generators; and if you're willing to get into such expense, you might as well get an entire Quirk or Wincharger system. The auto rear end, of course, is a very long-lived and maintenance-free unit carrying a ton and with several-hundred horsepower flowing through it. So in a few-horsepower wind generator, it should last a tremendous length of time and consume relatively little power, if it is broken in and lighter oil is used.

Notes on Mechanical Aspects

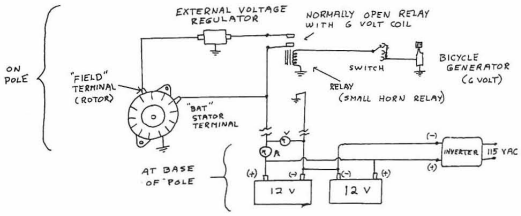
- for best efficiency, remove original oil and put in 20 W motor oil and *new oil seals*
- spider gears in differential may have to be welded together ("spiked")
- tail axle tube must be welded shut
- assembly should be balanced on pivot (spindle)
- a wheel center can be conveniently bolted to the original studs and the steel or fiberglass of the blades affixed to it by welding, bonding or clamping
- a fiberglass or sheet-metal shroud should at least partially protect the alternators and pulleys (not shown)
- ideally a commutator would transfer power from the generator to the ground (to permit free turning of the generator with the wind). This would be very difficult to build as 12 volts would be impeded by even a slight resistance and the generator rendered ineffective. The cables are allowed to hang free with enough length for 2 or 3 revolutions. A steel cable slightly shorter than the power cables, firmly fastened to the base of the pole and the differential housing, would provide a "stop" and prevent the power cables from being ripped off.
- a heavy marine or military type plug in the power cables at the base of the pole will allow their being unwound if they become twisted around the pole.
- stays from the pole cap to the ground will give the whole unit more stability
- the bicycle generator can be of the common type that is spring-loaded against the tire, and in the same way pushes against the alternator belt. In case this is too fast, a suitable surface of rubber on the rim of the brake drum would provide a surface for the generator to run against. A section of an inner tube could be stretched around the outside of the drum like a large rubber band
- all welding should be arc, if possible
- bolts you expect to get loose again should be at least galvanized, preferably brass or stainless steel
- if the belts are kept tight and the pulley ratio not too tight, belt drive will work quite well with 1-2 generators. If 3 or 4 are to be used, a second pinion pulley and belt must be used. Also auto belt drive isn't good with larger generators (greater than 1 KW).



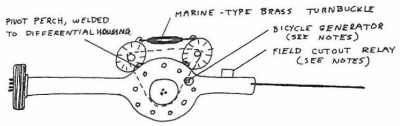
SIDE VIEW SINGLE ALTERNATOR UNIT



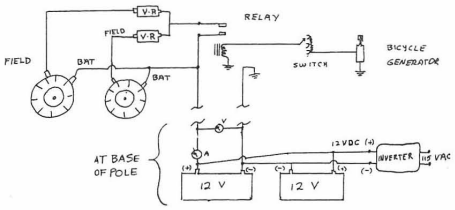
TOP VIEW SINGLE ALTERNATOR UNIT



SINGLE ALTERNATOR SYSTEM



TOP VIEW 2 ALTERNATOR UNIT



2 ALTERNATOR SYSTEM

Electrical Notes

- the bicycle generator-relay system cuts off the rotor current flowing from the (+) side of the battery when the speed of the wind is too low to produce power. In addition when the relay opens, the rotors free wheel, greatly reducing the drag on the propeller, allowing it to get up speed more easily. This is especially important in low-starting torque, high efficiency 2-bladed types.

- a 3-position switch is shown in the generator line. This will control the cut-in speed of the alternators. It may be desirable to change this according to the seasons or wind conditions. This could be replaced by a rheostat, or left out completely if desired.

- a good anemometer is a nearly indispensable aid in setting up and monitoring the machine, as is a $15 "VOM" or electrical multitester.

- the number of batteries needed will vary with the size of the system and how steadily the wind blows in your area, but remember that the batteries represent the only way to capture the wind's energy when utilities are off or using less power than is being generated. Therefore the more AMP-HOURS of battery capacity you have, the more efficient the system will be in using wind energy.

- the batteries will be one of the major expenses of the system so all the standard precautions should be taken to insure efficiency and long life.

1. Add only distilled water.
2. Keep them clean and dry.
3. Check them with a hydrometer frequently (1.230-1.280 corrected for temperature)
4. Have heavy wires and good connectors (covered with grease to prevent corrosion).
5. Don't completely discharge them, especially in winter.

- an integral alternator-regulator unit is wired just as units with a separate regulator (see sketches and schematics) with the low speed cutout relay taking the place of the ignition switch.

- these wires grounded securely to differential housing

- the more batteries are paralleled, the more wind energy you can store and the more will be available for peak use periods.

- the 2 alternator is almost identical to the single. Three or four can be paralleled in the same way. Make sure the relay has adequate capacity (current handling ability) if several units are used.

- all wires should be *soldered*, not clipped, clamped or screwed on the wind generator unit and the joints protected with acrylic, silicone or some other protective material.

- field and bicycle generator leads can be 16 or 18 gauge copper insulated, but (+) and (-) power leads from the stators to the batteries and inverter *must* be very heavy copper like arc-welding or auto "jumper" cables or most of the power generated will be used up in heating the power leads, and the voltage regulator won't work properly.

- wires on the wind generator should be tied down to prevent flexing in the wind .

- the external voltage regulator (if present) and cut-out relay should be sealed as well as possible against the weather.

- be sure all electrical units (alternators, bike generator, relay, voltage regulator) are well grounded to the differential housing. Small pieces of braided grounding strap brazed to the housing are good.

- once installed, the solid state rectifiers (in the alternator) and voltage regulator are rugged and reliable, but if their polarity or battery polarity is reversed (the battery is hooked up backwards), they can be permanently damaged in a few seconds.

- the 1969 and later alternators with "IC" regulators are by far the best ones to get, but in any case it's probably not worth using the older DC generators (pre-1960 approximately) as they have much less power output and more maintenance, wiring, and poorer regulation and reliability.

- a spark-gap (¼" or so, obtainable as a TV-antenna accessory, or home-made) should be put between the (+) cable at the base of the pole, and the (-) terminal grounded by a steel stake, to protect against lightning. Unless you really need the power, it's probably best to

disconnect the batteries and inverter during thunder and lightning storms.

- at least a DC volt meter and ammeter to monitor generator output should be mounted in the battery box, and preferably an AC ammeter and volt meter in the house, barn, etc., to monitor inverter output.

- never completely discharge the batteries as this shortens their life.

- lock the blade with the emergency brake whenever disconnecting the power leads between the batteries and the alternators. To disconnect the alternator from the batteries while it is charging could damage it.

- the excellent regulation provided by the IC regulator should significantly increase battery life.

- an alternator has brushes, but the slip ring has no breaks like the generator's commutator, eliminating nearly all the wear and sparking. Also an alternator's brushes only carry the field (rotor) current (1-3 AMPS) while a generator's must carry the full output (20-40 AMPS). Therefore alternator brushes generally last many times the life of generator brushes.

- if you stick to 12 V DC power, remember that every auto has two very useful large motors, the starter and the generator (the DC type, not an alternator). The starter is a series-type motor, with tremendous starting torque, good for low speed, heavy jobs, but takes lots of power and the generator is a shunt-type motor. This is really a versatile unit that can produce up to about 1/3 horsepower at a variety of speeds and can be picked up in any junkyard from 1955-1963 American cars. These units can be rewired or rewound if you are really a do-it-yourself type, but can be used directly and the speed controlled by a rheostat between the fields and the armature (about 10-15 ohms at 25 watts).

- actually if you wanted only a small amount of AC, one of these units driving an alternator from a later car with the diodes bypassed for AC and the DC motor (generator) adjusted to the right speed with the field rheostat to the proper speed will produce 115V AC at 60 cycles at a fraction of the cost of an inverter.

- for a really cheap auxiliary power supply, in case the wind doesn't blow, a 2½-3 horsepower horizontal crankshaft lawnmower engine will run an auto alternator, which can produce 12 V to charge the batteries or 115V AC 60 CPS if the engine speed is adjusted properly, usually 1800 or 3600 RPM.

- actually, in obtaining old alternators and generators, I stopped at a number of service stations and asked to look through their trash and got more old units than I knew what to do with for nothing, and most of them, after cleaning, were either perfectly usable or needed only a bearing, diode, or set of brushes!

- Chrysler specifies regulation (charging) of their IC-alternator from 50-5000 RPM; Ford and GM, I couldn't find.

Costs

- it's impossible to give a figure, as this depends on scrounging, but quality parts in some areas are a must.

- look at the ampere-hour capacity of batteries. A $35 battery often has twice the capacity of a $25 one as well as better materials and construction.

- rebuilt alternators ($25-$60) are usually just as good as new ones, if they come from a reputable firm and much cheaper. J. C. Whitney Co. of Chicago, a mail-order auto-parts firm, has good prices on these items. If you're handy, junkyard ones can be renovated for even less.

- the inverter(s) are another major cost, and as the solid state "multivibrator" type are quite new, there isn't much chance of finding a used one. The older mechanical reed type is rarely found, and anyway is very inefficient. A 500 watt continuous, 550 watt intermittent unit costs about $110 from such places as Lafayette Radio or J. C. Whitney. If more power is needed, two or more units can be bought. It's possible to make one from parts, if you are handy, but considering the time and effort and the cost of the parts, it's not practical unless you can "scrounge" the parts.

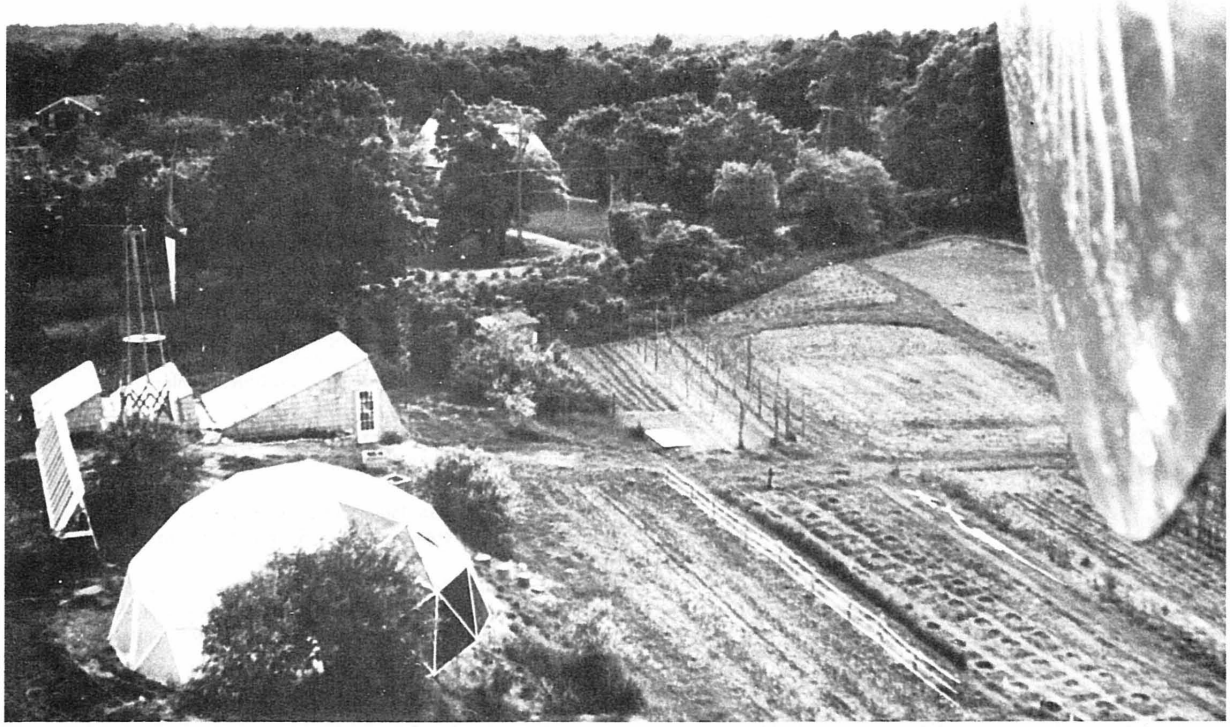
I guess all this makes pretty dull reading, but for the person serious about such a project, I hope it is of some use. Good luck in your various ventures!

— *Frederick Archibald*
Biology Department
Dalhousie University
Halifax, Nova Scotia, Canada

* * * * *

POSTSCRIPT

The last major hurdle of a low-cost wind generator is the blade technology and construction. Currently the only dependable blade design is a high-speed airfoil blade made of wood or fiberglass. This type of blade can be handmade, but becomes more difficult in larger sizes. We are presently investigating nautical sail design to determine if the long tradition and recent advances in that art can be turned toward low-cost wind generators. Progress toward that end is the success of the self-regulating sail-blades of Marc Sherman's water-pumping windmill described in this Journal.



Explorations

Earlier in the Journal we mentioned briefly the impact that Howard Odum's report to the Royal Swedish Academy had on all of us last fall, both intellectually and emotionally. It could have been said to have had a comparable effect to a doctor's report, pinpointing the progress of a fatal disease. One knows the prognosis is going to be bad and can, of course, only get worse. But, before actually hearing the report, one's fears are still somewhat amorphous and vague, having the tenuous quality of a bad dream. With the report, the specifics take shape. One can no longer be evasive in one's responses. It was so for us with Professor Odum's report, which John Todd discusses here. No longer are the problems ominous but ill-defined. Professor Odum makes only too clear where and how we are endangered, relating this not only to the false concept of energy held by our economic system but also to the living world in which it is based but habitually chooses to ignore. We feel it is a perhaps painful but essential part of Explorations.

A careful reading of this article and that of Richard Merrill, under Land and Its Use, will reveal many parallel, even convergent, themes. It is worth noting that they were written three thousand miles apart and completely without collaboration. What sets them slightly apart from many that have discussed energy in recent months is the fact of both Rich and John's continuing awareness of the inter-relatedness of all economics, energy and agriculture to the finite planet we seem bent on exhausting.

The second article in this section by Eugene and Marya Anderson of the University of California at Riverside is one that is interesting on a variety of levels. As New Alchemy has started working in other countries, we have become all too aware of the fact that "help" in any form is ill-conceived if it is not accompanied by an exhaustive effort to understand the people to whom you would offer your knowledge or skills. While too much pondering could lead to a Hamlet-like paralysis, it is still terribly important, before rushing foward with one's good works, to understand a culture and to know, as the Andersons point out, that there are often taboos and practices which, although often incomprehensible from our frame of reference, can be a deep-rooted part of a people's thought patterns.

Another idea that emerges from the article as thought-provoking is that of the politics of food. Here there is no need to draw on examples from the third world, so successfully have we managed, on this continent, to use food as a means of exploitation. Aisle after aisle of supermarket shelves stacked with highly refined, extravagantly packaged, nutritionally dubious and ever more expensive foods make shopping frustrating, at best, for the comfortable and devastating for the poor. Their exploitation takes another dimension when one considers that it is often the poorest people who find junk foods most irresistible as the only piece of the glittering affluence surrounding them that is in any way attainable.

— NJT

Photo by Peter Sherman

The Dilemma Beyond Tomorrow:

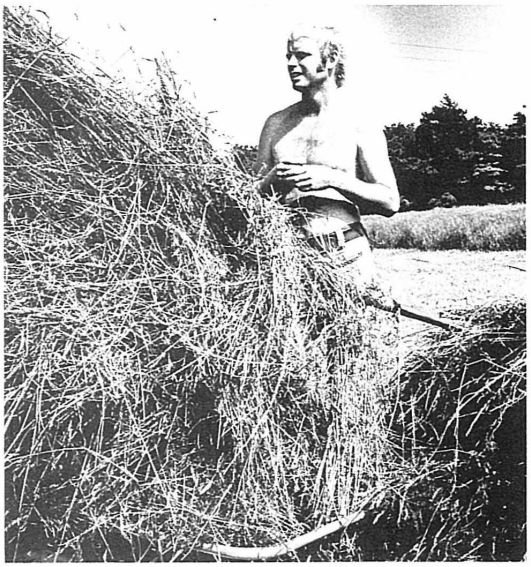


Photo by John Cressey

A Look at How the Fundamental Laws of Nature Have Been Defiled by Modern Industrial Societies Thereby Threatening the Fate of Mankind

Late last fall I attended an ecology conference at Goddard College in Vermont organized by Murray Bookchin, the well-known political ecologist. The Goddard discussions began with a look at the "energy crisis" which was just beginning to flex its muscles, inconvenience and scare people. Several of those present, savvy students of energy and its use in our society, had pretty much concluded that the whole business was a trumped-up affair to benefit the few at the expense of the many. Subsequent events have pretty much borne out their early analysis.

But underneath Oil's dirty underwear there is something critical that needs reading and understanding. Manipulated events can be heraldic in that they provide a model for looking at economic forces in the world by which we can see a bit more clearly into the future. The pseudo-crisis has had educational value with frightening portent.

I should like, at this point, to make four statements about energy in relation to society and then discuss them a bit more fully, beginning with the last point first.

1. Energy and its use is critical to the fate of society.

2. Our knowledge of energy is primitive and lacking in wisdom.

3. Even if the present crisis is the result of manipulatory activities, the forces which enable Oil and others to be manipulative are growing. Within our lifetimes a terrible scramble for the remaining cheap energy will take place. This almost certainly will mean war and oppression.

4. Contemporary "advanced" societies have built themselves a humpty-dumpty civilization based upon a crude understanding of nature, energetics and society. The scary thing about this is that megatinkerers, oil barons of whatever nationality, could actually collapse the whole industrial world without meaning to, merely by playing their narrow-interest power games. I shall give a brief example of what I mean, but it should not be forgotten that there are at the same time comparable events that could be, and are, occurring in many other sectors of society.

DOWN ON THE FARM, or DO WE EAT TOMORROW?

It is difficult for us to imagine stores empty of food. We have no precedent for such an event. But every time you see a gas station with an "out of gas" sign, remember that the problem is magnified down on the farm. In our mechanized society an empty tank in a tractor can quickly mean an empty shelf in a food store. The lag time can be as short as nine months. Even slight energy shortages have the potential to trigger myriad unexpected events.

As I mention in the article describing New Alchemy's Ark, food production in America, unlike agriculture in many regions of the world, is highly energy-intensive and dependent upon huge oil inputs. The disparity, in energetic terms, between U. S. agriculture and that of peoples with sensitive gardening approaches to farming is as high as 25:1 or even 40:1 in favor of the latter. This is a side of the green revolution its proponents rarely discuss. Some farmers in places like Malaysia and New Guinea are capable of producing twenty calories of food for one calorie of energy expended; we use five calories or more of energy to produce one calorie of food on the American table. We are hooked on high energy modes of food production and because this fact has been ignored, a population has been placed out on a limb.

Energy is used in a variety of ways in the production of food. There is the manufacture of necessary modern machinery and equipment, then transportation, storage, drying, processing and packaging, not to mention a number of other inputs including advertising, all of which require fossil fuels for their sustenance. To make things worse, our agricultural lands have been so badly treated and misunderstood in ecological terms that a whole arsenal of chemicals is required to fend off pests, kill weeds, check diseases and provide plants with nutrients. These chemicals are all ultimately dependent upon fossil fuels in their manufacture and many are petroleum derivatives. Herbicides, pesticides, fungicides and fertilizers can be purchased by farmers only if oil remains cheap and readily available. The manufacture of both nitrate and phosphate for fertilizer requires excessive amounts of energy, surpassed on a per unit output basis by few other industries, such as aluminum.

Industrialized agriculture cannot get along without these inputs, as many alternative paths have been closed behind us. We are increasingly paying the price for treating land as a commodity rather than as something alive and sacred. When the oil tinkers tinker, they could unleash events which will bring real troubles to the farms and the larders of the country.

Already there are ripples as a result of the mini-crisis. In the fall of 1973 a number of farmers were finding it difficult to get enough gas to dry their high-yield corns. The problem is at once ironic and typical; the new corns are harvested "wet", having a higher water content at harvest time than older varieties. Spoilage results if they are not artificially dried.

But the worst problems in the food production chain are in the industrial linkages. Cutbacks in availability of oil to petrochemical industries, as well as increasing prices, could put a squeeze on pesticides, herbicides and fungicides. If these products "short fall" on farm lands, there could be a serious drop in production of foods. Shifts to biological farming methods can and must take place, but they cannot be rapid, as they usually take many years to be effected and require more intensive techniques and planting strategies, not to mention a wholly different attitude toward agriculture. One petrochemical industry spokesman predicted a sixty-five billion dollar drop in his industry and 1.6 million jobs lost in 1974. While he was no doubt exaggerating the magnitude of the problem for ends not yet clear, there is little doubt that shortages and price increases of an unprecedented nature are taking place and that these will inevitably affect farm inputs. One example will suffice to make my point. Within a period of a few weeks, the price of phosphates from Morocco, a major phosphate producer, rose from $14 to $42 a ton.

This whole scenario, it must be remembered, has to be seen against the backdrop of a world without substantial food reserves. Nations with faltering industrialized agricultures cannot be bailed out, short of war or blackmail on their part. If a pseudo-crisis can induce strains into a system, then a genuine reduction in fuel availability could seriously dislocate a modern society.

A real energy crunch is on the way. At this point I should like to bring forth some of the arguments of Howard Odum, one of the fathers of ecology in America. Odum's view of the future is one of the most apt, and we would do well to listen carefully to his message.

For several decades Howard and his brother, Eugene Odum, have been students of Nature, trying to comprehend the primary ecological forces that underlie biological change. They have done much to advance the science of ecology, and a landmark paper by Eugene entitled, "The Strategy of Ecosystem Development", (1) chronicled the characteristics of ecosystems and environments, their use of energy and their changes over time towards more diverse, complex and stable states. Nature changes constantly. The environmental factors and man's impact on these changes are beginning to be understood. Howard Odum, in a small volume, "Environment, Power and Society", (2) attempts to apply the mechanisms of nature and the methods of ecology to an understanding of human societies and their relationships with the living world. The book, with its charts and flow diagrams and its jargon borrowed from the language of systems, has not been widely read outside the discipline of biology, although its message was very clear to those who studied its contents. Professor Odum concludes that highly industrialized societies are so out of tune with nature that their fate will be sealed within the lifetimes of many alive today.

Recently Howard Odum presented a paper to the Royal Swedish Academy of Science entitled, "Energy,

1. E. P. Odum, 1969. *The Strategy of Ecosystem Development.* Science, Vol. 164, 262-270.
2. H. T. Odum, 1971. *Environment, Power and Society.* John Wiley. 336 pp.

Ecology and Economics" (3). Its message was directed both to the public and to world leaders and stated that through our ignorance of energy and nature we have created a world community that is precariously balanced. He predicted a one-hundred-fold drop in the world's population within five to twenty years, a drop closely paralleling a comparable reduction in the amount of energy available to industrial societies.

I should like to précis some of his arguments here, as the paper delivered to the Royal Swedish Academy has yet to appear in print. I apologize to him for any misinterpretations that might enter into my analysis of his ideas.

Odum views energy, whatever its source, be it coal, oil, nuclear fission or the sun and the wind, in terms of its value. By value he means real work after the energy has been extracted, processed and delivered — in a sense paid for. This is energy at its point of ultimate use. He also grades energy in terms of what it takes, energetically speaking, to make it work directly on our behalf. If it takes almost as much energy to mine, process and manufacture the components and substructures of power-producing systems and maintain the support organizations, as can be delivered for ultimate use, then the *net energy* is very slight. He argues convincingly that energy is not seen in this way by economists.

He has modeled inflation through his technique of seeing money as an energy-linked phenomenon in the "ecosystem" of nations. Seen this way, the relationships between energy and money begin to clarify. Inflation, in these terms, is directly related to the diminishing availability of net energy - as the amount of net energy readily available to a society decreases, so does the value of its money. The relationship appears to be a direct one. The quality of energy is also tied to this idea. If more energy is put into the energy-getting process, be it arctic oil, coal, or nuclear plant, than was necessary previously when fuels were more available, then less real work can be bought with the energy produced. At this point, money is worth less, independent of the machinations of high finance or government. To summarize, the value of money is directly tied to the net amount of energy available to the society that prints it.

The available energy reserves will have to be reevaluated by both modern governments and most of their critics in light of Odum's line of argument. If net energy is the criterion upon which we are to base our planning for the future, then present estimates are much exaggerated as they are based on available reserves or gross energy. Howard Odum states, "Suppose for every 10 units of some quality of oil shale proposed as an energy source there were required 9 units of energy to mine, process, concentrate, transport and meet environmental requirements. Such a reserve would deliver 1/10th as much net energy and last 1/10th as long as was calculated."

Here we are beginning to probe the essence of the quality of energy and the dilemma beyond tomorrow. Nature has her own set of rules and what we can glean from the use of energy in ecosystems seems to apply to ourselves. From this we can see that competitive and cooperative relationships between societies have different meanings at different periods in their development.

If we are to avoid the fate that has afflicted all previous major civilizations, we will have to identify and cope with shifts in energy value. A forest, meadow, village or country will best survive if it uses its energy for the most useful purposes at any given point in time. Energy requirements can and do shift dramatically.

In nature rapid growth seems to be adaptive only during periods when new and cheap resources are available. Ruthless competition exists between plants as well as animals, when a new spacial resource becomes available. For example, when a field is cleared, colonization takes place which involves rapid shifts in species domination and abrupt rising and falling in population densities. The discovery of the fossil fuels locked in the earth's crust and subsequent use of them triggered a process in human societies in some respects analagous to those in the newly exposed field or meadow example. New energy resources became available. The scramble to exploit them was imperialistic and aggressive. Those that succeeded in obtaining these resources have in effect "changed the world."

A second phase may be approaching when readily available energies basically have been tapped. In nature, those energies remaining are used for maintenance and the gradual shift to other modes of interaction. Rapid net growth specialists like the weeds in the fields are replaced by a diversity of organisms, longer-lived, and of higher quality, with more subtle, frequently synergistic relationships which maximize their energy efficiencies. The area that was a field changes into a forest that is more diverse and stable.

Odum feels that we are going to be forced to shift from a rapid growth society to a steady state society and that we will have to begin soon or the crashes that in nature are characteristic of shifts from growth to steady states may be felt by ourselves.

There is a constructive side to his message: should we shift to a steady state system, the quality of life could, in theory, be maximized. Odum speculates that only in such a society could socialistic ideals of equitable distribution be effected.

At this point, I should like to probe the concept of energy quality and its importance in understanding the significance of the present scramble for new energy

3. H. T. Odum, 1973. *Energy, Ecology and Economics.* Paper invited by Royal Swedish Academy of Science. 26 pp.

sources. One of the most difficult and important ideas Odum introduces is the idea that higher quality energy must subsidize lower quality energy if the total energy output is to be maximized. The forest provides a good illustration: leaves at the top of trees transport fuels so that more shaded leaves which have less solar energy available to them get some additional energy. In this way the dim light that reaches the forest floor can be utilized even though it is of lower quality. Energy is maximized because the uppermost leaves provide a support base for lower ones which work less efficiently. High quality coals and oils, when they are inexpensive, keep goods and services cheap. These goods and services, in turn, provide the subsidy for marginal kinds of energy which would not yield much on their own. I shall elaborate on this concept when discussing the role of nuclear power in the field of energy as a whole.

Economists and technocrats are predicting that the marginal energy yielders might one day become economical. Odum claims this to be a fallacy on the grounds that they require the subsidy to exist at all. Present day marginal energy yielders represent lower quality energy sources.

It is at this point in the argument that the technologists like to point out that new technologies with greater efficiencies will be developed to reverse the equation and save us before readily available fossil fuels are exhausted. The story may not turn out so beneficently, as technologies with high end-point efficiences, (for example, engines that develop considerable power with relation to fuel requirements) actually acquire their efficiency through energy-expensive manufacture, maintenance and support structures. To produce more efficient engines requires more energy in the form of extremely complex factories. The percentage of net energy yielded may actually decrease with more efficient engines.

Environmental technologies being developed in the name of pure water and pure air also reduce the amount of net energy available to society for useful work. In relatively small and balanced human communities, pure air and water are provided by a free energy subsidy from nature. Wind, water, sun and soils work together to purify wastes and human by-products. But natural purification works only when human societies are made up of relatively small units surrounded by ecosystems such as lakes, swamps and forests that have the ability to purify and restore. When urban sprawls become too large, nature's aiding capacity is overtaxed and the free subsidy vanishes. At this point we have to maintain livable environments with costly and energy-intensive technologies like sewage plants, which include tertiary treatment facilities, waste extraction, transport systems and others. The cost to society, as a result of overshooting the natural carrying capacity of nature, is great and unhappily, is ignored by almost all.

Societies must be designed using nature as a recycling partner if they are to survive the period when high energy purification technologies can no longer draw on cheap energy sources to sustain them.

There is much discussion of new sources of energy, especially solar energy, these days. The New Alchemists and others are trying to use these energies on a small scale in more delicate and sophisticated ways. Trapping the sun's heat to provide livable climates in greenhouses and housing structures takes advantage of an energy source normally quickly lost to the atmosphere. But to see large-scale utilization of solar energy as a replacement for oils and other fuels may well prove to be an ill-founded fantasy, and to expect solar power to permit our civilization to continue on its present course is nonsense.

Solar scientists see our salvation in the large-scale manufacture of solar cells that translate the sun's energy into electricity. These cells will be mounted on vast solar collectors, some of them in space. But the solar energy striking a given unit of collecting area is very low, some 10^{-16} kilocalories per cubic centimeter. This means a tremendous amount of energy in the form of subsidies from oil and coal economies will be needed to manufacture a very large number of cells and installations for concentrating the energy and transforming it into electricity for its ultimate use. The net energy available to society may not be nearly as high as solar exponents believe.

However, plants which have an incalculable amount of surface area exposed to the sun will remain the best utilizers of the sun's energy. Their end products, food, building materials and wood fuels, represent the most effective use of the sun's energy. Plants have tiny semiconductor photo receptors based upon the same principles as have been adapted for use in solar cells. Unlike manufactured solar cells, they constitute another of nature's subsidies.

It follows, if the above notions are correct, that the whole concept of environmental technology needs re-evaluation and that those technological processes which duplicate nature's work must be seen as economic and energetic handicaps. The contemporary dilemma has been created by the establishment of high technology industrial and urban regions which have long overshot nature's healing capacity. Our attempts at correction and purification of these ecologically unsound areas will actually run down available high quality fuels at a more rapid rate. If we stick with our present system we are trapped, because we will need to use a disproportionate amount of energy to sustain a livable environment which in turn will leave less energy available for primary work. For future societies to thrive, growth limits should be set by ecosystems rather than by economic dictates which span only a few years. It is unlikely that new forms of energy, even nuclear

energy, will be able to bail us out if we don't restructure the human landscape of this country.

Nuclear energy is considered by many high technology advocates to be their trump card, but this is a myth the perpetuation of which is in part responsible for continuing on our ill-fated course. Professor Odum, in discussing the energetics of nuclear energy, does not feel the need to go into the dangers inherent within the use of the atom in order to make us rethink what we are presently doing in promoting a large nuclear industry. On the other hand, I think the safety factors, nuclear waste storage and the slow but steady build-up of radioactive materials in the environment are justification enough not to develop nuclear energy as the panacea to all our energy problems. Odum's argument rests on the fact that the net energy from nuclear power plants is low, being presently subsidized by coal and gas economies.

In his talk to the Royal Swedish Academy, he states,"High costs of mining, processing fuels, developing costly plants, storing wastes, operating complex safety systems and operating government agencies make nuclear energy one of the marginal sources which add some energy now, while they are subsidized by a rich economy. A self-contained, isolated nuclear energy does not now exist. Since the present nuclear energy is marginal while it uses the cream of rich fuels accumulated during times of rich fossil fuel excess, and because the present rich reserves of nuclear fuel will last no longer than fossil fuels, there may not be major long-range effect of present nuclear technology on economic survival. High energy cost of nuclear construction may be a factor accelerating the exhaustion of the richer fuels."

The use of breeder reactors is the next link in the efficiency chain. They use less fuel in the production of electricity. However, their net yielding ability is not yet known, in part because of the huge research and development costs involved. Further, contemporary nuclear plants may consume the fuels needed by the breeders before breeder technology comes of age, so we may never know whether or not they could be net yielders, independent of fossil fuel subsidies.

Nuclear enthusiasts are often quick to point out that the ultimate solution to energy in society lies in creating fusion plants; the fusion phenomenon being akin to fabricating small "suns" here on earth. But workable pilot plants have yet to be developed, and there is no concrete knowledge either as to potential net energy or as to how large an energy subsidy will be required. Societies may not be able to afford to shift to the fusion process from their oil and coal bases, even if the concept of fusion should, one day, prove workable.

If the above concepts have a basis in fact, as I believe they do, it is possible to look with fresher eyes into the dynamic of our present society. The picture that emerges is one of instability and unhappy changes unless we begin to create anew human communities within the limits placed upon us by the living world upon which we depend.

Countries and regions within countries operating upon their own energy resources require less money to function and are in a fortunate position when they export goods and services. Perhaps a corollary of this point is that regional development should be tied more closely to indigenous energies when the future in the long term is seen as being more important than short term wealth and instability. Certainly such an approach would tend to enhance diversity and stability within a region. It might be argued, and quite rightly, that disparities between regions would arise and that the inhabitants of less favorably endowed areas would be poorer. This is partly what I mean by the term, "the limits of nature." Present disparities between regions are sometimes equalized only because of an abundance of cheap energies. This cannot be sustained for long. I have seen communities within a few miles of each other in Haiti, where non-human energy is very expensive and scarce, that are totally different. The root of the differences lies in the local ecosystems themselves. It is when the less fortunate are inextricably dependent on the more fortunate for survival that oppression and injustice reaches its peak.

I would like to suggest that there might be compensations, even though disparities will be generally seen in a negative light. If it were somehow possible to adjust the size of a given community or population to the ability of the surrounding landscape to sustain it, then viable societies might evolve. In these cases, the social goals of equality would have to be worked out within the framework of a region's productive capacity. It may be that sophisticated political theory will one day tell us that an optimal social/political course within a rich and fertile river valley will be different than one for residents of high mountain valleys with inhospitable climates, even given the same goal of maximizing the human experience. In designing adaptive societies, ecological realities need to be placed within the political sphere.

Countries that have high amounts of energy to sell are, in Odum's view, in a strange predicament. If they sell oil (a rich energy source) and don't use it for useful work at home, they too become subordinate nations requiring technical goods and services. Many Arab nations are becoming increasingly aware of this and are shifting more of their energy to manufacturing within their own boundaries. Should they do this on a wide scale they could topple energy-poor manufacturing nations like Japan. Japan's future could provide a barometer of the eventual fate of modern industrial nations.

Those countries or regions that will have the best chance of shifting from their present course closer to

steady-state, lower-energy societies will be those that use primarily internal energy sources and relatively high degrees of indigenous technologies in redirecting their path to safer grounds. Those with the richest internal energy sources will, I suspect, retain more of the characteristics found in high growth, cheap energy economies of today.

It is necessary for us to admit to ourselves that there will continue to be differences in relative wealth between regions in the future as there are today, but this fact should not negate the need for political consciousness to strive for social structures which maximize equality within a region. It may be that well-fed, healthy peoples with small amounts of energy available to them will redirect their lives towards stewardship and artistic and philosophic goals. Wealth as understood by materialists may be an enemy rather than an ally. I don't know this..... but I do feel that when we subtly incorporate the living world into our social consciousness, we have a better chance of surviving, and extending the human condition. An enlightened state will depend on a far greater appreciation of the underlying forces of nature.

There have been systems in nature known to have shifted from fast-growing to steady states through a gradual substitution of components from the former state to those of the latter. I suspect that, in these instances, there still existed a fair amount of reserve energy to effect the substitution. But when readily available energy is exhausted, removed, or tied up within a few species, then dramatic crashes can and do take place. Odum's point here is apt when speaking about shifts in human societies:

"Because energies and monies for research, development and thinking are abundant only during growth and not during energy levelling and decline, there is a great danger that means for developing a steady-state will not be ready when they are needed, which may be no more than 5 years away, but more probably more like 20 years."

The urgency induced by this re-evaluation of our present state is amplified by the humanitarian gestures on the part of some wealthy nations in providing food and medical aid to countries suffering from famine and disease. In Odum's opinion, this practice does not stabilize the world as we have been led to believe, but instead depletes existing reserves, ensuring that the world community will suffer en masse, instead of piecemeal. If he is right, we will find ourselves confronted with an agonizing moral crisis. The only consolation may be that, if it were known that a widespread drop in the human population were inevitable under the present modus operandi, perhaps a powerful impetus would be created to develop alternatives. Many of the techniques described in the "Journal of The New Alchemists" are designed as substitutes, utilizing what presently exists within a given region. Indigenous courses of action, to be widely effective, will require significant changes in social and political consciousness and a tremendous amount of hard work and commitment to a future that must be very different from the present.

The place of medicine within the framework of energy reductions is not well understood, but disease as the leveller of populations will again resume its primary role in the fate of humanity. Odum, seeing medicine in energetic terms, concludes that our "medical miracles" are also high energy miracles and that the energy for total medical care is a function of the total energies of a country. As the energies per person fall, energy for medicine declines and chronic disease will again become a population regulator.

Epidemics will also become more prevalent. Epidemic diseases operate under a different principle than chronic diseases. Chronic diseases test the vitality of individuals within a given population, whereas epidemics sweep through a high percentage of a population and the effects are more dramatic and widespread. Nature's systems normally use the principle of diversity to minimize epidemics. The other side of the coin is that an epidemic is a biological mechanism whereby inherently unstable monocultures are eliminated. Man's societies may represent, biologically, a kind of monoculture. Certainly his agriculture is characteristic of unstable systems. We have avoided crashes solely through methods that can exist only as long as there is cheap and universally available fuel. Odum's case is succinct:

"Man is presently allowed the special high yields of various monocultures including his own high density populations, his paper pine trees, and his miracle rice only so long as he has special energies to protect these artificial ways and substitute them for the disease which would restore the high diversity, ultimately the more stable flow of energy."

What is our future going to be like if we continue? Professor Odum's view of tomorrow is an unhappy one:

"The terrible possibility that is before us is that there will be the continued existence on growth with our last energies by the economic advisors that don't understand so that there are no reserves to make change with, to hold order, and to cushion a period when populations must drop a hundred-fold. Disease reduction of man and of his plant production systems could be planetary and sudden if the ratio of population to food and medical systems is pushed to the maximum at a time of falling net energy."

We are, whether we like it or not, confronted with the awesome and unprecedented task of reconstructing human societies so that they come into line with the laws of nature. Hopefully we can do it in a way that extends rather than constricts the human experience. In short, to change the world we are going to have to change ourselves. The beginnings are tangible and concrete, and there are guides including ecological concepts.

We find that there are resources, often in the strangest places, as we become less concerned with high energy and more concerned with diverse wholes. If we are willing to change the way we live, then we can begin to restore and reconstruct. By passing through the portals of nature, we can begin to work with or through her so that the scars begin to heal. The path will involve the three strands of practicality, science on a small and human scale, and a wisdom that is philosophical, even mystical. Separately change cannot come about, but perhaps..... and this is only perhaps, together the world will begin to sing.

It is easy to begin. The Ark and the Backyard Fish Farms reflect wholistic and small-scale thinking, and although they are early explorations into man in nature, they will help give confidence and directions.

Time is not on our side. Hence the urgency and tone of the "Journal." To some, like Odum, our survival is at stake; should they be proved wrong, we still stand to gain. If they are right, there can be virtually no alternative that is not hell, until the living order of the earth's mantle is restored.

— *John Todd*

* * * * *

This Ant

It stormed all night, thunderous, raining
wind-syncopated on leaves which thrashed
against the sky or, torn away, struggled

on the air like bats until beaten down
and plastered to sidewalks and roads.
Now light, and a calmer wind. The rain's

pounding lessens to a second-thought
tap on a drumhead. A long grass stem
dips as a black ant climbs the green stalk

past boulders of water to stand finally
at the tip, feet braced against the sway,
and wave antennae at the sun.

— Don Esty

* * * * *

On the Need for Studies of Food Consumption Ideas

1. The Problem

For some years we have focused our research on fishing communities. Fishing is, of course, a distinctive mode of food production. It is the last stronghold of hunting, as opposed to agricultural and factory production, in the modern world, and as such an anachronism — one which the New Alchemists are trying to eliminate, by developing fish farming. Study of fishing societies led us to a general interest in the change and modernization of food production, and

this in turn has taken us on to problems of food consumption.

In the social sciences, as elsewhere, there is little attention paid to the origin and change of food habits. As everyone concerned with the world food problem knows, every culture has an enormously complex and intricate pattern of beliefs, practices, attitudes, taboos, principles and strategies relating to the preparation and consumption of food; and these beliefs are often a major hindrance to the introduction of new, nutritionally desirable foods. Moreover, even with the best of nutritional education, such changes as do occur are often in the wrong direction. Thus in spite of the best nutrition research and education in the world, the United States as a whole has been changing its collective dietary patterns for the worse; more fat and sugar is consumed, fewer fruits and vegetables, and the sugar is increasingly sucrose, which feeds tooth decay bacteria and is suspect of other sins, instead of the less dangerous sugars in fruit, honey, etc. (U. S. Dept. of Agriculture, 1969). Similar deterioration occurs elsewhere; thus in Chile, mothers decided that nursing was old-fashioned, and greatly shortened the nursing period, with disastrous effect (György and Kline, 1970). In our recent research in Malaysia, we found a shift from fruit and vegetables to fat and sucrose, similar to the changes taking place in America.

Nutritionists, agricultural developers and other concerned parties have repeatedly noted such changes, but rarely try to explain them. Rejection of new foods is laid to "tradition" or "superstition", while deteriorative changes in diet are passed off as "ignorance" or, with somewhat more sophistication, explained as prestige-seeking imitation of the west. These are obviously inadequate. Who are the Americans imitating? Their inadequacy is often cloaked behind a body of incorrect beliefs about food habits, some of which beliefs are even stranger than any taboos of the developing societies. Thus the ancient Jews are credited with a fantastic prescience about the vectoring of trichinosis, and their ban on pork thus explained. It is obvious from the taboos listed in Deuteronomy that 1) ideas of sanitation and disease vectoring were exceedingly rudimentary in those days; 2) the pork taboo is part of a long list of taboos, which cover organisms as diverse as vultures and oysters, none of them particularly noted as disease vectors; 3) these taboos fall in a pattern — they all involve animals that are strange, unusual, or anomalous, e. g., in cleaving the hoof yet not chewing the cud. Clearly pork was banned for reasons other than its possible role as a trichinosis vector. Similarly, the Hindu rule against eating beef is explained simply in terms of religion, but is actually a more involved problem (Harris, 1966). The cow is protected because it is more useful alive — for traction, milk and manure. The beef *is* eaten, by lower-caste and some upper-caste individuals. Perhaps the taboo is explained in part by a need to make sure that these individuals get some protein. But, more generally, it is clear that one gets far more protein per acre by saving cows for milk, and having bullocks for plowing the fields for lentils and beans and chickpeas, than by ranching beef. Religion has thus apparently served in great measure as a sanction for hardheaded, practical economic behavior. (On these subjects, cf. Simoons, 1961, for expansion and further viewpoints.)

Anthropology has devoted some attention to these things; not surprisingly, the French are well ahead in this field (Levi-Strauss, 1964- ; Verdier, 1969, with comment by Anderson, 1970[a]). Partly in response to French activity, the British have begun work on the subject, e. g., Leach, who writes mostly on taboo rather than food per se (1964). Yet even the best recent popular books on food contain numerous errors and misinterpretations, and the amount of concrete analysis of food consumption remains exceedingly small. Sociology and psychology, in spite of their interest in man's other physical needs, pay essentially no attention to the subject.

2. Some Actual Cases

Herewith we will briefly note three cases that point up certain facets of the situation.

The Cantonese Cuisine. We have elsewhere analyzed Cantonese cooking, which we studied in Hong Kong, in some detail (Anderson and Anderson, 1969; Anderson, 1970[b]; Anderson and Anderson, ms). This is a highly traditional cuisine, the rules of which are definite and long-established. As Cantonese cooking has reached a high degree of efficiency in resource use, it provides an interesting case.

The cuisine can be analyzed as a minimax game: minimizing such factor inputs as fuel, time, effort and cooking ware, while maximizing nutrition, taste quality and the production of food; minimizing fertilizer and biocides while maximizing the yield of nutrients per acre. A few examples of the process: rice, the staple, produces more calories per acre than any other grain or indeed any other starch crop in the Cantonese climate. It is also rather high in protein and B vitamins as starch crops go, especially if it is not milled overmuch. Eaten with the rice are soybean products, the highest protein-per-acre yield of any crop in the traditional world, and a fairly complete protein at that, i. e., supplying reasonable amounts of all the amino-acids that humans cannot synthesize. Also consumed are large amounts of cabbage-related greens (high in vitamin C and other vitamins in the otherwise vitamin-poor cold season), chili peppers (high C and A), carrots and orange sweet potatoes (very high vitamin A), and fish (cheap, easily available protein). The animals raised — pigs, chickens and ducks — produce maximal protein on minimal feed. They have high conversion ratios and can be fed on scraps, or turned loose to eat the pests and weeds

from the fields, saving money and time on control. The cooking process typically consists of stir-frying or steaming for brief periods on very high heat, making efficient use of time and fuel while not destroying heat-labile nutrients. Even salt is used with maximal efficiency, to pickle or preserve foods, which are added to the meal to season it to taste – salt is almost never applied separately.

Thus we find a traditional regime in equilibrium with the environment, making about the most efficient use of resources that a traditional, unmechanized peasant society can achieve.

Penang Hokkien Diet. During somewhat over seven months of research in Penang Island, Malaysia, we studied the dietary beliefs and attitudes of the Hokkien-speaking Chinese who form the largest single group in the island's population. Here we observed, among other things, the deteriorative modernization so commonly remarked on by writers elsewhere.This was most marked in child diets, but was found throughout the system. Nursing of children, formerly carried on for some years, was being limited to a year or so, depending on how "modern" the family was. The children were weaned onto rice gruel, soft sweets and sweetened condensed milk or other milk products. This diet was exceedingly high in starch and sugar, and very low in all other nutrients – even the commercial milk products being highly diluted, in practice, with sugar and water. Formerly the pattern had been to nurse the children for a longer period, gradually introducing rice gruel and other foods. Commercial, sucrose-rich sweets had not been available and fruit had been the snack food of choice. The result of this dietary change was a spectacularly high incidence of tooth decay, especially of the front teeth (incisors, spreading to canines). Such decay is rare in the U. S., where soft foods and sweets are less prevalent in the child diet, at least after the child is old enough to eat solid food. We did not observe clinical malnutrition – partly because we were studying fishing settlements, where even the youngest child gets at least some fish – but the growth rate of the children was lower than that of American or modern Japanese children. The adults in the modern Hokkien population consumed large amounts of fat, as cooking involved much deep-frying in lard. A family of six would use one-half to one pound of lard a day, and sugar, commercial sweets being very popular. A standard snack was flour-and-water noodles in soup, the soup involving much lard or very fat bacon. While not causing malnutrition, as a lot of meat and vegetables were eaten, this diet led to gross overweight and to continued tooth decay. This diet is in part traditional, the noodles especially being a famous Hokkien dish for hundreds or thousands of years, but has been changed for the worse by a combination of factors. Increased wealth of the community and increased production of meat and sugar has allowed the purchase of much more lard and sweets than could have been bought in traditional days. Why was the extra money not spent on lean meat, fruits and the like? The result is a complex social-structural problem. Lack of nutritional education is part of it, but the main part is the felt need of the community to rise in status by westernizing. This need is created by certain tensions and problems affecting the Penang Hokkien community. Long-established in Malaysia and with weakened ties to traditional Chinese culture, this group is still subject to anti-Chinese sanctions by the Malaysian government, which has in recent years been trying to raise the economic level of the Malays which form about half the population of Malaysia to that of the Chinese which constitute approximately one-third . The remaining one-sixth consists of Indians, aboriginals and Europeans. The economic and political measures taken by the government – in effect, positive discrimination toward Malays in education, government jobs, etc. – has affected the poorer segment of the Chinese community. The Hokkien of Penang have been also hard hit, by the decline of Penang as a port area. Most of the poor Chinese of Penang are members of the old, long-established, somewhat de-Sinicized Hokkien community, and most of these Hokkien are poor where other groups, notably the Cantonese, have been more successful and have remained closer to Chinese culture. The Hokkien see their position as worsening. Left with increasingly vague ties with China, no possibility of being accepted as Malays, and a sense of hopelessness over the economic situation, they have developed feelings of alienation. These have often caused, among other things, a shift in the direction of westernization – other doors to a stable cultural pattern being seen as closed. And the leading edge of westernization in the third world has been white flour, white sugar, soft drinks, candy, cookies and fat. These foods are easy to manufacture; the largest number of factories in any one industry in Malaysia is involved in food-processing, most of them in the production of these foods. In addition there is a large home industry of sweet and noodle-making. These foods are easy to store and to sell in the tiny shops so characteristic of Malayan towns and villages. On the other hand, the excellent, varied, cheap and nutritionally superior fruits that Malaysia produces are seen as both "backward", as they are produced by the more traditional rural districts, and identified with the Malays. Meanwhile, fat has been accepted as a sign of health, indeed of security; a very fat man is thought to be healthy and well-to-do, even psychologically well-off; fat children are desired. This is a considerable exaggeration of a pattern well established in Chinese culture; in old China, some flesh was desired, but not gross overweight. We feel this exaggeration of the traditional pattern is a sign of increased, even perhaps "exaggerated", need for security and reassurance.

The Health Food Syndrome in the United States. With a student, Janet Farley (ms. and pers. comm.) we have done some very preliminary investigating of the rapid shift to health foods and organic foods in the United States. These foods are exceedingly well-established in certain U. S. communities, notably the Seventh-Day Adventists, and have become essentially a part of the traditional folkways of these communities. They have recently been discovered by the young, and are now – as *Time* magazine well puts it – "the Kosher of the counter-culture." This we see as part of a pattern. Along with astrology, magic and so on, the health-food movement is a counter-science; a pseudo-scientific movement, traditional and well elaborated, with its own "authorities" and body of data, and a long heritage, much of it one of identification with the underdog or at least with the dissenter. Disillusioned with the science that has given us the nuclear bomb, the jet plane, biochemical warfare and the Nazi gas oven, the young seek an alternative science. This is in itself interesting; obviously the demons of war are not produced by science per se, but by politicians' use of it. However, American youth has been brought up to think that "Science" has given us these blessings, along with others such as cars and factories, and the idea that technology is an independent force, rather than a tool that can be used or misused, has become firmly rooted. Thus, logically, rejection of war and materialism means rejection of the science that produced it. Specifically, in regard to food, such things as store-bought bread and white sugar, tasteless and overused as they are, are identified with orthodox food science, and thus good food must be sought in the alternative stream. The tasteless, textureless character of much modern food has greatly helped, since whole grain homemade bread, for example, is clearly more interesting to taste as well as theoretically more nourishing. But considerations of aesthetic quality are at best secondary.

Further work on this matter is needed, specifically to correlate involvement in the organic food movement with degree of rejection of orthodox science and other aspects of life that are felt to be in opposition to the counter-culture. (Cf. Deutsch, 1967, for the history of the organic movement and its identification with protest; Deutsch is very unfairly biased against organic foods and the book is far from the objective appraisal needed, but it is the nearest thing we have . All the literature on the subject, as far as we can ascertain, is partisan on one side or the other).

3. Directions for Future Research

Our concern is to relate food habits and patterns to other social concerns, and to explain both, or at least to understand them enough to allow us to make verifiable or disprovable statements about them – in short, to predict changes in food habits as related to other patterns of behavior. This involves understanding of the ecology of agriculture and diet, to prevent the gross mistakes of some developers who have tried to modernize agriculture by making peasants give up food they needed for balanced diets, or introduced changes that upset traditional production of such necessities. It also involves some understanding of the history of the society in question, specifically its economic organization and the distribution of political power within it and between neighbors and contacts.

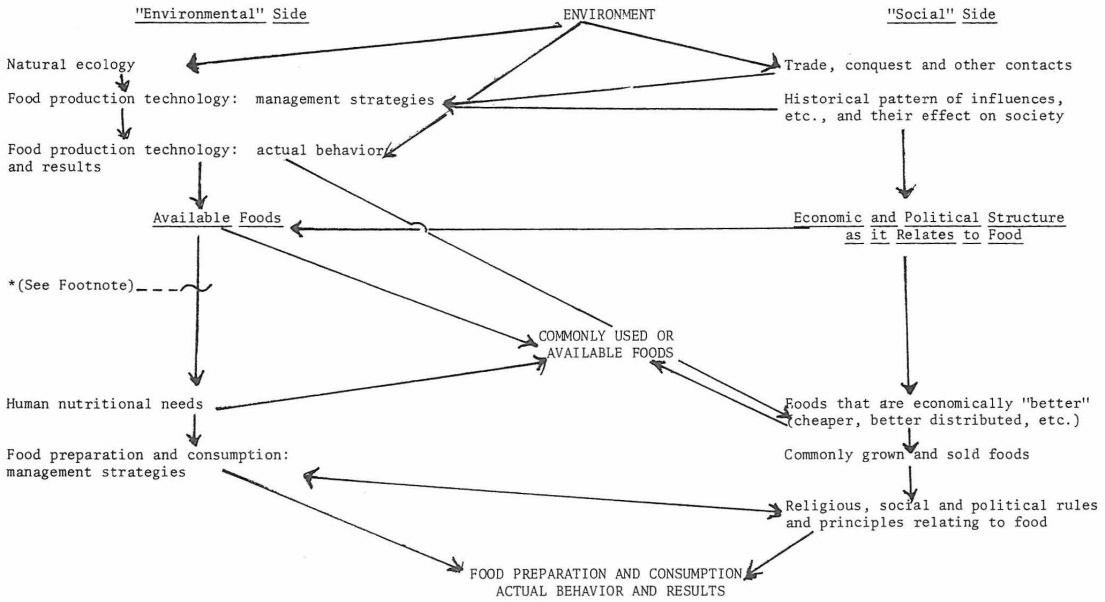
We hope, further, that nutritionists will devote more effort to establishing dietary needs and the effects of various foods and food chemicals. The current acrimonious argument over the merits of vitamin C as a cold-preventer (cf., notably, Pauling, 1970) indicates that even this long-studied and well-known chemical is poorly investigated. To us, as relatively unbiased observers, it seems that both sides are far more dogmatic than the evidence permits; statistically-significantly large samples and adequately controlled experiments are not overly abundant in the reported literature. Similar controversies, less well-publicized but none the less important, are being waged over the minimum calorie requirements of the human organism; requirements for trace minerals; toxicity of a whole range of additives and food chemicals, including naturally-occurring ones like oxalic acid; and many other things. The ratio of dogmatic statements to hard, well-controlled experimental evidence is consistently too high, and the social scientist is somewhat at a loss in evaluating needs. We are also not helped by the lack of field studies of the nutritional status and food consumption patterns of both traditional and non-traditional societies. It seems that the nutritional requirements of the rat and other laboratory rodents are far better known than those of *Homo sapiens.*

4. Very Crude Steps toward a Model

The following schematic diagram has been developed as an extremely rough beginning of a model for guiding research. It is based on a number of models (e. g., those found in the cited works by Levi-Strauss, Harris, et al.) combined and modified in light of our research. We are currently trying to refine it.

And the model concludes with the actual nutritional status of the population as well as its food habits.

It should be noted that change introduced at any point changes everything in the model. However, for convenience we have not drawn in the reverse arrows, for, for example, introducing a new crop often changes everything else as, most spectacularly, when New World food crops like maize and chili peppers were introduced to Asia. Population rose very rapidly, in part through these dietary changes, putting a strain on traditional political systems which had trouble turning out administrative personnel fast enough to govern the population. Ecosystems were stressed, for example, by the shifting -cultivation system, overloaded by increased pressure brought about by population growth. And, of course, food preparation and production were stretched.



*Many investigators believe that adaptation to available foods changes nutritional needs.

Refinement of the model is needed, especially on the "social" side, which is at present hard to quantify and in places debatable. We think we are right in relegating ideology and religion to a very minor position, but this may not be so; other workers disagree. We have also left any "instinctive" or "inborn" factors out, but they may just possibly be relevant.

5. Exhortation

This whole field of concern has grown in our minds because our research has made us more and more aware that food consumption patterns and beliefs must be understood if the world is to be fed. While food production technology is more important, and raising the incomes of the poor is certainly more important, in giving the human race an adequate diet, food consumption cannot be ignored. Some Asian countries, for example, have concentrated on rice production increase because of the belief among both public and leaders that rice is the perfect food. Since protein and certain vitamins and minerals are more generally inadequate than starch and B vitamins in the Asian diet, though starch and the B's are far from sufficient either, this has had a dubious effect – especially when growing more rice means growing less protein, as when insecticides on the rice kill stream fish, or when mechanizing rice agriculture means growing few buffaloes in an area dependent on retired plow-buffaloes for meat. Another unexpected problem was found in analysis of fishing development; we found that many tropical fishermen make their real profits from sales of high-priced "luxury" fish, and thus fishing development is hindered, through lack of capital, in areas where meat is the prestige food. We assume, contrariwise, that the livestock industry has more potential in these areas than it does where a feast means gorging on high-price seafood. Such things can affect the entire economy and are more complicated and, therefore, more interesting even than such changes in taste as the worldwide Sucrose Revolution with its legacy of carious teeth.

– *E. N. Anderson, Jr.*
Marja L. Anderson
University of California, Riverside

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UPDATE ON JOURNAL TWO

"A Water Pumping Windmill That Works." pp. 21-27.

The design has undergone a number of changes since original publication. For example, we have found that while the automobile crankshaft is the least expensive strategy for translating rotary to reciprocal action, it is not as durable as we had hoped. We now are using staying, higher quality bearings and a "flywheel" reciprocating rod attachment to increase the mill's ruggedness. If you intend to build this mill, consult update in JOURNAL THREE or contact us.

"New Alchemy's Ark." pp. 35-43.

This design has been changed considerably. JOURNAL THREE contains a current brief, but accurate, description. JOURNAL FOUR will give a detailed account of design and construction. If a drawing of the Cape Cod Ark would be useful to you, send us a stamped self-addressed envelope with your request.

"Towards a Self-Sustaining Agriculture." pp. 44-61.

This article is from Radical Agriculture by Richard Merrill to be published by Harper & Row, August 1976.

"Walton Two: A Compleat Guide to Backyard Fish Farming." pp. 79-117.

p. 88: Dome covering materials: We are now using a greenhouse fiberglass material (two layers separated by 3/4" batons) manufactured by Kalwall Corporation.

p. 90: Life Support Systems is out of business, as far as we know.

p. 101, column 2, paragraph 4: We have found that some filamentous algae, at least, are eaten by our tilapia. They might be suitable for introduction directly into the system, but only after testing to see whether your fish will eat them.

Update on Fish Suppliers Listed on Page 103.

p. 103, paragraphs 1-3: Both Cal Hollis and Ray Fuller have had difficulty filling orders for tilapia. The only sources we can currently recommend are:

Tilapia: Lake Annette Fish Hatchery and Farms
P.O. Box 5665
Greenville, Mississippi 38701

Israeli Carp: Perry Minnow Farm
R.F.D. #1, Box 1015
Windsor, Virginia 23487

We may still be able to supply a few fish, as described on this page, but New Alchemy-West definitely cannot.

p. 103 (cont.): Predators: Large mouth bass (4"-5" in length) were effective predators in one pond in 1974, withstanding high pond temperatures.

p. 104, paragraph 1: We also recommend Delta Net and Twine Co., P.O. Box 356, Greenville, Mississippi 38701.

p. 108: Postscript to feeding instructions: If you cannot obtain supplemental feeds readily, a small amount of commercial floating trout or catfish chow will enhance fish growth. Be sure to use floating pellets so that consumption by the fish can be watched. Do not feed more than they can ingest in a few minutes. Purina and other feed dealers handle fish feeds.

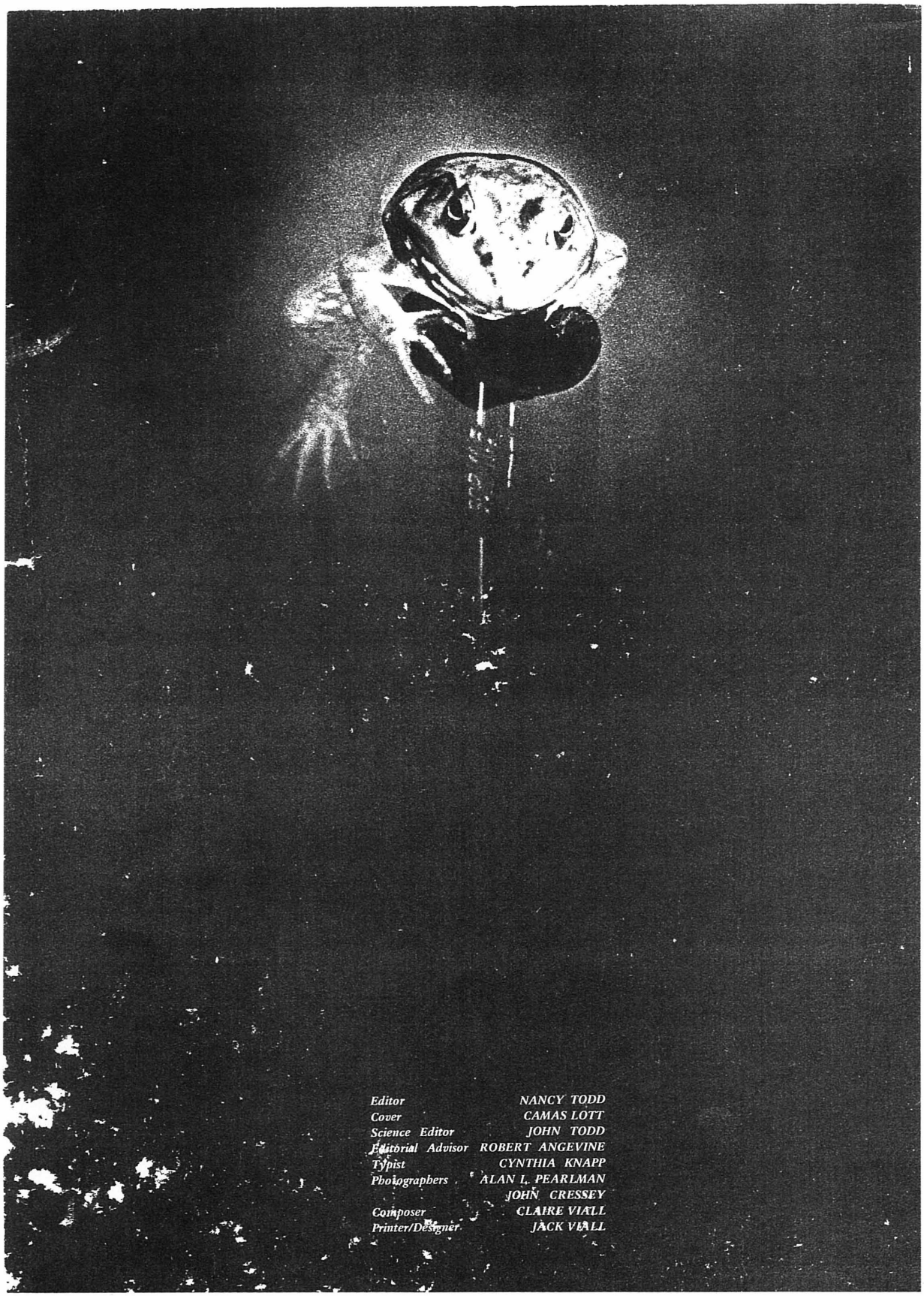
p. 111, Reference no. 5: McLarney, Henderson and Sherman is no longer in press, but has been published. The full citation is: McLarney, W. O., S. Henderson and M. M. Sherman. 1974. A new method for culturing *Chironomus tentans* Fabricius larvae using burlap substrate in fertilized pools. Aquaculture 4(1974): 267-276.

p. 119, Reference no. 4: Same as above.

Wintertree

Wizened magic-man
Catches Sadness in gnarled hands,
Crumbles it to a fine frozen powder
And, tossing it into a dark sky,
Makes stars.

— Don Esty



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