THE LAND REPORT

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THE COVER was designed and sketched by Iralee Barnard, Hope, Kansas. Iralee illustrated the Smoky Hills Audubon Society publication, Favorite Prairie Wild Flowers and Grasses, and has designed note cards featuring prairie wild flowers. Her sketches have appeared in previous Land Reports and can be seen on pages 5 and 6 of this issue.

At The Land...

The Student Program: Eight Semesters Completed

The spring 1980 semester, running from February 13 to June 1, was the eighth semester in the history of The Land Institute. There were five new students: Michael Chapman (a student at the University of California, Santa Cruz), Deb Parks (a graduate of Augustana College, Sioux Falls, S.D.), Bill Craig (Kansas State University student) and Stan Tippan and Phyllis Bos (Kansas Wesleyan students). Four research associates continued their work from the first semester: Kelly Kindscher (a graduate of the University of Kansas), Pam Ellinghausen and Mari Peterson (Augustana College, Sioux Falls, S.D. graduates), and Marty Bender (graduate of Wittenberg Univ. in Springfield, Ohio). Sometimes they met as two groups, but we usually began the day at 9:00 A.M. as one group in a general session. During the term, the research associates each conducted several classes on such topics as prairie ecology, organic farming, food cooperatives, soft energy path economics and wind energy systems.

The Land semester is structured to spend approximately half the time in intellectual pursuit and half the time working physically. During the cold, wet and muddy weeks of February and March, most of the time was spent in-

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The Land Institute is a non-profit educational-research organization devoted to a search for sustainable alternatives: agriculture, energy, shelter, waste management.

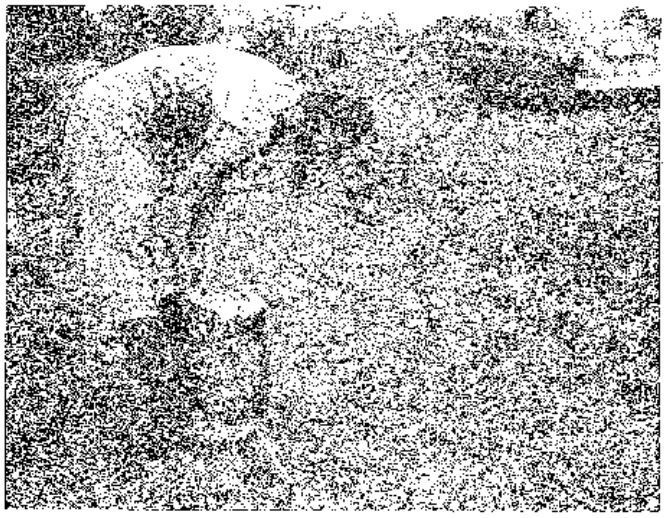
side in reading and discussion with some physical work being done on the greenhouse. But in April and May, sweating and tanning began as students helped plant the new rows in the herbary and the new experimental plots, and much less time was spent in class sessions.

The Land Institute semester is different from a regular college class. There are some assigned readings, both for the group as a whole, and on an individual basis, but the student is expected to be self-motivated and read widely on his own from the books and magazines in the Land library. At the first gathering each morning, everyone is encouraged to share that individual reading. As individual projects are chosen and developed, the reading becomes more specialized for each person. From time to time, the class goes to Manhattan, Kansas to use the Kansas State University library.

During this eighth semester there were not as many assigned readings as former classes had. We try to structure the curriculum with enough flexibility that students can help mold it to meet their interests. Some groups prefer more traditional class structure than others.

There are no tests. If students are taking The Land semester for college credit (Kansas Wesleyan and Marymount Colleges in Salina grant undergraduate credit and Emporia State University grants graduate credit), Wes and Dana Jackson evaluate their work based on class participation, individual interviews, physical projects, and articles for The Land Report, which students with individual projects are expected to write.

The physical work part of our Land semester is done on individual projects and by helping with the ongoing research and maintenance of The Land Institute. We encourage students to choose their own physical projects, as they tend to be more fulfilling, but if they do not develop projects, they are expected to do whatever is needed. This spring students moved batteries, (over



Pam Ellinghausen

Stan Tippin, Marty Bender, Bill Craig

300 pounds each), rototilled, raked, planted the new herbary rows and the new experimental plots south and east of the Indian House. While preparing for our Prairie Festival they mowed, weeded, helped mulch the garden, built outhouses, made signs, and helped wire extra lights and power to the area for the musicians performance.

Each semester there are visitors who come to make presentations or lead discussions, and this semester was no exception. Craig Birrell came to talk about the farmers' market in Concordia, Kansas last summer. Ron Henricks, from the energy project of Kansas Legal Services, talked to students about electric utility rates and the issues related to rural electric cooperatives in Kansas buying 17% of the Wolf Creek Nuclear Plant. Dave Martin, Solar Energy Coordinator from the Kansas Energy Office spent a morning at The Land talking about educational and demonstration projects in solar and wind in Kansas and legislation relating to renewable energy. Mike and Ferris Weber, from Sacramento California, stopped to visit on their vacation, and Mike told about his work as the science curriculum coordinator in the Sacramento City school District and the school nature areas he helped establish. Bill and Jan Whitney from Aurora, Nebraska shared their interest in prairie restoration. Nick Fent, Saline County geologist and naturalist, talked about the minerals and fossil organisms he finds while drilling water wells. Diane Togtmeier explained what it is like to be a volunteer environmental lobbiest in the Kansas legislature. Former student Jim Peterson gave a talk about the history of agrarian political movements. Aaron Blair described his epidemological studies at the National Cancer Institute. The students also traveled to Aaron's parents' farm in Republic County to learn about work horses from Bernard Flair, and they visited Leland Lorenzon near

Canton, Kansas. One morning they were shown through Alternative Energy Sources, Inc. by Jim Wesch and learned about the solar hot water heaters and wood-burning stoves and furnaces sells.

Students do not live at The Land, but sometimes they share apartments or a house in town, as did Deb, Michael, Bill and Kelly this semester. Most of them car pool or bicycle out (about 6 miles) in good weather. They are invited to use any ripe vegetables in the garden; and this spring rhubarb, radishes and onions, lettuce, spinach and chard were available. Once a week Dana Jackson usually fixed a kettle of soup and some loaves of bread and we all had lunch together in the Jackson house.

Each semester's program is different, because the different backgrounds and interests of students influence what we do. Yet, we notice when former students visit, they fit in well with whatever discussion or activity the current group is engaged in. They care about the earth. They try to live lightly. They want to help make changes and search for alternatives which lead to a sustainable livelihood for future generations.

The Fall 1980 semester begins September 4. The Land admits students of any race, color and national or ethnic origin. We recommend that applicants have completed at least one year of college. To apply, write a letter describing past academic work, job experience, interests and goals to Wes Jackson, The Land Institute, Rt. 3, Salina, Kansas 67401. Call (913) 823-8967 for appointments to visit.

Deb Parks in the garden.

New Board Members Elected

At the annual meeting of The Land Institute and the Land Institute Board of Directors on June 9, 1980, four persons were elected to three year terms on the Board of Directors: James Forsythe, Richard Courter, Dwight Platt and Terry Evans. They replace Frank Anderson, Nancy Miller, Sam Evans and Wendell Nickell, who retired from the board. Serving for two more years are Karen Black, Steve Burr, John Simpson and Dana Jackson. Board members with one year remaining in their terms are John Schwartz, Bernd Foerster, Gordon Maxwell and Wes Jackson.

The board also voted to ask three individuals to become honorary members of the board of directors: Paul Sears, Carter Henderson, and John Todd. Currently in the honorary category are Amory Lovins and David Brower. E.F. Schumacher was an honorary member before his death in 1977.

Grants Are Received

The Land Institute is funded primarily through tuition payments and private donations from Friends of The Land. During the Spring semester, 1980, we made several proposals to private foundations for assistance on special projects. The Youth Project granted $2000 for planning The Great Plains in Transition Project and $2500 for County Energy Planning (shared with MACEA). The Organic Gardening and Farming Research Center granted $4000 for research on perennial polycultures. The Land Report received $1000 from the Joyce Foundation.

One day in February, during a blizzard, we began to think about blooming wild flowers and grasses when Mrs. Edith Muma called to announce a special $8000 grant from the Jessie Smith Noyes Foundation for the prairie herbary. This grant provides a salary for a part-time herbary director and funds for equipment and travel. This spring we purchased a new Roto Hoe from Herbary funds.

The Land Institute was especially pleased to receive a letter from the Jessie Smith Noyes Foundation in May stating that they had approved a renewal grant of $26,000 for tuition and stipends for the academic year 80/81. Of this amount, $10,000 is intended to provide tuition for five students for two semesters each, and $16,000 is awarded as two $8,000 stipends for two graduate students assisting in the areas of appropriate technology and county energy planning. Mari Peterson will receive the stipend for county energy planning. The appropriate technologist is yet to be chosen. The letter stated: "In renewing this grant, the Foundation reaffirms its belief in the importance of the development of appropriate technologies for provision of food, energy and shelter."

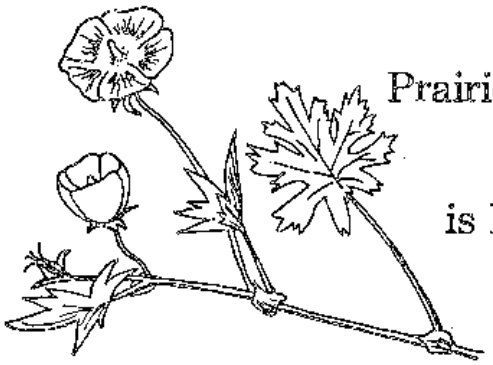
In Memory of Rev. W. E. Cassell

Dana Jackson

Wes and I first began learning from Rev. W. E. Cassell as freshmen at Kansas Wesleyan in 1954 and 1955, and we continued learning from him until his death on April 23, 1980. When we began The Land Institute in the fall of 1976, he agreed to serve on our first board of directors. A scholar in the classics, in the Old and New Testament, Rev. Cassell was also familiar with the Club of Rome study, The Limits of Growth, and he understood our serious desire to search for alternatives in agriculture, energy, shelter and waste management.

One of our most valued resources at The Land Institute is a set of three tapes, made when Brother Cassell spent a morning on December 10, 1976, talking to our students. Many of his endearing qualities come across on those tapes: the way he rolled his r's, his Kentucky "cain't," his affection for a red Irish Setter, his way of saying, "You follow?" or "Did you get that?" and his unparalleled ability as a teacher. "Do you know what Armageddon is? No?...Well, now, we'll just have to make you literrrrate." He took the students from the Bible to Rosseau to Nietzsche to the Bhagavad Gita, explaining the origin of words such as "eschatology" or "epistemology" with a sense of humor and a sense of drama.

It was a privilege to have known Rev. Cassell for 25 years and to have him associated with The Land Institute.



Prairie Herbary is Planted

The Land Institute is establishing a prairie herbary. The word "herbary" is defined in Webster's Third International Dictionary as a garden of herbs or vegetables." We have applied this archaic word to our garden of perennial prairie plants, many of which were used as cooking herbs or vegetables by the American Indians. Our herbary will contain as many perennial native and naturalized grasses and wild flowers of the prairie states as is possible to grow and maintain. The herbary will be similar to an arboretum in its educational usefulness, but it will also be important in our research devoted to the development of alternative crops. It will serve as a savings bank or germplasm nursery of native herbaceous perennial plants.

The Director of the Land Institute Prairie Herbary is Marty Bender.

Establishing the Prairie Perennials

In the spring of 1978, The Land Institute students planted forty prairie plant species in rows five meters long, and we were pleased that thirty seven of them were successfully established. This first modest effort was supported out of our general funds. This spring we received an $8000 grant through the Jessie Smith Noyes Foundation's special discretionary funds to extend the experimental plots and create, as far as we know, the first herbary of native prairie perennials.

Two hundred rows were planted this spring with seeds obtained from the Soil Conservation Service Plant Materials Center in Manhattan, Kansas, and from Marty Bender's field collections in Kansas, Oklahoma, Nebraska, Texas, New Mexico, Missouri, Ohio and Mexico (yes, there are prairies in all of these places). We also transplanted seedlings of about thirty prairie species that were donated to us by the Prairie Plains Resource Institute in Aurora, Nebraska. We would greatly appreciate donations of seeds, since field collections in unfamiliar locations depend more often than not on an eagle eye from the driver's seat and on the chance that wind and rain have not scattered all of the seeds. Next spring we will start our seeds in peat cups in our solar greenhouse.

Using the Herbary for Research

In the search for alternatives in agriculture, The Land Institute will use the inventory of perennial plants in the herbary as candidates to be included in polyculture research, which is explained in detail elsewhere in this issue. By having the plants in the field, we can record observations on the growth habits, the times of flowering and seed maturity, seed shattering, etc. By collecting the seeds from the five meter rows, relative seed yields can be determined. The seeds can also be used in experiments.

Using the Herbary for Educational Programs

It seems to us that teachers are reluctant to take students into the field or to utilize a nature area if they do not know the names of the plants. Our prairie herbary, with the names of species clearly marked, will provide an efficient laboratory for teachers to learn the plants. As soon as the herbary is well enough established, we plan to offer short plant identification workshops for both elementary and secondary teachers. We will also conduct tours of the herbary and present information on the role of the plant species in (a) developing the ecological capital, the soil, on which most of American agriculture rests, (b) as a source of future germplast for a perennial agriculture, (c) as entities which exist for their own sake, independent of the needs of Homo sapiens. Regular students at The Land Institute will be expected to learn the plants from staff members who do know them and to assist as tour guides.

Eventually The Land would like to develop special programs for students at various grade levels and design the herbary tours to meet their interests and abilities. Follow-up materials for the classroom can be prepared in consultation with the teachers. Although we plan to pattern activities after those at children's museums and planetariums, there will be a tremendous opportunity for creative uses of the herbary.

Perhaps in the future The Land can also provide moderate amounts of seeds to schools and nature centers for prairie re-establishment projects and compile a catalogue describing the plants for which seed are available and directions for cultivating these plants based on actual experience at The Land.

The Value of Prairie Plants

The desire to set aside prairie areas has been primarily motivated by an appreciation of the prairie's natural beauty. At The Land we are also motivated by the important practical value of prairie plants. We see the prairie as a standard against which to judge our agricultural practices, and we seek to understand what elements in that steady-state economy can be adapted to create a sustainable agriculture, rather than the wasteful one we have developed.

Dear Mr. & Mrs. Jackson,

Thank you for showing us the ways that we can get different sources of energy. I thought the way the sun was related to the way things grow was neat.

Sincerely,

Laird Garner

Dear Mr. & Mrs. Jackson,

Thanks for showing us your Land Institute. I like the batteries the best.

Sincerely,

Linda Scanlan

Dear Mrs. Jackson,

Thank you for showing us around the Land Institute. I liked the prairie flowers the best.

Sincerely,

Polly Adams

Alternatives in Agriculture

Biological Intensification of Agriculture: Polycultures

Kelly Kindscher

It is easy for those of us searching for a sustainable agriculture to talk of a de-centralized, utopian, future agriculture. It is difficult to see the path for the agricultural transformation that must take place. The problems of soil erosion, chemical contamination of our food and land, and the excessive energy usage that our present agricultural practices create are obvious. It is time to change our agriculture. This paper will suggest the use of biologically-intensive cropping systems or polycultures as one step towards a sustainable agriculture.

A polyculture can be defined as any area of land that is being used for more than one crop at a time. Polycultures offer many advantages over monoculture. Their use will gradually increase when it is shown that biologically complex cropping systems can substitute for the chemical control (especially the use of pesticides and chemical fertilizers) of our present agriculture. When this begins to happen, our present agriculture will evolve into an organic agriculture (see figure 1). With a further increase in biological complexity, the energy-intensive, mechanical aspect of our present agriculture can be greatly reduced. Then, we will be using organic polycultures of annual and perennial plants and be well on our way to a more sustainable agriculture.

The History of Polycultures in America

The Native Americans often grew corn, beans, and squash in polycultures. Their mixed plantings made better use of space. Their methods varied from tribe to tribe. The Omaha planted seven kernels of corn in one hill and squash seeds in the next and so on, alternating across their fields. If ground space were limited, beans were planted with the corn, the stalk serving the same purpose as poles.[1] The Seneca planted every seventh hill in their cornfields to squash and beans. Their rationale was not based upon some agronomic principle, but "because it was thought that the spirits of these three plants were inseparable."[2]

The early American colonists grew their corn in polycultures as they learned from the first inhabitants of the land. Small grains, such as wheat and rye, were grown in monoculture. But their acreages were quite small, being determined by the amount of time and work it took to harvest.

The introduction of machinery, especially the horse-drawn cultivator, the reaper, and the thresher changed agriculture. A lot of tedious work was eliminated and production per farmer increased. However, the increased complexity of technology meant a decrease in the complexity of the arrangement and number of crops grown. Monocultures became a necessity. With the further development of mechanical technology, allowing yet larger farming operations, chemical technology, through the use of synthetic fertilizers and pesticides, replaced biological technology.

Benefits of Polycultures

Monoculture allows for the isolation of one plant from all others. This is the simplest cropping system, but seldom found in nature. It is the easiest to manipulate because the only interactions are between plants of the same species, unless, lack of cultivation or soil preparation has allowed the field to become weedy. But in a monoculture, simplicity is also its weakness, and so mechanical and chemical surrogates are needed to compensate for the lack of biological diversity.

Natural plant communities are diverse. A sustainable agriculture will replicate the natural vegetation of an area to as great a degree as possible. This replication process will almost certainly mean the use of polycultures. Polycultures are characterized by balance and stability. This is their true strength.

Most of the recent research on polycultures has been done in tropical, third-world countries where climate, economics, labor, and mechanization are quite different from the U.S. However,

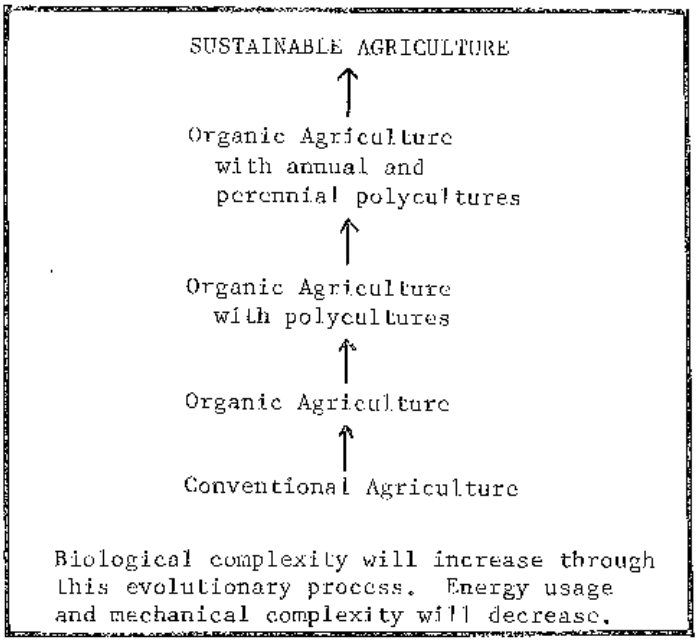


figure 1

the basic biological processes are very informative. This research, along with the few recent studies on polycultures in temperate North America, shows the advantages and potentials of polycultures. Donald Kass, in his review and analysis of polyculture cropping systems concluded:

> . . . definite advantages over monoculture exist. In terms of withdrawal of nutrients from the soil, economic return, improvement of nitrogen status of the soil-plant system when one of the crops is a legume, and greater stability of yields over time, the benefits of polyculture are clear.[3]

Some studies have shown that polycultures offer other advantages too: higher crop yields,[4] more efficient water use,[5] reduced soil erosion,[6] decrease in pest loss,[7] less competition from weeds,[8] better use of light,[9] an increase in beneficial soil bacteria,[10] and a larger supply of local, fresh food.[11]

The greatest advantage of polycultures may be that more than one parameter can be maximized: for instance, the yield of one component crop and protein content of another component crop. Probably no polyculture cropping scheme could have all of the above advantages. But many of the above advantages could be gained through proper selection of crops, careful arrangement in the field, and proper timing. The potential of polycultures can be seen. Further research and experimentation are needed.

Crop Competition

In a polyculture there is more than one species of plant growing in the field at one time. It must be determined how much the different crop components interfere or compete with each other. Basically, crops that can biologically complement each other or can self-compensate, that is, respond positively to the presence of another crop, are the ones to be selected for polyculture cropping schemes. For instance, a corn-bean crop mixture is better suited for a polyculture than other crop mixtures.

Polycultures are most advantageous when inter-specific (between crop) competition is less than intra-specific (within crop) competition. As an example, if the competition between a corn and a bean plant, at a given population, is less than the competition between two corn plants, then there will probably be an advantage to growing them together. In most cases, the reduced competition allows for a higher overall plant population, thus allowing for higher yields.

Yields and Land Equivalent Ratios

The highest yield of a crop per acre will usually occur when that crop is grown by itself, in monoculture. The highest total yield of two or more crops per acre will usually occur in polyculture. When two crops are grown together, their individual yields are often less than the monoculture yield for the same area. To compare yields of a polyculture to a monoculture, a land equivalent ratio is used. This is calculated:

$$\frac{\text{Yield of crop A in polyculture}}{\text{Yield of crop A in monoculture}} + \frac{\text{Yield of crop B in polyculture}}{\text{Yield of crop B in monoculture}}$$

An interpretation of the land equivalent ratio is the number of acres of monocrops needed to produce a yield equal to one acre of the crops grown in polyculture (see figure 2).

The Mechanical Dilemma

Polycultures can have higher yields, but the crop mixture may be difficult to harvest. The mechanical dilemma that a polyculture causes can be illustrated by an experience that occurred when my father planted pumpkins in one of our milo (grain sorghum) fields.

There were some places where the milo stand was uneven, so my father planted pumpkin seeds in between the milo plants. At milo harvest time, our neighbor was out cutting our milo for us with his fourteen foot wide combine, when all of the sudden he stopped and yelled to us over at the truck: "Hey, there's pumpkins out here!" We hurriedly drove the pickup out to the middle of the field and picked the pumpkins, most of which were still green. It amused me later to think of how those pumpkins stopped that acre-eating machine right in its tracks.

A bean-corn polyculture causes a similar mechanical dilemma. But it can be more easily solved, due to the nature of the crops involved. A combine would not have to be altered too much to be able to harvest both corn and beans at the same time. Since our agriculture has achieved a high level of mechanical complexity, it seems that we are capable of developing machinery for polycultures. This is a task for the mechanical engineers. It is encouraging that recent research, aimed at reducing the difficulties of a mechanized harvest of polycultures, has been quite successful.[12]

What we have done is try to perfect monoculture to fit our mechanical agriculture. Mechanical complexity has replaced biological complexity. Large-scale mechanization of agriculture has only been possible with our energy-affluent times. And when the realization of an energy-scarce future occurs, our agriculture will change. To meet this change, we need to develop machines capable of handling biologically-complex polycultures. At the same time, we need to begin developing polycultures that are self-maintaining and needing little mechanical control. It will be the development of self-maintaining polycultures that brings us closer to a sustainable agriculture.

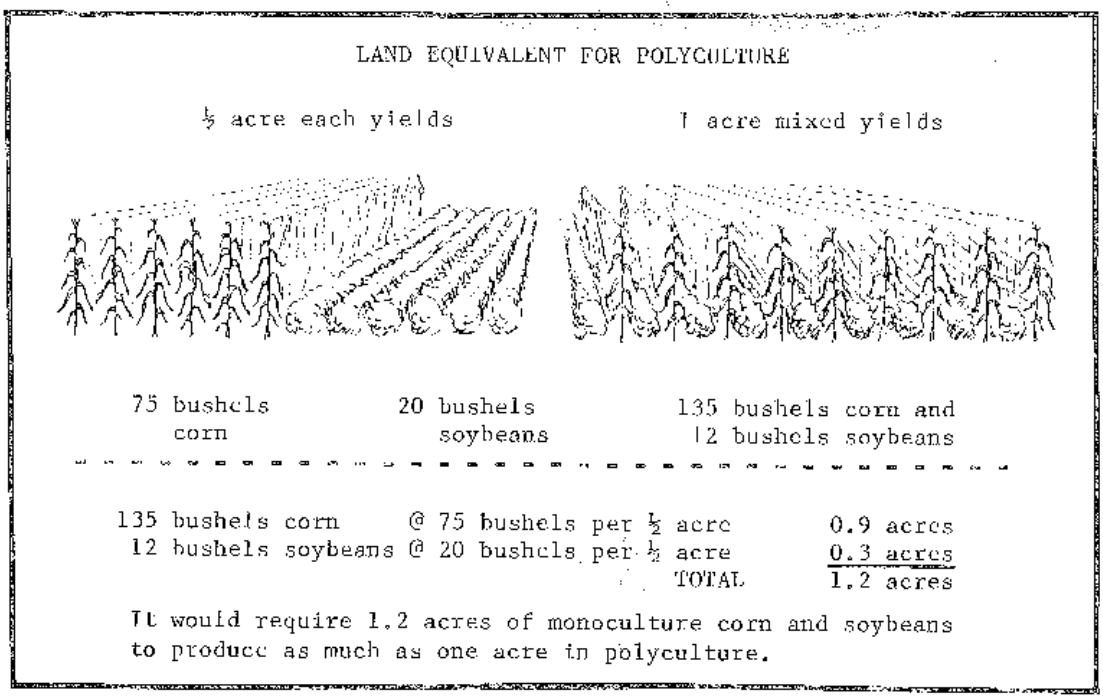


figure 2

Grain-legume Polycultures

Traditionally, legumes, a high protein food source, have been important in cropping systems. They help maintain soil fertility through their symbiotic relationship with nitrogen-fixing bacteria and are valuable as a soil-conserving cover crop. Legumes can become the basis for self-maintaining cropping systems. For these reasons, legumes will play a major role in polycultures.

In a grain and a legume polyculture, component crops, such as corn and beans, can form a beneficial relationship. They have complementary rooting systems, the corn plant being a surface feeder and the bean plant having more of a deep-rooted nature. Together they can take advantage of a larger reservoir of soil moisture and nutrients. Also, beans can quickly shade the ground, preventing competition from weeds. This has led to a yield increase in a mung bean-corn polyculture.[13]

Beans are nitrogen self-sufficient and will not compete with the heavy nitrogen-feeding corn for this nutrient. They can produce nitrogen that can be used by a following crop. However, a large portion of their nitrogen goes into seed production and if shaded, nitrogen production may decrease. In an experiment in Nigeria, growing greem gram (a tropical bean) with corn, the bean supplied the corn with nitrogen during the growing season.[14] This may be possible with other legumes if they mature before the corn crop and their nodules start to decay, releasing nitrogen to the soil.

A corn-bean polyculture is probably most beneficial at a low fertility level because added nitrogen only helps the corn crop. An experiment in the Phillipines showed that the greatest yield advantage for a corn-soybean polyculture came when no nitrogen fertilizer was added.[15] But highest corn yields come with a higher nitrogen fertilizer application. With a high level of management (application of fertilizer and pesticides) there have been some instances of no yield advantages using corn-soybean polycultures.[16,17]

Some experiments have shown that beans have not reduced corn yields from what they would have been in monoculture. Experiments in Colombia have shown that even with a high level of management, beans did not reduce corn yields. There was also the yield of beans, creating a land equivalent ratio of greater than one[18] (see figure 2).

Our food production process is very energy-intensive, requiring large amounts of fertilizer, water, pesticides, and tillage. These practices will change when we begin to pay the true costs for energy. So we need to look at methods of food production that can give us adequate yields with less mechanical and chemical control. Polycultures may provide part of the solution to this problem.

Clover--to Maintain Polyculture Fertility

The transition from an energy-intensive agriculture that is mechanically and chemically controlled to a biologically-intensive agriculture that is maintained by the plants themselves will be a gradual process. The transition will start with the introduction of biologically-intensive farming practices.

One example is the use of self-seeding clovers, like yellow sweet clover, to keep soil nitrogen levels high. Sweet clover seed can remain viable in the soil for many years and a

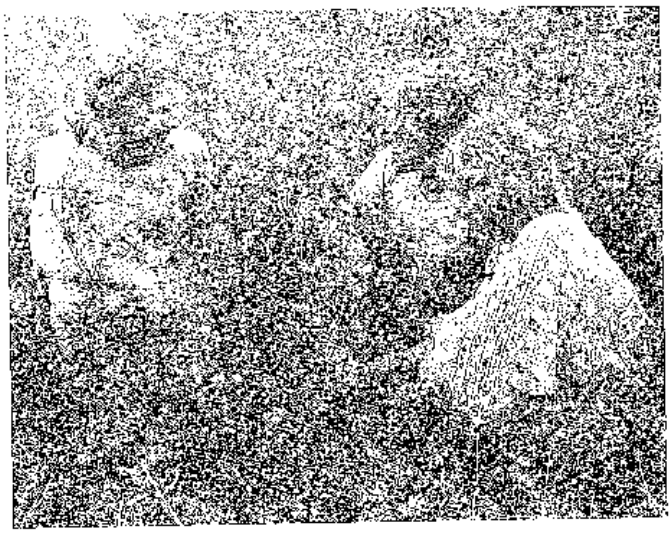
field that has had sweet clover go to seed on it will have sweet clover come up every year. This is the case on my father's farm, in south-central Nebraska.

Three years ago, we had a field of wheat on clayish soil that received the standard fertilization of nitrogen and phosphorus for our area. As the wheat was just starting its most vigorous growth, the sweet clover seed germinated and started to come up. By wheat harvest time, the clover was two-thirds as high as the wheat. Apparently, the clover interfered little with the wheat as it yielded 40 bushels per acre, a larger than normal yield. After harvest, the clover kept on growing, along with a few weeds, until frost.

Sweet clover is a biennial and makes rather rapid growth its second year before blooming. The clover made a good start in the Spring and when I disked the wheat stubble and clover mixture in April, getting the ground ready to plant milo, the clover was over a foot tall and already getting stemmy and tough. The disk rode over most of the clover, and by the time that it was all finally cut up and incorporated into the soil, it was already May and the clover had started to bloom. Nitrogen-fixation is highest during the blooming period. We planted the milo in the wheat stubble and clover mulch, using a lister, and as it grew, it looked good enough that we did not side dress it with nitrogen fertilizer as usual. Just before the milo headed out, it was a little yellow, showing a nitrogen deficiency. This probably was due to nitrogen being tied up in the decay process of the organic matter in the soil. But this was apparently only a short-lived phenomenon, as the milo went on to yield 88 bushels per acre, a larger than average yield.

In the above example, the clover growing in the wheat is an example of a polyculture forming a biologically-intensive cropping system, that begins to replace the energy-intensive one, in this case, the use of chemical fertilizer. It is also an example of a polyculture made up of a food-producing component and a soil-enriching component.

The sustainability of a wheat-clover polyculture followed by milo cropping system is unknown. This was only an observation, not an actual experiment. It does show there are a lot of unanswered questions and that a more biologically-intensive cropping system is adaptable to a highly mechanized farming operation. And as the price of fertilizer increases, reflecting the price increase of the energy needed to manufacture it, practices such as this one may become more common. Clover-wheat and other polycultures that include a legume can reduce the need of the chemical component of our agriculture--nitrogen fertilizer.



Kelly, Michael, & Sara Jackson looking at clover.

Pest Control

Polycultures also have the potential of reducing and possibly eliminating the use of pesticides. There are many examples of decreased insect damage through the use of polycultures. In an experiment in the Phillipines, intercropping peanuts and corn greatly reduced corn borer infestation. This reduction was attributed to the increased effectiveness of the predators in the corn-peanut intercrop.[19] In another experiment with corn, scientists at the Centro Internacional de Agricultura Tropical in Columbia found that the incidence of fall armyworm damage was reduced 88% when beans were planted 20 to 40 days before corn in a corn-bean polyculture.[20]

Polycultures can reduce pest losses because they increase the diversity of crop species. It has been shown that species diversity is an important factor in preventing population outbreaks in insects.[21] The use of polycultures to reduce pest losses is another example of using biologically-intensive cropping systems to substitute for chemical control.

Biologically-intensive Cropping Systems

Masanobu Fukuoka has developed a biologically-intensive cropping system in Japan that has proven itself over time. He does not till the soil and needs only minimal mechanization. His yearly cropping sequence is as follows.

In the fall, white clover and winter grain (either rye or barley) are broadcast into standing rice. The rice is harvested, threshed, and the straw is put back onto the field on top of the young seedlings. Rice seed is directly seeded into the field so that transplanting is unnecessary. It is broadcast into the winter grain in either late fall or early spring. In late spring, the winter grain is harvested, the straw is returned to the field, and a little manure is added. The field is flooded to ger-

minate the rice and stunt the growth of clover, and the cyclical process is started over again.

It has taken Fukuoka thirty years to develop this biologically-intensive cropping system. Yields are impressive, 22 bushels per quarter acre for both rice and the winter grain crops. At times, rice yields reach 29 bushels per quarter acre, possibly the highest in Japan. This system produces enough food to support five to ten people, each investing an average of less than one hour of labor a day.[22]

Fukuoka is using rice as his main crop and is working under different climatic conditions, which may offer him some particular advantages. Nevertheless, his system could possibly serve as a model for the development of biologically-intensive cropping systems for our own climatic conditions. Perhaps the most important aspect of his work is the demonstration that tillage, pesticides, chemical fertilizers, and large machines are not necessary to produce our food. Nor do the alternatives to our present practices necessitate slave labor or starvation.

Conclusion

Biological intensification of our agriculture through the use of polycultures offers many advantages. This paper discussed only the most simple polycultures, those with two crop components, but polycultures made up of several crop components would be more diverse and may offer further advantages. Polycultures can have more than just grains and legumes as vegetables, fruits, herbs, flowers and other crops could also be included. Perennial crops will probably play an important role in polycultures. Fruit and nut trees may be planted with other crops. Crop land that is subject to erosion may be planted to polycultures of perennial grain crops, such as those being developed here at The Land Institute.

Biological intensification of our agriculture through the use of polycultures can lead us towards a sustainable agriculture. Polycultures can provide us the potential to eliminate agricultural chemicals and to greatly reduce the use of energy-intensive machines. Larger machines can be replaced by smaller, more human-scaled machines as we develop a truly appropriate agricultural technology to complement our polycultures. In the future, people may decide that it is cheaper, easier, and more satisfying to work with polycultures rather than with chemicals and machines.

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Building a Compost Pile

Stan Tippin

Composting is the biological breakdown of organic material. The organic material in the early stages of decomposition represents the remains of all kinds of plants, animals and microbes. In its final stage the organic matter becomes humus, a complex, fine, colloidal material. The use of compost as fertilizer-mulch in the garden benefits the soil and the growth of plants.

Compost forms a granular structure which allows a soil to hold more air and water. This change means the soil will be easier to work, be less likely to erode, and will protect plants from drought. The chemical and physical activity of the organic matter also results in fewer nutrients leaching out, so a readily-available supply of minerals and nutrients are there for the plant to use in developing root systems thoroughly.

Due to its biological nature, the compost process is limited by environmental factors. Some of these constraints are moisture, temperature, PH level, nutrient concentration and availability, and oxygen concentration. As soon as the compost pile is completed, a fermentation process occurs in which excess energy of microbial activity is given off in the insulated mass of compost, causing an increase in heat. The temperature reaches 160 degrees Fahrenheit and stays this hot for a couple of weeks until the organic matter has been broken down, at which time the bacterial activity declines along with the temperature. The high temperatures during composting destroy pathogens and weed seeds.

One can make use of almost any kind of available organic materials in a compost pile, but it is good to have a balance of the important nutrients: carbon, nitrogen and phosphorus. The most advantageous time to prepare compost is in the spring or autumn. Michael Chapman directed the construction of a compost pile at The Land this spring, and the compost method we used is briefly described below.

First, loosen the ground where the compost pile is to be in order to ensure good drainage and start the action of organisms. Then place a layer of sunflower stalks on the ground for a base and to allow for air flow through the pile. Next put a post in the middle of the pile and proceed by adding a layer of green vegetation: weeds, food scraps, grass clippings, etc. (we used discarded lettuce and cabbage trimmings from a supermarket produce department as we began the pile fairly early in spring before there was much green vegetation). After the one to two inch layer of green vegetation, add

Michael Chapman and Stan Tippin

a one to two inch layer of manure (or other source of nitrogen), followed by one to inches of soil. Continue alternating the ingredients in thin, even layers until you have made a pile at least 3 X 3 X 3 feet high. As each layer is added, water it lightly to hasten decomposition. Pull out the post to allow air to circulate in the pile, then cover the pile with straw to help hold in the moisture. The pile should be watered regularly and turned to allow for better aeration. We turned the pile by rebuilding it next to its original site. The compost is ready to use when it is dark and rich looking.

Compost is particularly valuable in preparing biodynamic, French-intensive, raised beds. This type of gardening requires the proper nutrients and soil texture for success as the plants are grown close together. A lot of compost in the bed will make it rich and loose.

Michelle Adams and Maureen Hosey experimented with an intensive bed garden in the spring of 1978, but this gardening method has not been used regularly at The Land. The compost we started will be used next spring in raised beds.

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Perennial Polyculture Research

Marty Bender

In response to the soil loss problem in U.S. agriculture, we have been conducting research on perennial grain crops since the fall of 1978. Since much of the U.S. soil loss is associated with the cultivation of annual grain crops such as corn and soybeans on the uplands, replacement with perennial grain crops could greatly reduce soil erosion. Once these perennials are established they presumably could come up each spring from their roots; thus, they don't require the annual cultivation that bares the soil to the wind and rain. Presently, we are working in five areas of perennial grain crop research:

I. Yield Increase in Eastern Gamagrass
II. Biology and Life History of Zea diploperennis
III. Response-to-Selection Experiments
IV. Paired Studies
V. Forb Tests

(I) Yield Increase in Eastern Gamagrass. We have discussed this work in earlier Land Reports (No. 6 & 8). Briefly, we want to increase the seed yield of this high protein grain from a single bushel per acre upward to some unknown limit. There are two chromosome races: the diploid with 36 chromosomes and the tetraploid with 72. So far, we can only gather baseline information before we launch a yield-increase breeding program in a year or two hence. We want to know the degree of fertility (1) from self-pollinated plants, (2) between plants from the same locality, and (3) between plants from different localities but of the same chromosome number.

(II) Biology and Life History of Zea diploperennis. There is much that we need to know about this potentially important species including the limits of its range and habitat preferences. We are, of course, interested in its perennialism, a trait that few, if any seed companies care about. We would like to build up our seed supply and ask different people and organizations to grow it at latitudes and in climates where the winters are less severe and perhaps gradually pick up the genes for cold resistance. The few plants we left outside last winter died, as expected. If we can trick it into flowering in synchrony with our annual open-pollinated corn which has the same chromosome number, perhaps we can make several crosses. We might even half-heartedly try some crosses between it and its relative Eastern Gamagrass.

This spring we have established 240 individuals in the garden. Twenty are from seed collected from a 1450 meter elevation, 140 from 2000, and 50 from 2400 meters. Many of these latter individuals we have placed in 5 gallon plastic buckets with holes in the sides and bottom so they can readily be transported to the greenhouse to be protected through the winter. From the seeds which I collected in Mexico from naturally occuring hybrids between Zea diploperennis and corn, 15 plants have been established. Fifteen plants of this perennial have also been established from crosses Wes made in the Kansas Wesleyan greenhouse last winter.

(III) Response-to-Selection Experiments. Of the five areas in which we are conducting research, this may be the most important in the long run, for it deals directly with a basic biological principle central to our effort. Crudely stated, can herbaceous perennial grains equal the yield of herbaceous annuals?

We will compare the response of a perennial to an annual of the same genus in order to determine which responds the most dramatically to selection for high seed yield over several years. Both now and in the future, plants will be spaced a foot apart. In the fall, seeds will be collected from each plant and weighed. Seeds of the top performers will in turn be planted out in succeeding years.

SELFING PERENNIAL vs. SELFING ANNUAL

1) Lespedeza cuneata vs. Lespedeza striata
2) Lespedeza cuneata vs. Lespedeza stipulacea

Seeds could not be found for an outbreeding perennial grass, Pennisetum purpureum, versus an outbreeding annual, Pennisetum glaucum.

(IV) Paired Studies. It may be difficult to grow a perennial grain crop in monoculture because the same crop would be in a field year after year, making it susceptible to disease and insects, and causing the roots to compete with each other at the same level underground. By growing a variety of perennial species together in polyculture, the diversity would eliminate these problems. So we need to find combinations

of perennial species which would give greater seed yield in polyculture than in separate monoculture. It was with this in mind that we planted two polyculture experiments last year, one consisting of five grasses and one legume, and the other consisting of four grasses. However, after having made measurements of the biomass and having observed the experiments for a year, we realized that they were incorrectly designed and contained too many species to allow us to make significant conclusions.

Consultation with two agricultural statisticians at the University of Nebraska in Lincoln resulted in a much simpler polyculture design known as a paired study. In a paired study, a pair of perennial grasses is grown in separate monoculture and in what we might call bicultures of three ratios. For example, in a paired study involving Switchgrass and Indiangrass, with each growing in a plot 4' by 20' in size, there are four replications (for statistical reasons), and each replication contains a plot of Switchgrass, a plot of Indiangrass, a plot of Switchgrass and Indiangrass planted in a 50-50 ratio, a plot of Switchgrass and Indiangrass in a 75-25 ratio, and a plot of Switchgrass and Indiangrass in a 25-75 ratio. We chose to experiment with three ratios for the polycultures rather than just the 50-50 ratio in order to see what effect different ratios would have on seed yield. So for each replication, the seed yield from the two monocultures can be proportionally compared with the seed yield of each of the three polycultures.

To achieve the most meaningful information, the perennial and the annual should also be of the same breeding mode; that is both be self-pollinating or both be obligate out-crossers. With this restriction, only a few comparisons could be made. We were very fortunate to obtain seeds for some legumes through Jack Walstrom, a local SCS plant materials specialist. Unfortunately, germination has been poor, so we presently have two experiments for the genus Lespedeza and hope to have two experiments for the genus Trifolium.

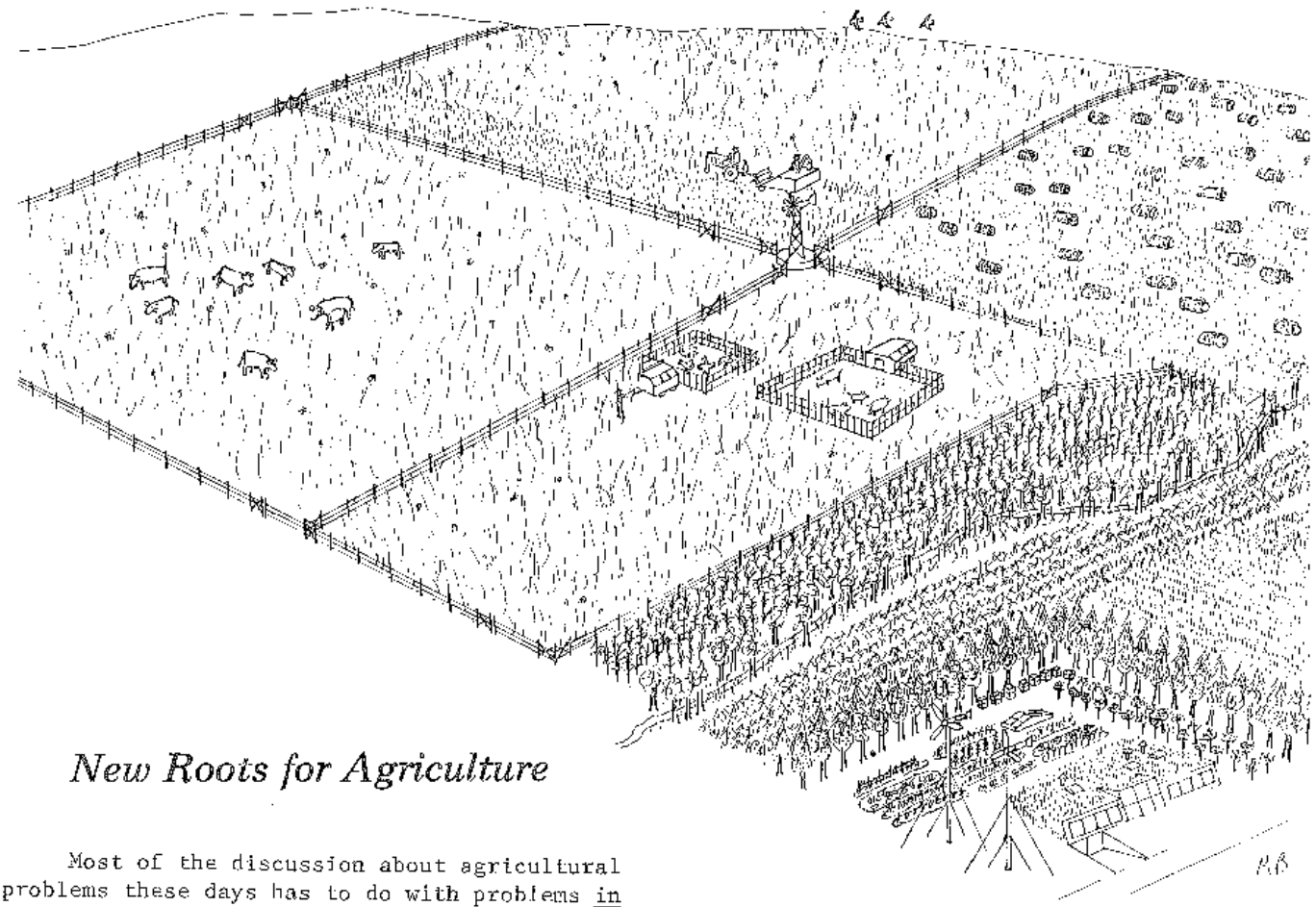
Depending on the results from many paired studies, research may proceed to studies of triplets or even larger groups of perennial grasses. When compatible combinations of grasses are found, then research can be done to increase the seed yield of each compatible grass. Five paired studies were planted this spring, with the first four listed being tall grasses and the fifth, short grasses: 1) Switchgrass and Indiangrass, 2) Switchgrass and Sand Lovegrass, 3) Indiangrass and Sand Lovegrass, 4) Switchgrass and Sand Dropseed, and 5) Buffalograss and Blue Grama.

(V) Forb Tests. Some of the perennials in a polyculture of perennial grain crops will be forbs (wildflowers), such as legumes. It is well known that legumes fix nitrogen on the prairie, but what do other forms do? There are numerous families represented on the prairie such as mints, composites, spurges, borages, etc. Do they contribute to the overall stability of the biotic community, or are they "just there?" From the human's point of view we are interested in total production of seed but the prairie did not evolve, necessarily, to meet that human purpose. But if we start with prairie plants which have their own emphasis and shift their purposes to meet human goals, we need to know whether the presence of various forbs can contribute to seed production. Consequently we have designed what we call forb tests. For example, in a forb test involving Switchgrass, Indiangrass, and Gray-Headed Coneflower, there are four replications and each replication contains a plot of Switchgrass and Indiangrass in a 50-50 ratio, a plot of Gray-Headed Coneflower, and a plot of Switchgrass, Indiangrass, and Gray-Headed Coneflower in a 37½-37½-25 ratio. (Switchgrass and Indiangrass remain in a 50-50 ratio and make up 37½+37½=75% of the plot, while Gray-Headed Coneflower makes up the remaining 25%). All plots are 4' x 20'. Not only will forb tests determine what forbs are compatible with grasses for seed production, but after many tests, it may be possible to make generalizations about the effect of various plant families on seed and biomass production of such polycultures. Five forb tests were planted this spring: 1) Switchgrass, Indiangrass and Gray-Headed Coneflower (composite); 2) Switchgrass, Indiangrass and Maximillian Sunflower (composite); 3) Switchgrass, Indiangrass and Illinois Bundleflower (legume); 4) Switchgrass, Indiangrass and Purple Prairieclover (legume); and 5) Buffalograss, Blue Grama, and Purple Prairieclover (legume).

On the 6th of August, Wes Jackson and I will present four papers on perennial grain crop research at the 7th National Prairie Conference being held in Springfield, Missouri.

*This really is an unrefined question. If our paradigm is "sustainability" first and "yield" second, we should not care in the absolute sense whether the perennial matches the annual. Perhaps the perennial can equal the annual on a given year but can it continue to compare with the annual year in and year out? Afterall, perennials do have a history of doing pretty well in the second and third year before production heads steeply downward.

In thinking about the balance between "sustainability" and "yield," it is a question of emphasis. The conventional plant breeder does not totally dismiss "sustainability," just as the New Age plant breeder cannot dismiss "yield."



New Roots for Agriculture

Most of the discussion about agricultural problems these days has to do with problems in agriculture: chemical contamination, high energy use, low prices, corporate ownership, etc. New Roots for Agriculture by Wes Jackson is about the problem of agriculture, the inherent destructiveness of most till agriculture, particularly annual monoculture.

This book describes how many problems in agriculture could be solved almost all at once if we could develop perennial polycultures in time. The last chapter is devoted to a utopian vision of a farm outside a solar village in central Kansas in the year 2030 and is a description of a sustainable agriculture and culture. The sketch above by Marty Bender appears in that chapter.

New Roots for Agriculture, published in cooperation with The Land Institute, will be available in August from Friends of the Earth, 124 Spear Street, San Francisco, Ca. 95105.

SMALL FARM ENERGY SEMINAR

The Small Farm Energy Project will conduct its third "Small Farm Energy Seminar" at Hartington, Nebraska on August 15 and 16. Alternatives to high costs of energy and fertilizers will be featured. Participants will tour cooperating farms to see solar water heaters and grain dryers, minimum tillage equipment and other innovations. The Seminar will include research reports on three years of studies by the Energy Project. In 1979, cooperating farms of the Energy Project saved nearly $1100 per year in energy compared to other farms not making changes in energy use patterns.

More information on fees, agendas, meals and lodging is available from Energy Seminar, Small Farm Energy Project, P.O. Box 736, Hartington, NE 68739.

SEVENTH NORTH AMERICAN PRAIRIE CONFERENCE
Aug. 4-6

Southwest Missouri State University in Springfield, Missouri is hosting this conference. Papers will be presented in the areas of Prairie Floristics and Faunistics, Cedar Glades, Prairie Ecology, Landscaping and Restoration with Prairie Plants, Prairie Management and Preservation. Five field trips to significant Missouri prairies and glades are offered. To receive a program and registration form, write the Department of Life Sciences at the University (zip: 65802).

Alternatives in Energy

Towards Community Self-Sufficiency

Mari Peterson

The County Energy Planning Project mentioned in the last Land Report is now underway. The Mid America Coalition for Energy Alternatives and the Land Institute have joined forces to promote local decision-making on energy issues in Kansas. Diane Tegtmeier of MACEA and I are coordinating the project.

Currently we are working with the people of Wabaunsee County in the Flint Hills region of Kansas. As an experimental county, it meets the criterion of being a county "with a reachable population preferably containing no major urban areas or industrial complexes." Diane and I have enjoyed meeting the people of Wabaunsee County, and particularly appreciated being there during the spring blooming of the redbud and dogwood trees.

There have been three meetings in the county to date. The objective so far has been to develop local interest in an energy planning project. At the first two meetings we suggested a county-wide weatherization program as a way to get everyone interested in the energy project before gathering data. Several farmers brought up the fact that on-farm fuel consumption is a much larger expenditure (problem) for them than home heating costs. As a group, they decided to gather energy data first as a way of determining what action to take later. There seemed to be too large a mix of energy issues in the county to try approaching any one on a county-wide basis.

The third meeting was particularly exciting to Diane and me in that the people present began to take control of the project. They decided that before gathering data to determine energy use patterns, they should contact all county organizations to generate interest and support for the data gathering effort. (The data gathered will be the basis for determining where to conserve energy and where to adopt alternate forms of energy in the county.)

Before the end of May, citizens in Wabaunsee County will begin gathering data. They will study energy use in each of these sectors: residential, agricultural, commercial, industrial, mining & construction, and transportation. It is important to know not only the total energy consumed in each sector, but also how it is consumed. They need this information in order to properly match energy forms to end-use needs, a principle widely disseminated by Amory Lovins. During the last stage of data analysis they will make projections of the energy consumption patterns in the county for the year 2000.

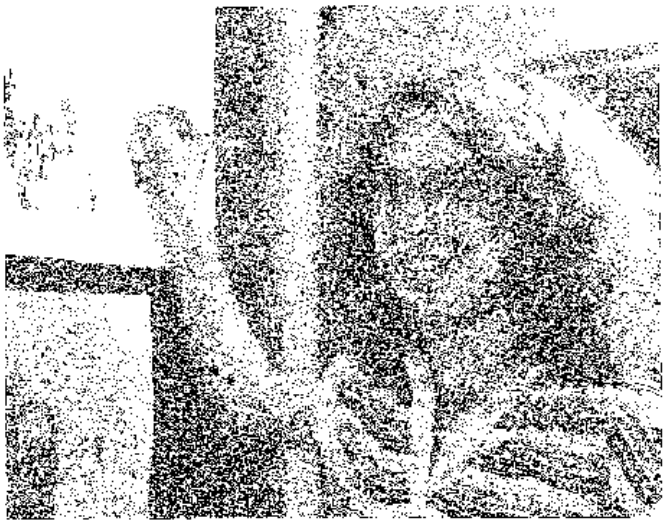
We have been using the County Energy Plan Guidebook by Alan Okagaki and Jim Benson as a baseline in formulating worksheets for data gathering. I have been adapting this generalized approach to better fit Kansas' energy use. The major modification I am working on is to develop a way of gathering meaningful data for the agricultural sector. (This was allotted only a paragraph in the C.E.P. Guidebook.) There is also a need to develop a method for gathering better end-use data for the industrial sector in particular. In addition, we are refining the technique for projecting energy use to the year 2000. The Okagaki-Benson book relies primarily on population changes as the key to changing energy consumption. Many other factors will influence these projections; one that we're already acutely aware of is energy price changes.

While I have been searching for the best data-gathering techniques, Diane Tegtmeier has been searching for funding to keep our project alive. Most foundations are waiting for us to move this project beyond its formative stages before they're interested in providing money. Our budget is very slim right now, but we're fairly optimistic about the prospect of securing funds this summer or fall.

Diane has also served as the principal contact with the people of Wabaunsee County, making endless phone calls and sending out letters to generate support and coordinate activities.

We are both very grateful for the advice we have received from Dr. Jerry Wade in the area of community development, and Dr. Mike Veren in statistical and data gathering considerations. Both men are at the University of Missouri in Columbia. Dr. Jim Converse, a rural demographer from Kansas State University in Manhattan has helped us better understand the changes taking place in rural Kansas.

Sometime this summer we plan to move into



Phase II of the project. This entails spreading the effort out into approximately eight counties which will represent the remaining 96 counties in the state. I am beginning to determine which factors are most important in carving the state into energy districts. Once we begin Phase II, Diane will serve as the eastern coordinator of the project, and I will serve as western coordinator. By that time we hope to have a workable approach for county energy planning. The people of Wabaunsee County will be instrumental to this end by offering advice and critiques of the current methods as we go through Phase I.

Diane and I would like to thank everyone in Wabaunsee County who has shown interest and offered suggestions so far. We expect there will be many others involved as they begin to work out their energy issues in the county. Those who have shown interest so far are: Wendell Baker, Marjorie Baxter, Rella Belt, Elton Carrington, Patty Converse, Bill Corpening, Michelle Crisler, Sharon Durkees, Jim & Ann Fredrickson, Ron & Kathy Henderson, Bud Hentzler, Bob Herman, Donna & Rex Logan, Cindy Manz, Rich & Debbie Roberts, Olga Saffry, Rhonda & Barry & Shannon Showalter, Lowell Thierer, Darrell Turnbull, and Curtis Waugh.

Is it a Miracle? Barry Commoner's Alcohol Fuels Policy

Mari Peterson


Sugar Beet

One should be skeptical of any system designed to glean an exceedingly large profit with no apparent costs. Hidden costs tend to creep in over the years. Barry Commoner's proposal suggesting we in the U.S. can provide all our transportation fuels by the year 2000 from agricultural crops and residues is just such a system and seems too good to be true. Estimates by the U.S. Department of Energy do not come close to providing all our transportation fuel.[1] Barry Commoner and the people at the Center for the Biology of Natural Systems (CBNS) at Washington University have taken a very novel approach to the alcohol fuels issue, and although I admire their ingenuity, I do not believe they can be miracle workers.

Changing the Crop Mix

The key to the CBNS proposal is a restructuring of the current agricultural crop mix for cattle feed production. Currently 64% of our cropland is devoted to feed production.[2] This cropland is used for feed grains (corn, oats, barley, sorghum); pasture; hay; some wheat, rye, and rice; soybeans; corn silage and sorghum silage. The CBNS crop mix would be 25% corn, 25% sugar beets, plus 50% hay and pasture. This mix would increase the overall amount of metabolizable carbon (carbohydrates) produced, without significantly changing the level of nitrogen (protein) produced. This would enable the feed land area to serve as a source of fuel and cattle feed through the use of the fermentation and distillation residues, the spent mash, as the main component in the cattle feed (along with some hay.) By working only with the land devoted to feed production, the current food, fiber, and export production patterns remain unaltered.

The most significant alteration in this new crop mix is the 75 million acres being devoted to sugar beet production -- a drastic increase from the approximately 2.5 million acres currently used in sugar beet production. Also notable is the transition to an even less diverse agricultural system.

Another equally significant change is the addition of 38 million acres to feed production. This amounts to an overall increase in cropland by about 10%.

Having Your Cake and Eating It Too

Barry Commoner and the people at CBNS want to use the land to feed the American people, export commodities to the rest of the world, maintain livestock production and fuel the United States' transportation network -- a seemingly large burden for land that is already deteriorating.

In order to perform this monstrous task, two system objectives were outlined by the researchers. First, they need to increase the overall biomass production. Secondly, they must find ways to decrease land residue requirements.[3]

There are three ways by which the overall biomass production is increased. The first is the introduction of high-yielding crops such as sugar beets which produce twice the overall biomass yield of corn. The second is the elimination of low-yielding crops such as soybeans which have one-third the yield of corn. The soybean feed market is replaced by use of the spent mash and the soybean oil market is replaced by corn oil. Finally, CBNS assumes a 50% increase in forage crop yield. Intensifying forage crop production by this amount without increasing the land area devoted to this purpose certainly entails an increased use of petrochemical fertilizers.

At the same time that more is demanded of the land, proportionally less is returned to the land in the form of organic matter. They claim that changes in the crop mix "probably" will re-

sult in "somewhat" more residue, thereby enabling more residue to be available for removal while the same amount can be left on the land as with the present system.[4] The other recommendation is that the moldboard plow no longer be used, thereby reducing residue requirements. None of the reports I researched made clear how much residue will be left on the land as compared to present practices, and how much will be converted by lignocellulosic processes to ethanol.[5] This is an important missing fact since half of the ethanol in the CBNS plan for the year 2000 is derived from conversion of crop residues.[6]

A Miracle or a Hoax?

How can one best decipher a miracle? My belief is that the best approach is to settle in on the issue -- What are the bottom line considerations and what is happening in these areas? From the environmental perspective of the Land Institute, the bottom line must be -- What is happening in terms of soil loss and soil health in this alcohol-producing agricultural system?

Soil loss. This is a very important consideration since the land will be intensively worked, marginal land will be brought into production, and many crop residues will be removed from the land (their proposal calls for the use of the corn stover as the process heat source.) In addition, residues from the other crops will be converted to alcohol in varying amounts.

One of the CBNS reports I reviewed suggested means of counteracting soil loss, but I have questions about all their methods.[7] Several proposals are also suitable responses to present soil loss conditions but are not widely practiced. For example, CBNS claims that an early corn harvest will allow time for cover crops such as rye or vetch to be sown after the corn is removed. Does a cover crop have time to get sufficiently established in the northern corn belt before cold weather sets in? What is the motivation for farmers to undertake this practice?

CBNS suggested that alfalfa and legumes could be planted. It seems the only way this could be done is by bringing even more marginal land into production for rotation. Under their alternative plan, all the cropland is put to use for food, fuel, and feed. If the legumes are to be planted with other grasses in the pastures, this will not affect the net amount of soil loss since the pastures are subject to rotation, and therefore susceptible to soil loss.[8]

By selecting proper crop varieties and using "proper" (more) fertilization, they believe the residue yield can be greatly increased allowing for more residue to be left on the land. One of the problems here is that under their system the residue has an economic value in that it can be converted to alcohol; therefore, this implies a farmer will willingly forego additional income in order to save his/her soils. Does this seem likely?

Since there is very little change in the amount of pasture land from the present system, there is no inherent change in the amount of cover crops that can serve to lessen erosion.

Recall that their plan requires the cultivation of 38 million acres of marginal cropland. According to the Soil Conservation Service, 35 million of the 111 million acres of potential cropland can be brought into production with no additional development (such as tile drainage, clearcutting, rock removal, etc.)[9] Twelve million of these acres do have significant problems, though. Six million are subject to high erosion, two million have very low fertility, one million experiences common flooding, among other problems. There is likely to be an increased need for petrochemical fertilizer, and an increase in soil erosion on these lands. Almost all of this potential cropland is currently in nonrotation pasture and rangeland. Plowing this permanent cover by necessity implies increased soil loss.

Soil health. Organic matter in the soil is vital to its health. Organic matter prevents nutrients from leaching out or becoming inorganic compounds; nutrients are more easily released to the plants. It also serves to capture and retain moisture.[10]

The health of the soil is becoming a more critical issue as we are forced to move away from a fossil fuel-based economy. The manufacture of fertilizer is very energy intensive and will therefore become less viable as our fossil fuels dwindle. When the artificial injections of "health" (fertilizer) are no longer feasible, we may be shocked to find out how poorly managed our soils really are. Already, some soils have lost 30% of their organic matter.[11] Without the fertilizer, we'll find these soils are really in poor health.

In addition, we must quit dumping carbon dioxide into our atmosphere. Organic matter not stored in the soil's carbon sink but used in alcohol fuels will mean more carbon dioxide is being released to the atmosphere. Scientists are uncertain of the exact effect of having a large reservoir of CO_2 in the atmosphere, but they do agree that in some way it will alter climatic conditions.

I realize that if lignocellulosic conversion processes are developed, the conversion of crop residues into alcohol will be tempting with or without Commoner's policy. What is important at this stage of the development process is to call for caution in the use of crop residues for purposes other than replenishing the soils.

What Is a Renewable Resource?

Advocates of massive alcohol fuels policies, such as Commoner, are taking a shallow, short-term approach to understanding what a renewable resource is. If alcohol from biomass is to be a renewable resource in Commoner's proposal, then it must be a sustainable system over indefinite periods of time. To qualify as renewable, the intensive plant production and resource utilization cannot exceed the replenishing capacities of the soil. It is the renewing capabilities of the soil which make the production of plants a renewable resource. But we are already aware that soils are not being replenished as fast as they are being washed away and depleted of nutrients.[12] A more intense and less diverse agricultural system will do nothing to alleviate this problem. Small-scale, on-farm production of alcohol fuels for farm use in conjunction with a perennial polyculture agricultural system may indeed be sustainable.

We need people with the ingenuity of Barry Commoner and the staff at CBNS to devise truly renewable systems to sustain our transportation network. Perhaps this may be a hydrogen-based transportation economy with hydrogen produced through photovoltaic cells rather than an alcohol fuels system. In the meantime, dollar for dollar (or pound of soil for pound of soil),[13] conservation is the best resource to tap.

References & Notes

1. The Center for the Biology of Natural Systems predicts alcohol production can be 10 billion gallons/year by 1985, 30 billion by 1990, and 100 billion by the year 2000. (Testimony by Barry Commoner and the CBNS staff before the U.S. Senate Committee on Agriculture, Nutrition and Forestry; Subcommittee on Agricultural Research and General Legislation on "The Potential for Energy Production by U.S. Agriculture," July 23, 1979, Table V.) One DOE estimate is that the U.S. can produce 3-3 1/2 billion gallons/year by 1990. (Biomass-Based Alcohol Fuels: The Near-Term Potential for Use with Gasoline, U.S. Department of Energy, prepared by the Metrek Division of the MITRE Corporation, August 1978, p. 37.) The upper estimate for ethanol production in another DOE study is 11.6 billion gallons/year by 2000. (The Report of the Alcohol Fuels Policy Review, U.S. Department of Energy, June 1979, p. 45.)

2. Agricultural Statistics 1977, U.S. Department of Agriculture.

3. Testimony by Richard Carlson, research associate at CBNS, before the Joint Economic Energy Subcommittee on "Integrated Food-Energy Production Analysis." (March 17, 1980.)

4. Carlson, p. 6.

5. Lignocellulosic conversion technology is currently under development at Purdue University, Gulf Oil, General Electric, and other places. Cellulose which normally cannot be used for livestock feed or alcohol conversion would be treated to release the sugar residues which can be converted to alcohol.

6. Barry Commoner, "The Potential for Energy Production by U.S. Agriculture," Table V.

7. Richard Carlson, Barry Commoner, et. al., "Interim Report (to the Ford Foundation) on Possible Energy Production Alternatives in Crop-Livestock Agriculture." (January 4, 1979)

8. Rotation is necessary in the CBNS plan. There are 75 million acres of sugar beet production in their model. This is an upper limit because of the necessity to rotate sugar beets with other crops to avoid nematode infestation. As a rule of thumb, sugar beets should not be grown on the same piece of land more than 1 in 4 years. This means that the pasture land in the model must be brought into the rotational scheme. Whether or not legumes are planted in the pasture will have little effect on the soil loss that results from opening that pasture up through plowing.

9. Soil Conservation Service, Potential Cropland Study. (October 1977.)

10. See Bill Craig's paper "Some Impacts of a Biomass Energy Conversion System" in this issue of The Land Report for more information on this subject.

11. Same source.

12. See the discussion of the Soil and Water Resources Conservation Act in the RCA Appraisal 1980, Review Drafts, Part I & II. Soil Conservation Service, U.S. Department of Agriculture.

13. I also reviewed the "Progress Report of Studies on the Economic Potential of On-Farm Energy Systems" by CBNS for this paper. (September 20, 1979.)

ENERGY AWARENESS FAIR

The Sunflower Alliance is again sponsoring this event on August 23-24 at the John Redmond Reservoir near Burlington, Kansas and the Wolf Creek nuclear plant. This fourth annual gathering begins at 12:00 noon on Saturday with a potluck lunch. Workshops and entertainment follow in the afternoon, and there will be a dance in the evening. The Sunday program starts with a "Walk for Survival" at 8:30 A.M., and a religious service at 11:00. The main rally begins at 1:00 P.M. and will feature Ted Davis (Physicians for Social Responsibility in New Mexico), Judith Johnstud (witness at the Three Mile Island hearings), and Max McDowell (investigative journalist). No dogs, drugs, alcohol or soliciting allowed. Camping available.

Some Impacts of a Biomass Energy Conversion System

Bill Craig

In a sustainable economy, the only source of energy is the sun. In the past we have been able to mine solar energy fixed by plants in earlier geologic ages, but as we will soon deplete these reserves of coal, oil and gas, we must look at ways we can tap the sun's energy more directly. The replacement of fossil energy for heat by solar power is well known, but we have yet to devise a system to provide liquid fuels. To provide these fuels, many have proposed that we convert biomass or grain crops into alcohol. Gasahol biomass conversion is an area where our short term demand for large amounts of energy could lead us into an environmental catastrophe.

Light coming from the sun contains sufficient energy for the creation of chemical bonds which store energy. Some of the initial solar energy must be used to drive the process itself. The amount of energy that is used in a system for the collection of the sun's energy is proportional to the quality of energy collected, if we use Amory Lovin's criterion for the quality of energy based on the temperature gradient.[1] When utilized by living tissue, these compounds have the equivalent of a 5000° C. working temperature.[2] This is much larger than the temperature required for transportation energy needs. Organic carbon is also uniquely useful, for it is the only form which can sustain the metabolism of living tissue, although it can be used in place of many other forms. Using organic chemical energy for heat and mechanical purposes is like using diamonds for sandpaper.

A Review of Technologies

There are three methods for the capture of the sun's energy in forms sufficiently energetic for the formation of chemical bonds: photosynthesis, photochemical, and photovoltaic. Of these three, photosynthesis is the best known and most spoken of for the production of liquid fuels.

Photochemical production of energy is a process by which some of the chemical steps of photosynthesis are simulated for the production of chemical energy. These techniques, while quite promising for the future, are at present only theoretical in development.[3]

Photovoltaic generation of electricity is the tapping of light energy in the form of an electrical charge in a solid-state device. The mechanics of this are similar to those used in the pocket calculator, but on a much larger and simpler scale.[4] The electricity produced can be either utilized directly or stored in a chemical form for later use. For example, the charge generated can be used for the electrolysis of water to form hydrogen and oxygen gas. One of the more interesting proposals is to form the photovoltaic substance into small grains and immerse them into an electrolyte for the direct production of hydrogen.

Photosynthesis is the means of fixing energy which all plants utilize for the collection of metabolic energy. It is a long and complex process in which two distinct units of light are used for the production of ATP and NADPH, which in turn are used to drive a long cycle of biochemical reactions. These fix the energy in the form of sugar, starch, cellulose, or poly-isoprenes (latex).[5] At first glance it would seem to be an attractive system for the production of liquid fuels, but there are a wide variety of good reasons why it should not be used. Three are low efficiency, depletion of the soil, and competition for scarce food and material resources.

Efficiency

The photosynthetic system can, at its best, collect about 35% of the light that falls on it and produce about 6% usable energy. These values have only been achieved for short periods of time under laboratory conditions with monochromatic light. In the real world, photosynthesis fixes energy for plants, and much of the energy initially fixed is used for the metabolism of the plants, as much as 40% for photorespiration and 30% for dark cycle respiration. Thus the most efficient energy-collecting plant communities are Amazonian-type jungles, able to fix only about 1% of the sunlight that falls on them.[6] In temperate climates most plants do not fix light energy during the winter. The lack of available nutrients and water further limit productivity. In reality, plants, on the average, fix only about .1% of the incident energy.[7] If we take a conservative estimate that one unit of input is required for every three units of return in standard farming practice, and subtract this input from the efficiency of the collection system, about 0.066% of the light energy is usable as output. This is, unfortunately, in a form not directly usable for liquid fuels, and so it must be converted into a usable fuel. We have estimated that at least 60% of the remaining energy would be used in this refining process.[8] Thus a biomass conversion system can deliver only about .039% of the light energy that falls on it as usable energy.

For comparison, a photovoltaic system can collect about 15% of the light it receives.[9] Assuming it takes about one third of the energy produced over the life of the cell for its manufacture, we have a net energy gain of 9.9%. Then if it takes 50% of that energy for electrolysis, we have 4.9% of the light energy still present. If delivery energy inputs and other transportation losses account for 10% of that, we can utilize 4.45% of the original solar energy in a photovoltaic system.[10]

Depletion of the Soil

In addition to the low efficiency, we must consider the effect of removing large amounts of carbon from the biosphere. The soil is the largest surface reservoir of carbon, containing about 30×10^{14} Kg. The atmosphere contains about 7×10^{14} Kg. The soil is also the largest source of CO_2 in the atmosphere, which comes from a continual decay of organic matter.[11] The soil must be continually replenished with new organic matter for the balance to be maintained. In fact, some soils require 1100 Kcal of energy a year per square meter just to feed the biota of the soil.[12] In effect, a biomass conversion system would take some of the matter that would be returned to the soil and burn it in the atmosphere. If only 1/3 of the soil carbon is depleted in this manner, the amount of CO_2 in the air could double.[13] This could cause a drastic change in the climate due to an intensification of the "greenhouse effect."

The Role of Organic Matter in the Soil

Most of the biomass sources proposed as feedstocks for making alcohol are worth more as organic fertilizer than as a direct energy source. (See the table.) These values are not the only ones to consider if we are to look at the effects of a biomass conversion system on the soil. The need for organic matter in the soil is well documented. It is the organic matter that makes soil different from the sand or clay it came from. Soil under cultivation is already somewhat depleted of organic materials, and some soils have lost as much as 30% of the carbon originally present in the virgin soil.[14] A system that would remove more of the plant's mass from the soil would cause a further depletion of the soil.

Feed Stock Available in U.S.	Energy Value of Direct Conversion[a] (kcal)	Energy Value of Plant Nutrients[b] (kcal)
Municipal Sewage	1.3×10^{12}	1.10×10^{20}
STOVER	0[c]	
Livestock Manure	1.188×10^{15}	1.1×10^{17}

a) From David Pimentel, "Biological Solar Conversion and U. S. Energy Policy," Bioscience, Vol. 28; No. 6 (376-382)

b) Calculated from values of replacement inorganic nutrients taken from La Vern Faidley, "Energy Requirements and Efficiency for Crop Production," Am. Soc. Ag. Engineers Technical Paper, 77-5528.

c) Pimentel gives no value since he considers that none of the stover is available for biomass conversion because of erosion problems.

Maintenance of soil organic matter is imperative: organic materials increase water infiltration and storage capacity, cause better bonding of particles and a reduction of erosion. Organic matter makes the land more easily tillable and capable of releasing nutrients to plants, and acts as a chemical buffer, thereby making the soil more stable chemically. These effects have been shown to increase crop yield in plots receiving organic matter over similar plots receiving the same total N, P, and K, but no organic matter.[15] Organic matter in the form of manure has been shown to allow fewer nutrients to run off plots as compared to control plots receiving no fertilization at all. Studies have also shown that the use of organic fertilizer reduces (in some cases) soil loss by 100% and runoff up to 80%.[16]

Competition for Food Resources

Would it be proper for the U.S. to divert a substantial amount of agricultural production into the production of fuels at a time of world food scarcity? At the present the U.S. has some

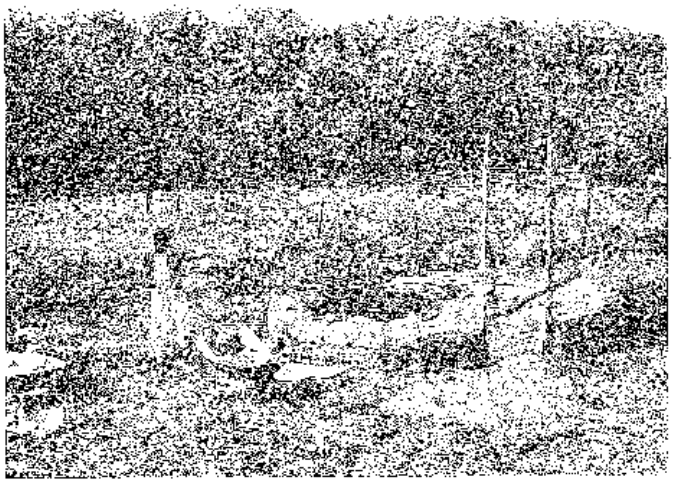
contd. on pg. 23

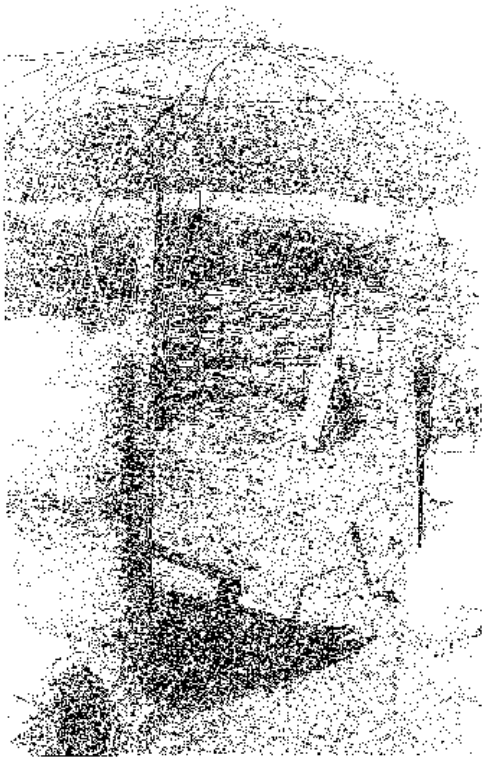
Bill Craig, Wes Jackson, Mari Peterson

Alternatives in Shelter

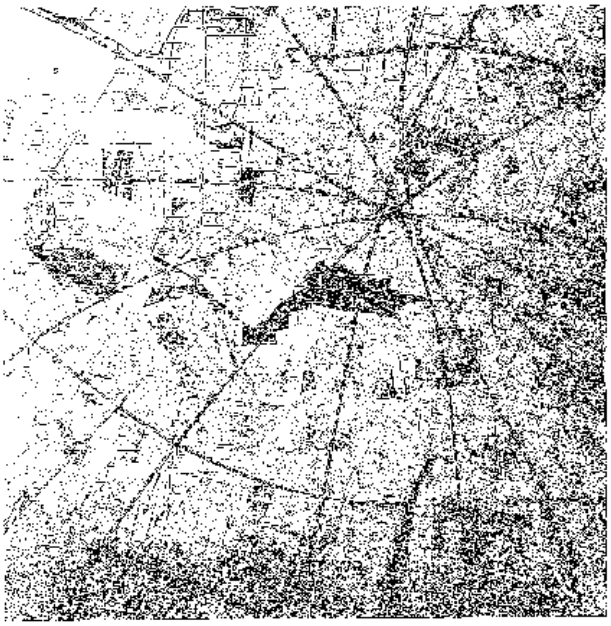
The Newspaper House

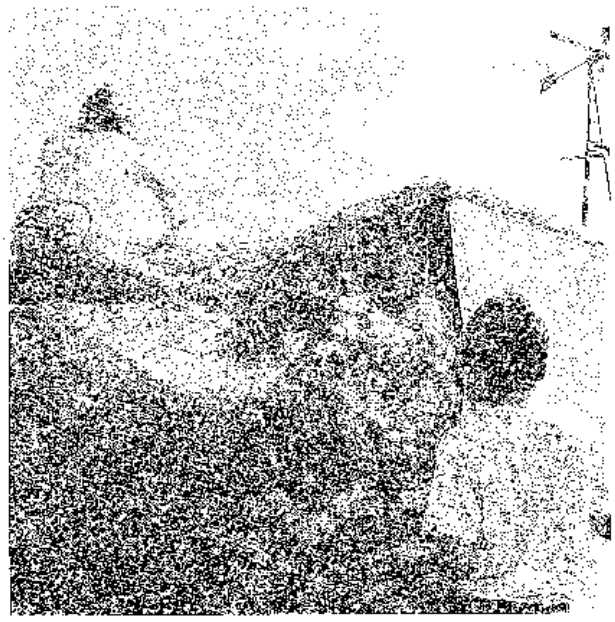
from Start

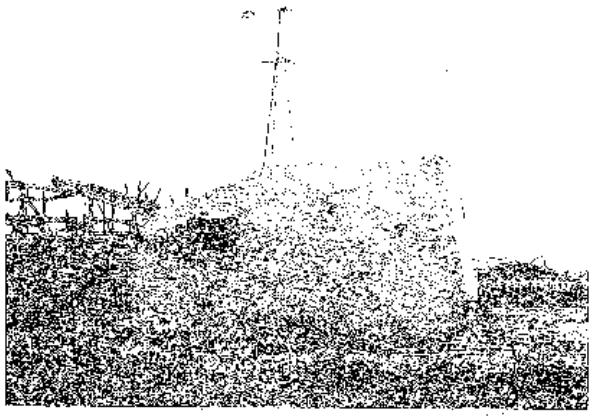




In the fall of 1976, Eric Herminghausen began collecting newspapers to build an experimental shelter. He bundled them together with baling wire into blocks and built a wall of newspapers over a concrete foundation. Spring semester students continued work on his "igloo," and Cindy Jones, John Jankowski (below) and several others covered the rebar and chicken wire with concrete on the outside. The newspaper house was then graced with a door, a window, a red and blue plastic skylight, and a solar collector.







Plastering the inside was the next step, but no student was interested in taking it on as a project. The concrete began to crumble in the upper half where we used lime, sand, and a much reduced portion of Portland cement. The lower part remained fairly solid, except by the door. The newspapers got wet when it rained, and some molded. Materials and equipment stored inside began to get wet. We began to be embarrassed by the newspaper house, even though we still loved its lines and the concept of recycling newspapers this way. And one day...

to Finish

We began tearing it down.

Michael Chapman is shown above throwing bundles of newspaper into the truck to be taken to a company which buys newsprint.

Eric had a good idea, and the newspaper house was charming for a time. Now we are ready to try other good ideas.

contd. from pg. 21

measure of international esteem from our continuing export of foodstuffs. This would almost surely stop with a substantial alcohol fuels program. This would remove one of the last positive factors in our continuing balance of trade problems. The question must be viewed as being a choice of which is more important, cars or people.

As we address these questions, we should also consider the type of legacy which we wish to leave our children. Should it be a depleted soil and an infrastructure suited only to further depletion of resources, or a truly sustainable economy?

A large scale biomass fuel program would be a Faustian bargain which neither we nor our children can afford, for like all deals, the bill will come due.

References and Notes

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10. Edward M.Dickson, The Hydrogen Economy, (New York: Prager Publishers, 1977) p. 38, p. 51-62.
11. M. Schitzer, "Humic Substances: Chemistry and Reactions," Developments in Soil Science, 8. (Amsterdam: Elsiver Scientific Pub. Co., 1978).
12. George W. Cox and Michael D. Atkins, Agricultural Ecology, (San Francisco: W. H. Freeman, 1979), p. 337.
13. The amount of CO_2 released would be greater than the amount present in the atmosphere, b but due to the unknown nature of CO_2 sinks, the actual increase will be hard to quantify.
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EARTH DAY '80: APRIL 22

Salina Journal photo by Jeff Britegan

Several elementary school classes brought sack lunches to the Salina Government Center Commons for the Earth Day Program coordinated for The Land Institute by Deb Parks. Marty Bender entertained them between musical programs by the New Dawn Singers from South High School, Don Wagner and Scott Wilson playing Bluegrass, folksinger Pat Wilson, and children from Hawthorne Elementary School.

Between the performances, speakers (Jim Wesch, Dana Jackson, Marlene Moore, Ginny Usher, Karen Black, Steve Burr, Ron Force, Mary Ann Powell, Andrea Norton and Sister Marilyn Stahl) told about community projects that benefit or could benefit the environment.

Almost everyone attending visited the Smoky Hills Audubon Society table to see the live Swainson's Hawk which Maure Weigel displays in programs he gives about raptor rehabilitation.

Salina's program was part of a nationwide tenth anniversary celebration. EARTH DAY 1970 was a watershed in citizen understanding of environmental issues. EARTH DAY 1980 was a parade of community-based projects to provide safe, reliable energy, nutritious food, clean air and water and improved waste management. Americans rededicated themselves to the goal of enhancing the quality of life for present and future generations through a cleaner, healthier environment.

Gaining Political Sophistication for the Second Environmental Decade

Dana Jackson

> It is a pleasure for me to advise you that you have been selected by the Region 7 Environmental Protection Agency Awards Committee to receive a 1979 Environmental Quality Award for contribution towards protecting the quality of the environment...Governor Carlin has graciously consented to join me in presenting the awards. The awards ceremony, with reception immediately following, will be held at 1:30 P.M., March 17, 1980, in the Office of the Governor, State Capitol Building, Topeka, Kansas.

When Wes and I each received a letter from Kay Camin, the Regional Administrator of EPA, beginning as above, we had mixed reactions. We were grateful to Bill Ward who nominated me, and Rob Mohler, who nominated Wes, for appreciating our work. We recognized that positive news stories coming out of the EPA were valuable. But we rejected the notion of taking off the good part of a working day to burn gas 115 miles to the state capital for a short ceremony and refreshments. However, Joyce Fent, also from Saline County, was being recognized for her efforts to preserve agricultural land from urbanization, and since three out of the eight Kansas awards were being given to Salinans, it merited an editorial in the local newspaper. This gave us the idea that perhaps there would be some attention paid to the awards ceremony by the press in Topeka, and perhaps we should take advantage of that attention to make statements about environmental issues in Kansas. We changed our minds and decided to attend the ceremony.

We drove to Topeka on the 17th of March with ten copies each of our carefully-worded statements. We were ready to hand them to the press, and we imagined the news-hungry reporters assigned to cover the ceremony would be delighted to have our written material to quote.

The ceremony in the Governor's office was efficient. Governor Carlin held the large wooden placques while Kay Camin read a statement about each person whose work was being recognized. Then the governor handed the placque to the recipient and shook hands. It was over in minutes.

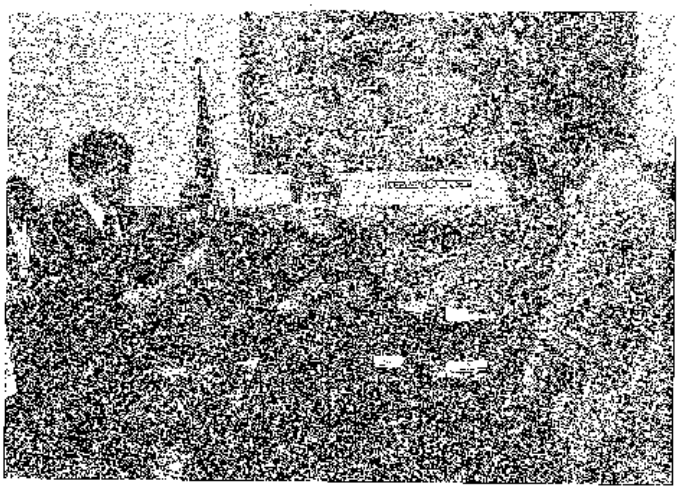
We looked around, but we didn't find any members of the press, except one TV cameraman. (The manager of his station won an award for a documentary about water.) The room was crowded with relatives of award winners, legislators from their home districts, and a few members of the Governor's staff, but no reporters. We gave copies of our statements to Governor Carlin, Kay Camin, and our representative Jane Aylward, and then were quickly ushered into the Lt. Governor's office to a large table filled with sandwiches, cookies and soft drinks. No reporters there either.

Wes later took our statements to the media office shared by several newspapers. They did not even know that a ceremony was held as the governor's office had not put it on the calendar. They accepted our statements, but we never saw nor heard of their appearing in print.

We felt foolish driving back to Salina late that afternoon. Governor Carlin obviously was not interested in the press taking his picture with a bunch of environmentalists, or writing a story about his cooperation with the EPA. Our statements about the Wolf Creek Nuclear Plant, the Tallgrass Prairie Reserve and the preservation of agricultural land from urbanization probably did not get read by anyone.

My conclusion: ENVIRONMENTALISTS MUST BECOME MORE POLITICALLY SOPHISTICATED.

The environmental movement officially began with Earth Day, April 22, 1970. But the participants did not stop with teach-ins and demonstrations. Environmentalists continued to work, and in the past ten years they have influenced the passage of such federal laws as the Clean Air Amendments of 1970, the Federal Water Pollution Act of 1972, the Endangered Species Act of 1973, the Safe Drinking Water Act of 1974, Toxic Substances Control Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. That handful of fulltime lobbyists in Washington representing the Sierra Club, or Friends of the Earth, or the Natural Resources Defense Council, or Environmental Action, has certainly been more politically sophisticated than Wes or I, or they would not have accom-



plished so much. Underpaid, understaffed, and often unappreciated, they have helped to educate the grassroots and rally them for letters and phone calls at critical times. Passing strong environmental protection legislation was their objective, and they were successful in the 70's.

Times have changed. Even though we will need federal laws to control acid rain, toxic wastes, and save Alaska, it is going to be much harder to push legislation through. Tactics and strategies must be applied to the realities of the '80's. Special political savvy will be needed not only at the national and state level, but especially at the local level where much more must be accomplished.

Analyzing the '80's: the Environmental Decade Conference.

In April the Conservation Foundation gathered nearly 300 environmentalists in Estes Park to discuss what would be important and what could be accomplished in the second environmental decade.

The first sessions presented alternate views of the future, focusing on major economic, social, demographic and technological trends likely to affect the environmental issues of the 80's. Lester Brown, Garrett Hardin, Dennis Hayes and Larry Kaagan set the mood for the conference in the first panel discussion: restrained, but deep pessimism. Garrett Hardin: "There is no mechanism for making progress on global problems...Nothing teaches like disaster. Pray for a disaster." Dennis Hayes: "People are beginning to get the messages, to understand about enduring shortages caused by depletion of resources, but we probably do not have time for messages to percolate through society to make intelligent policy..."

Later, Governor Lamm of Colorado declared that he believed the world to come would be truly traumatic. "We have to 'fast track' our solutions as the world is really beginning to unravel...the system is not capable of legislating solutions to problems in an age of limits."

My feeling of pessimism deepened as Lester Thurow, Professor at the Sloan School of Management at M.I.T., declared "anti-growth" a losing ballgame and outlined the need for reindustrializing America and increasing productivity. Also, we heard two comparisons of the realization of limits to the stages of grief over death as described by Elizabeth Kubler-Ross. David Dodson Gray said that people deny limits (e.g. that we are going to run out of oil), are angry, try to compensate, then bargain, etc., just as they do when they are told they have incurable diseases. Someone commented at this point that it was beginning to feel like an environmental hospice at the YMCA Camp of the Rockies, and I agreed.

Other sessions dealt with responses to the economic and social challenges ahead and tried to examine policy implications of those changes. David Harrison, a senior staff economist for regulation and natural resources on the President's Council of Economic Advisors talked about cost/benefit analysis in air pollution regulation based on quantative risk analyses. If there were thirteen substances in the air known to cause cancer, our policy has been to try to regulate them all at some level. Harrison suggested that in the future we should regulate some very well and ignore others to produce the greatest risk reduction benefits. He suggested there be variation in stringency of control at individual sources. For example, of two plants emitting benzine, one amidst low population density and the other located in a heavily populated area, "virtually all benefits could be paid" by controlling the one plant located near the most people. Environmental Protection Agency reports would look better, but those who experience the cancer risk because it isn't economical to regulate in their area may not agree that this is a moral decision.

John Quarles, a former EPA administrator, explained in his conference address that the capacity of environmental agencies, particularly EPA, is already overloaded. Regulation responsibilities have multiplied, but not budgets and people power, so we have forced EPA into cost/benefit analyses, putting price tags on the lives of people.

The EPA after Ten Years

An article called "Fear and Loathing in the Cower Tower?" by Deborah Baldwin and Gail Robinson in the June 1980 issue of Environmental Action is very critical of the EPA. The authors claim that after ten years the EPA is suffering "battle fatigue." Its regional structure makes it susceptible to local economic pressures. It has no visible, well-organized constituency like the ones connected to the Commerce or Labor Department. It has no sense of mission, and the "already sluggish regulatory programs would come to a complete standstill without public interest groups urging them on."

The EPA has always been under tremendous pressure from corporations according to Baldwin and Robinson. Cost/benefit review has been greatly expanded at the EPA under the current administration "as an effort to placate EPA's recalcitrant corporate foes." A toll-free "hotline" is kept open for industry, but not for citizens. As industry regularly screams at the EPA regulations, the rule-makers must seek support from the general public to enforce the laws. $600,000 was spent last year by EPA's Office of Toxic Substances to increase public participation, but the Office of Management and Budget is taking away those funds for the next year. "Activists suspect the OMB wants to

cripple public participation because industry doesn't like it," the authors report.

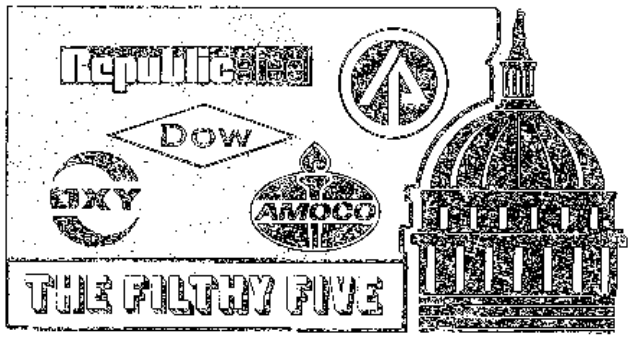
Corporate Power and the Political Process

What can we do to counter corporation power? Brock Evans, Sierra Club lobbyist, Peter Harnik, Environmental Action lobbyist, and Alice Teppler Marlin, Director of the Council on Economic Priorities, dealt with this problem at the Environmental Decade Conference. In addition to sponsoring "Big Business Day," the Council is setting up eleven shadow boards that would monitor every action by the boards of eleven bad corporations and make a very public year-end report. Harnik told about the "Filthy Five" campaign to replace Environmental Action's usual "Dirty Dozen." The "Filthy Five" (Dow Chemical, International Paper, Occidental Petroleum, Republic Steel, Amoco) have long histories of pollution violations and make large contributions to anti-environmental candidates. Activists are asking candidates for public office to sign a pledge to not accept money from these five. The "Candidate's Pledge of Independence" frees them from obligations to polluter companies.

Peter Harnik pointed out that not only do corporations invest money in politicians to insure them access for lobbying, but they have begun to imitate tactics of environmentalists through pseudo "grassroot" organizations and "public interest" foundations. A real public interest group, the Safe Energy Communication Council (1536 16th St., NW, Washington D.C. 20036), says that more than 200 utilities and reactor vendors have formed the Committee on Energy Awareness and are organizing "citizen groups."

Environmental activists may be able to expose these tactics. Our big problem is trying to compete for the hearts and minds of congressmen/women without the cash that corporations raise, mostly through political action committees. Corporations are forbidden from making political contributions, but citizen (employee) PAC's are perfectly legal.

In his speech at the Environmental Decade Conference, Gus Speth, Chairman of the President's Council on Environmental Quality (CEQ), spoke about the large flow of money through corporate PAC's to influence Congress to promote special interests. He quoted the warning from Common Cause, that "we are facing government of, by and for the PAC's of America." The number of corporate PAC's has grown from 89 in 1974 to 813 in 1979. U. S. Congressional committee chairs



receive an average of $43,000 from PAC's, and 155 congressmen/women received 40% of their support from PAC's in 1978. Speth believes we must correct this flaw in our political system by restoring the balance destroyed by statutory provisions favoring PAC's and by partial public financing of Senate and House elections.

PAC's have influence at the state level also. The Kansas Electric Cooperatives are associated with a PAC called "Funds for Friends." The First National Bank of Topeka is represented by "Citizens for Good Government." The "Political Action Council of Kansas" is affiliated with the Kansas Association of Commerce and Industry, and the "Civic Pledge Program" is affiliated with the Boeing Company. A candidate's campaign finance report must list the name of the contributing PAC, but one would not know the PAC's affiliation without checking its statement of organization in the Secretary of State's office.

Environmental groups could form PAC's at the state or national level, but could they be an effective force in countering corporate power? Mike McCabe, executive director of Earth Day '80, came to the conclusion that environmentalists could make more of an impact by door to door campaigning for candidates or issues, than through campaign donations. This would mean greater political involvement by the grassroots activists.

A Local Environmental Agenda

One of the main threads coming out of the Estes Park Conference was that we can't expect to accomplish as much through the federal government in the second environmental decade. Inflation, tighter budgets, higher defense costs, a mood of anti-regulation, and the possible election of Ronald Reagan as President (Governor Tom McCall suggested that environmentalists had better establish diplomatic relations with Reagan - just in case.) all contribute to this prediction. If we accept this conclusion, then we will help to make it come true, so of course we can't accept it. Alaskans won't save Alaska. Individual counties cannot regulate acid rain; the federal government must stay involved.

But we can work hard at the local level on two very important items. In an unofficial session, delegates at the Environmental Conference created an environmental agenda for the 80's with forty-two items listed. A straw poll rated soft energy paths as priority one and the preservation of agricultural lands as priority two. These top two issues can be tackled at the local level.

Mari Peterson from The Land Institute is working on a community development project in energy planning. People in Wabaunsee County are getting together to assess their end use energy needs and explore ways of meeting these needs through conservation and renewable energy sources. Partly because of The County Energy Plan Guidebook by Alan Okagaki and Jim Benson, people all over the nation are organizing at the county level to work together on their energy needs.

Enlightened local governments can pass ordinances which encourage and assist soft energy path development. Portland, Oregon will require all homes sold after 1974 to be weatherized, according to former Governor of Oregon, Tom McCall. The University of California Appropriate Technology Newsletter, UCAT NEWS AND VIEWS, Fall 1979 issue discusses action by local governments which have made a great impact upon the number of solar installations in California (at that time, 50,000). In the previous six months, thirty-five local jurisdictions in California had adopted or were in the process of adopting, ordinances or programs which encouraged the use of solar energy, such as requiring all new homes constructed to have solar hot water heaters or passive solar design. If present trends continue, California will have 1.5 million solar installations and 30,000 people employed in the solar industry by 1985.

Almost all land use regulations are made by city and county planning and zoning commissions and city and county councils or boards. In their hands lie the food supply of our grandchildren, as they make decisions affecting the destruction or the preservation of agricultural land. But local government is the most susceptible to the pressure of economic interests, and urban development is replacing farmland all over the United States. The planners working for cities and counties generally know the right principles, and they do Ian McHarg-type plastic overlays to identify prime agricultural land, but by the time the local developers, businessmen and chamber of commerce get through with the plans, old patterns of development prevail.

In May I gave the commencement address to graduates of the College of Architecture and Design at Kansas State University. The speaker's stand faced the audience of parents and friends, and I stood with my back to the graduates. The speech had been prepared for the graduates, and I felt awkward delivering it to the wrong audience. Thinking about it later, however, I decided that parents and relatives probably were the right audience. The graduates in architecture, landscape architecture, and community and regional planning had studied energy efficient design and ecological land use principles. Their parents who serve on city and county commissions, or influence them, needed to hear me talk about the priority items for the environmental agenda in the 80's, soft energy paths and the preservation of agricultural land.

Environmentalists in the 80's must build a broader base of support. Bridges can be built and coalitions formed if effective communication and education lay the groundwork. The June 1980 issue of Environmental Action contains an article by Rochelle M. Wallace called "Voting No on Nuclear," (pg. 30) which tells how Skagit County in Washington voted no on the siting of a nuclear power plant in their area. 71.6% of the voters declared their opposition to the planned nuclear facility in a nonbinding referendum. Puget Power has placed a "self-imposed" moritorium on the project and dismantled its Nuclear Information Center. This was the climax of nine years of litigation, education, organizing, campaigning, and coalition building. Even the local Chamber of Commerce joined in opposition to the plant.

In his speech at Estes Park, Gus Speth urged participants to form coalitions with the urban poor who experience the worst of environmental degradation, the working people who are often guinea pigs for toxic chemical testing, the nation's farmers who lose land in the millions of acres each year, and the concerned and enlightened businessmen (often victims of corporate power also) whose cooperation is necessary at the local level.

After hearing the speeches by Brock Evans, Peter Harnik, Gus Speth and Gov. Tom McCall at the Environmental Decade Conference, my pessimism dimmed, and hope returned. There is much we can do in the 1980's, but not unless we're "playing with a full deck" and applying the best stragegy.

People in Skagit County, Washington are politically sophisticated after their nine years of battle. Most of us don't like to become involved with an issue which could take that long to be decided. Achieving corporate accountability, election reform and effective local action based on coalition building will require imaginative strategy, designed by dedicated, patient people.

E. F. Schumacher said in Salina in March, 1977, "If you know you are going on a long journey, you just get up early." A long, hard journey through the 80's awaits environmentalists for sure, so set that alarm clock!

The Great Plains in Transition

An Open Letter to Six Governors

from Wes Jackson

John Carlin, Kansas; Charles Thone, Nebraska; Richard Lamm, Colorado; George Nigh, Oklahoma; William Clements, Texas; Bruce King, New Mexico.

In May, the Kansas City Star carried an article which, upon first reading, sounded like a humorous spoof. When it became clear that the six of you had, in fact, voted that $775,000 be paid the Army Corps of Engineers for a study of the feasibility of transporting water from the Missouri or White River to recharge the Ogallala Aquifer in the High Plains, I began to reach for the calculator. Fifteen minutes later, after making calculations based on numerous assumptions favorable to the project, I still doubted that the Corps would actually undertake the study. They may be hard up these days, I reasoned, but a simple letter should explain why they could not, in good conscience, accept the money. I understand that they have.

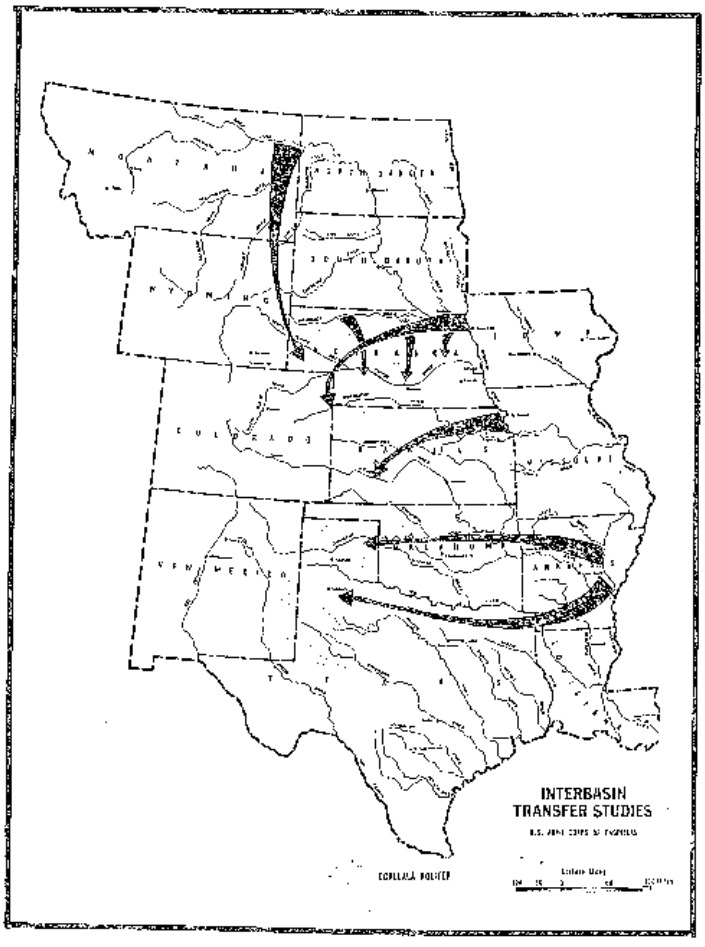
The estimate by the Austin, Texas, firm of Camp, Dresser and McKee of 14 million acre-feet withdrawal in a single year from the Ogallala sounded much too large at first. This upward discharge through metal and plastic irrigation tubing is greater than the 12 million acre-feet which flows by Lee's Ferry on the Colorado each year, and greater than the 12.5 million acre-feet annual discharge of the 33rd largest river in the country, the Delaware. If the Ogallala were a river, it would be in the top 30 of all our nation's rivers, including Alaska and Hawaii, and it only "flows" a few months each year. But in thinking about the nearly 24,000 square miles of irrigated land across the Ogallala, the Texas firm's estimate may not be far off.

To annually supply such a volume, the Missouri and the White are obvious candidates. Unfortunately, since the land from above the Ogallala is higher than either basin, gravity feed is out. It could be pulled off somewhere on the Yellowstone by gravity, but there isn't much water by that point, and it is mostly spoken for. Consequently, we are forced to consider the costs for moving water uphill.

Some Energy and Equipment Costs for Recharging the Aquifer.

No one can now give a trustable estimate as to how many tens of billions would have to be spent on pipe and reservoirs to divert either Missouri or White River water to the high ground above the Ogallala. We can, however, provide a reasonable estimate of the energy and ordinary materials cost, which includes pumps and motors, once the major conduit is laid. Though it would be a massive project, let us ignore that initial price and be optimistic in our estimates. One newspaper article said it would be a twenty year project, and since liquid fuels would be cost-prohibitive by the time the project was complete, the pumping energy would likely come from coal or nuclear power plants. If we assume that each kilowatt-hour will cost 5¢, a 188 feet lift of an acre-foot would cost $12.50. Wear and tear on pumps and motors is directly related to kilowatt-hour consumption. So, if we assume that an amount equal to the electricity cost be added to account for cost and maintenance of motors and pumps, a 188 feet lift of an acre-foot would cost $25.

St. Joseph, Missouri is 850 feet above sea level. Dodge City, Kansas is 2480, 1630 feet higher than St. Joe. Lift alone will cost $216 an acre foot. To replace 14 million acre feet a year will cost over $3 billion. Lubbock,

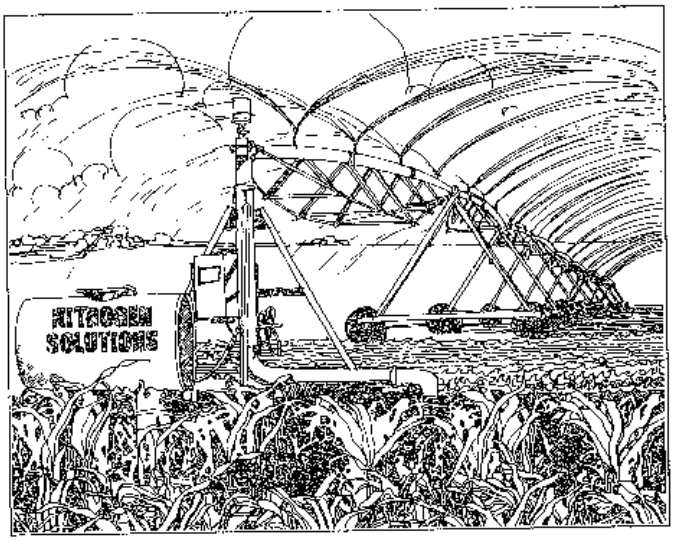


Texas rests at 3190 feet, requiring $311 an acre-foot to lift water from St. Joe, or over $4.35 billion for the 14 million acre feet total.

I realize the money you voted to pay the Corps is part of a $6 million package allocated by the Federal government to the High Plains Council in 1976 for the specific purpose of studying energy and water in the High Plains, and the economy which irrigation from the Ogallala has fostered. But what kind of an economy can expensive, pumped-in water support? Since irrigated land over the Ogallala is about 2.8 times more productive than dry land, we can make some assumptions about the value of the water to agriculture and quickly determine whether such a large plan is feasible or not.

Let us assume that 140 bushels per acre corn is grown with irrigation. Dividing by 2.8, we would expect only 50 bushels of corn equivalent to be grown on dry land. (Equivalent is inserted and emphasized here, for scarcely any yield could be expected from corn in the area without water. We would have to substitute some drought-resistant crop, such as sorghum milo.) Twenty inches of water spread over an acre is 1.67 acre-feet, the amount necessary to produce 140 bushel corn. This 20 inches pumped from St. Joe onto one acre at Dodge City would cost $361. Assuming that our 90 bushels of corn equivalent (the production gain due to irrigation) brought $3 a bushel for a gross of $270, we have a $91 deficit before we even begin to subtract the costs for growing the corn.

Of course, corn isn't the only agricultural product in this region which contains twenty percent of all irrigated land in the nation. Forty percent of all feedlot cattle are fed here as well. If we assume the corn is fed to cattle with a 9:1 conversion ratio, we can readily see that a steer brought onto a feedlot weighing 700 pounds and sold after a 300 pound gain at 1000 pounds will have consumed 2700 pounds of corn, or 48.21 bushels of corn equivalent. Looked at another way, this amounts to 0.54 acre of additional yield due to the 20



inches of water on each square foot. We can determine the number of pounds of water per pound of beef as follows:

$$\frac{62 \text{ lbs } H_2O}{\text{per ft}^3} \times \frac{1.67 \text{ ft}^3}{\text{for 20" } H_2O} \times \frac{43{,}560 \text{ ft}^2}{\text{per 1 acre}} \times \frac{0.54 \text{ acres}}{\text{to raise 2700 lbs of corn}} = \frac{2{,}435{,}509 \text{ lbs. } H_2O}{300 \text{ lbs. beef}}$$

or 8118 lbs. H_2O/lb of beef

This 8118 pounds of water per pound of beef is before we subtract the losses due to dress-out. When we hold all other costs to zero, except for the actual transport of water into the area (aquaduct construction, costs for growing corn, costs for growing the beef are all placed at zero), the 300 added pounds to that steer has a $194.40 price tag for water alone, or about 65¢ for each additional live weight pound. How can Dodge City feedlot owners compete with Iowa-fed beef?

Is there a Hidden Agenda in All This?

Obviously the proposed project will bankrupt the farmers if they have to pay anything close to the real costs. I read in one of the papers that probably only 1-3 million acre feet would be diverted each year instead of the 14 million acre-feet annual loss. At the time, I thought this was to placate the people downstrem from St. Joe, but it ties in with a brand new consideration. Since industry can afford to pay from 10 to 100 times more for a gallon of water than can agriculture, I now wonder if the motivation for inter-basin water transfer (from either the Missouri or the White River) is to support industry which wants to locate close to the coal and shale. Corporations probably realize that the water in the Ogallala is spoken for by farmers. So, I wonder if the trick is to get the diversion canals and pipeline constructed under the guise of maintaining agriculture, and then use it for industrial development adjacent to the new national sacrifice area for energy in the Rockies. A big new problem does threaten industry. Our new coal and shale resources are not near dependable quantities of water. Industry would like it otherwise, and so would certain powerful forces in the new energy region.

Is there a plan underway to play on the American public's sympathy for agriculture and get taxpayers to foot the huge bill for water diversion for industry? I don't know. But either our leaders can't count, or we are being tricked by corporate-industrial interests.

The Great Plains economy could dry up with the aquifer. The rural life, the small town life, and the values they espouse, which are

very important for the people who hold them and for the country at large, could disappear. But other alternatives for helping the area should be considered.

That $775,000 could have been spent on a feasibility study to look at the water conservation potential across the entire array of possibilities, including the greater use of return flow. One private firm could have studied different crop mixes and even considered more intensive use of the land on a much reduced acreage to produce some of the vegetable crops now being grown in California. The central location of the Great Plains would mean lower energy costs for distribution of farm products, which should offset much of the liability associated with a shorter growing season. I think we could show that much of the land could be put back into prairie grasses and help solve the regional soil loss problem with little, if any economic loss. Certainly, a decrease in the total grain which is fed beef could help our economy. The value of meat would scarcely decline at all with fewer days on the feedlot, and the savings in energy and money would leave a net gain. Certainly soil health and personal health would improve with less grain standing behind our red meat.

Whatever we do, we should avoid centralization. Centralized delivery of water is inherently different from the decentralized lifting of water from the aquifer now. Centralized delivery is in the tradition of the electric utilities where continuous power remains reasonably assured by virtue of the grid system. It would be cost prohibitive to develop a water system on a grid. And we are now seeing the economic vulnerability of that approach as we witness the decreased bond rating of the traditionally solid utilities.

We haven't even touched on the social and political implications of centralization, but for beginners, they both invite tyranny and technological priesthoods. Since even in the short run, water is more important than electricity, wherever possible, we should avoid centralization of water delivery.

I encourage you to step on the neck of this expensive madness now.

Urbanization of Agricultural Land

One million acres of America's prime farmland and two million acres of lesser quality agricultural land are lost to highways, houses, shopping centers and other urban development each year. The state of Kansas has eight percent of the prime agricultural land in the United States. Only Texas has more. Our of 480,000 total acres in Saline County, 371,000 acres are prime agricultural land.

Twenty-eight people came to The Land on the evening of EARTH DAY to hear Duane Goecrend (District Conservationist in Saline County), Dana Morse (Saline County Planner), and Joyce Fent (a member of the City Planning Commission representing the area within three miles of the city limits), discuss attempts to prevent urbanization of agricultural land in Saline County.

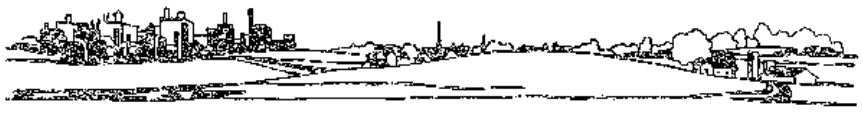
Everyone became actively involved in a discussion, moderated by Steve Burr, about how the dream of "two acres and independence" can be destroyed by proposed solutions, such as ten or forty acre minimum lot size for any new homes built in the country, or preventing new water districts from forming. An affordable place in the country may not have water, but water districts enable Mother Earth readers to move out and pipe water in. The Farmers' Home Administration was given the job of helping farmers form water districts. It is now enabling land speculators to build housing developments. FHA has not filed environmental impact statements unless forced to do so as it was in Saline County.

Homesteaders may in reality take better care of the soil than wheat farmers, and their land is not lost agricultural land if they grow gardens and orchards. However, once opened up for residences, farmland too easily becomes rural suburbia, inhabited by people who love to ride mowers. The growth-inducing impact (roads, schools, sewers, gas stations, fire departments, etc.) is hard to realize when the first house goes up in a rural area.

The EARTH DAY program was the first of several discussions on this topic which we plan to schedule at The Land Institute in 1980.

PRIME AGRICULTURAL LANDS SYMPOSIUM

The Salina Chapter of the Soil Conservation Society and the Kansas Association of County Planners are sponsoring a symposium on Prime Agricultural Land on October 17th, 9:00 A.M. to 4:00 P.M., at the Red Coach Inn in Salina, Kansas. The registration fee is $15, which includes lunch. Write Duane Goecrend, Soil Conservation Service, 760 S. Broadway, Salina, Kansas 67401 for more information.



Prairie Festival '80

Laura Jackson

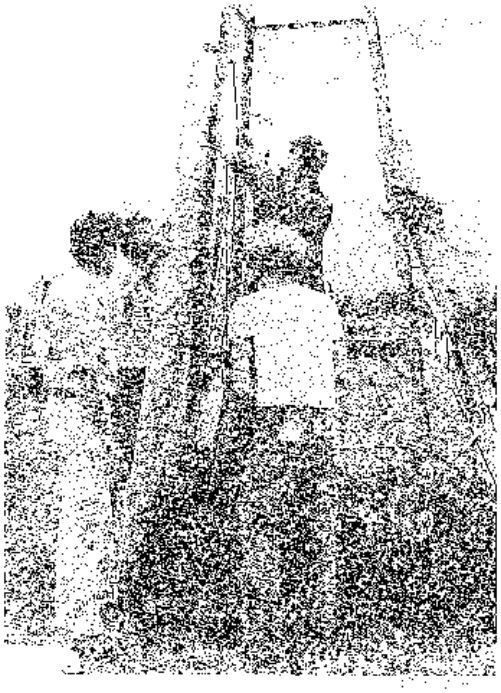
"Prairie Roots, Human Roots: the Ground of our Culture and Agriculture" was the title of a prairie program planned and produced by Jim Peterson and Terry Evans on the evening of June 2, 1979, under a grant to The Land Institute from the Kansas Committee for the Humanities. The Saturday program at Evans Ranch was followed by a Sunday open house, potluck dinner and speeches by Hunter Sheldon (Lovins), Amory Lovins, and David Brower at The Land. Friends of the Earth members in the region were invited to meet Friends of The Land. The weekend was such a success that The Land Institute decided to make it a yearly event.

Although all interested persons were welcome, Prairie Festival '80 was not advertised as a public event as it had been in 1979. There was no grant money to support it, so The Land charged minimal registration fees to meet some of the expenses. Prairie Festival '80 invitations were mailed to Friends of The Land, members of the Prairieland Food Cooperative, the Smoky Hills Audubon Society, other known environmentalists and alternatives groups in Kansas, and regional members of the New Alchemy Institute.

Terry Evans' photograph of a fairy ring at the Fents' prairie was featured on the invitation. The fairy ring, a beautiful, natural phenomenon on the prairie which inspires awe but has a scientific explanation, was the symbol for this year's festival. The combination of science and wonder is important to an organization on Cape Cod, similar to The Land Institute, the New Alchemy Institute; and the director and co-founder, Dr. John Todd, joined the celebration of the prairie ecosystem and prairie folk as the special guest speaker on Sunday afternoon.

Like any outdoor event, the fate of the May 31-June 1 Prairie Festival was governed by weather. As the first campers and picnickers began arriving at five o'clock on Saturday, the clouds that had been hovering serenely to our north began to look more businesslike as they marched toward us. About twenty-five campers set up tents in a brisk wind, and newcomers inquired nervously about the forecast. Nevertheless, Friends of The Land and other prairie lovers gathered in small groups at different spots to eat their picnic suppers before the first official event of the weekend, a concert given by "Hanson Pickin Bluegrass" of Salina. Glancing at the advancing clouds, the musicians wondered if they would be able to go the length of the performance before their speakers were zapped by a bolt of lightning, but they played their toe-tapping, sing-along music just the same. A strong south wind fought for control of the microphone, but the clouds kept coming from the north. It was an evening of uncertainty.

Wes Jackson introduced the open mike session for musicians and speakers who wished to share their love for the prairie or their efforts to protect its life, culture and future. Steve Burr discussed activities of the Smoky Hills Audubon Society and the political force of the National Audubon Society as a protector of the environment. Dick Courter described the efforts of the Alaska Coalition and Bill Whitney spoke about prairie preservation and the new Prairie Plains Resource Center in Aurora, Nebraska. Sue Lukens of the Kansas Organic Producers, Dan Bentley of the Lawrence Appropriate Technology Center, and Mary Ann Powell of the Prairieland Food Cooperative outlined the activities of



Stan Tippin, John Craft, Jim Peterson and Marty Bender set up a screen for the slide show.

their respective organizations. John Craft talked about the potential for wind energy in Kansas, and Paul Johnson, legislative advocate for the Kansas Legal Services in Topeka, talked about efforts to monitor the Kansas Corporation Commission in its regulation of electric utilities. Mari Peterson described the county energy planning project which she and Diane Tegtmeier of the Mid-America Coalition for Energy Alternatives are organizing. Maure Weigel and Dana Jackson spoke about the importance of involvement and network support.

By this time, evening had fallen. The clouds which enclosed us to the North , west and east were ominous, but not immediately threatening. Jim Peterson closed the program with a showing of the slide/tape presentation created for the first Prairie Program in 1979 by Dr. Robert Regier, Chairman of the Art Department at Bethel College. The song of a meadowlark and strains of a flute drifted out over the hill; the collage of color slides competed with the silhouette of a thunderhead lit by lightning on the darkening western horizon. The slides showed us bright flowers and clear, sweeping landscapes, but the clouds were low around us, and the wind was persistent.

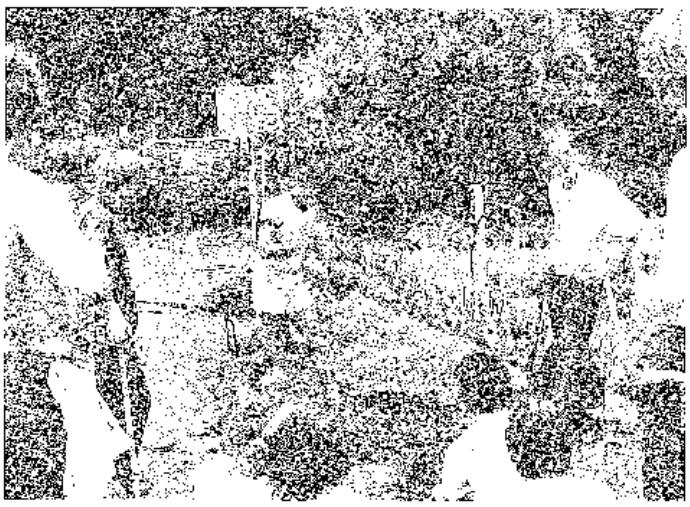
The tornado siren sounded in town that night. Tent campers in the orchard were on alert to retreat to the first floor of the building if necessary. No tornado approached our immediate area, but some houses were damaged north of Salina. The people who came to the prairie festival were lovers of the prairie, her protectors and defenders, yet they were completely at her mercy that evening.

Mari Peterson helps Sunday guests register.

The proverbial dawn did not break bright and clear, but still no rain threatened, the wind was down, and the sun's rays were cooled as they filtered through light clouds. The morning began with tours of The Land and explanations of the agricultural experiments. Then the 175 or so visitors had an opportunity to attend two of three, forty-five minute workshops on wind power, intensive bed gardening, or prairie wildflower identification.

John Craft, former research associate who installed both the Jacobs and the Wincharger wind generators at The Land, answered questions about the machines at The Land and the future of wind energy.

Two spring semester students, Stan Tippin and Michael Chapman, a student from the Univ. of California, Santa Cruz, Garden Project, and research associate Kelly Kindscher demonstrated how to double dig a French intensive bed in a section of the garden. They also fielded general questions about composting and organic gardening.



Wes explains Eastern Gamagrass research on tour.

Marty Bender, Director of the Herbary, started his workshop among the rows of prairie perennials by discussing basic flower and leaf identification. Then he took the participants across the road to a lightly-grazed pasture and taught them to identify Wild Blue Indigo, Penstemon, and other prairie wild flowers.

The workshops ended at 12:45. Children and food were hustled down to the picnic area for an unusual pot luck dinner. No jello, cool whip topping or hot dogs could be found. Sprouts, fresh garden vegetables and fruits, and whole wheat bread are the staples of a "New Age" pot luck. After lunch and some pleasant communion among the kindred spirits gathered there, Wes Jackson introduced John Todd.

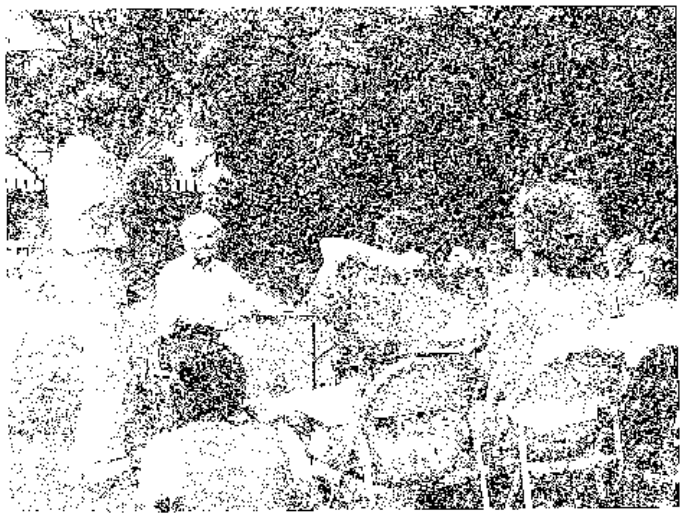
Todd began with an account of his metamorphosis as a passive "doom watcher" into a scientist actively searching for holistic alternatives to our civilization's path to self destruction. He attended an environmental conference stocked with scientists whose concerns were limited to their own specialized disciplines. The conclusion of each was that his or her study required more extensive, expensive research to validate it. No one would breach "his field" to examine problems in a broader way.

Another experience which helped him formulate the central ideas upon which New Alchemy are based came in the form of a graduate course that he taught at San Diego State University.

He and his graduate students tried to come up with a program to make some dry, rocky, ranchland just north of the Mexican border a liveable place for a community interested in being relatively self-sufficient. Their efforts were in vain until they decided to learn how the ecosystem of the area worked. When they took a closer look at every aspect of the life there, they discovered the presence of a water-loving plant, indicating a deep aquifer, and certain other plant associations which suggested tillable soils. Gradually a design emerged based on what they had learned from the earth.

The concept of the earth as tutor and pattern led to the founding of the New Alchemy Institute on Cape Cod and the construction of the Ark, a large, food-producing solar greenhouse. Within the Ark, the New Alchemists set out to "miniaturize the earth." In order to simulate the oceans' (70% of the earth) contribution to the biosphere, they built ponds stocked with Tilapia fish and "seeded" with pond water from different parts of the country. Eventually about fifteen species of algae were established, among them species that processed nitrogenous wastes. Observing that continuous circulation of a water system is necessary for higher productivity, the Alchemists established a closed loop of connecting ponds, so that water movement would resemble a meandering river. A species of tail-thumping carp was added to cir-

Tours began by the dump rake.



Wes Jackson introduces New Alchemist John Todd.

culate water vertically in the ponds. Terrestrial elements such as insects and vegetation were also added to the system.

Happily, the aquaculture systems inside the bioshelter resembled the fresh and saltwater systems outside, not only as producers of high protein food, but also as heat sinks. When the ponds were raised above ground in transparent tanks, they served as living low temperature furnaces. Thirteen ponds provide winter heating for the Cape Cod Ark.

John Todd told a very interested audience about other work of the New Alchemists, including the construction of the Ark on Prince Edward Island financed by the Canadian government, and the recent research to develop an agriculture that simulates the forest. They are creating an "arboretum of economic trees" at New Alchemy, trying to find varieties well adapted or adaptable to their climatic conditions.

Then he described his newest project, a sailing ship designed to transport live fish and tree seedlings around the world to areas of impoverished genetic stock. (For a detailed account of his plans, see the Fall 1979 issue of CoEvolution Quarterly.) A symbol such as this would capture the imagination of people all around the world, bringing them a keener sense of the earth as a global village.

At the end of the speech, Dana and Wes Jackson presented John Todd with a color print of the photograph by Terry Evans of the fairy ring that was the symbol of Prairie Festival '80.

Todd's speech was a testimony for the success of using the earth's natural systems as models for human endeavors. He substantiated our convictions that the alternatives we seek are not to be found in the imagination of science fiction writers or the reductionistic research of "Science" with a capital S, but in our own holistic understanding of natural systems and the problems at hand.

The listeners responded warmly, recognizing that the work done at New Alchemy and the work done at The Land Institute and in each of their own organizations was part of the same cauldron from which the Philosopher's Stone would slowly emerge. We were all made to feel as fellow new alchemists, cooperating in the synthesis of a new age livelihood based on sustainability.

Friends of The Land

The Friends of The Land have been extremely important to The Land Institute. Many helped collect materials to build the first building; many donated time and labor after that building burned to help start reconstructing the classroom/library/shop. Friends donated books and money to help develop another library. The Land needs these friends, and new friends too.

The Land Institute is a private, educational-research organization, financed by student tuitions and private gifts. Contributors receive THE LAND REPORT, any special publications, and notices of interesting events at The Land. The Land Institute is a non-profit organization, and all gifts are tax deductible.

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The beautiful greenish blossoms of the GREEN ANTELOPEHORN (Asclepias viridis) may be over-looked because of its less conspicuous color and also because the plant is low and spreading. The flowers form large clusters along and at the ends of the stems. The leaves are easily recognized as belonging to the milkweed family. This perennial prairie plant blossoms from late May to July.