The Ark Project
Spry Point, P.E.I.

The Year In Review
January, 1981

AN ARK FOR P.E.I.

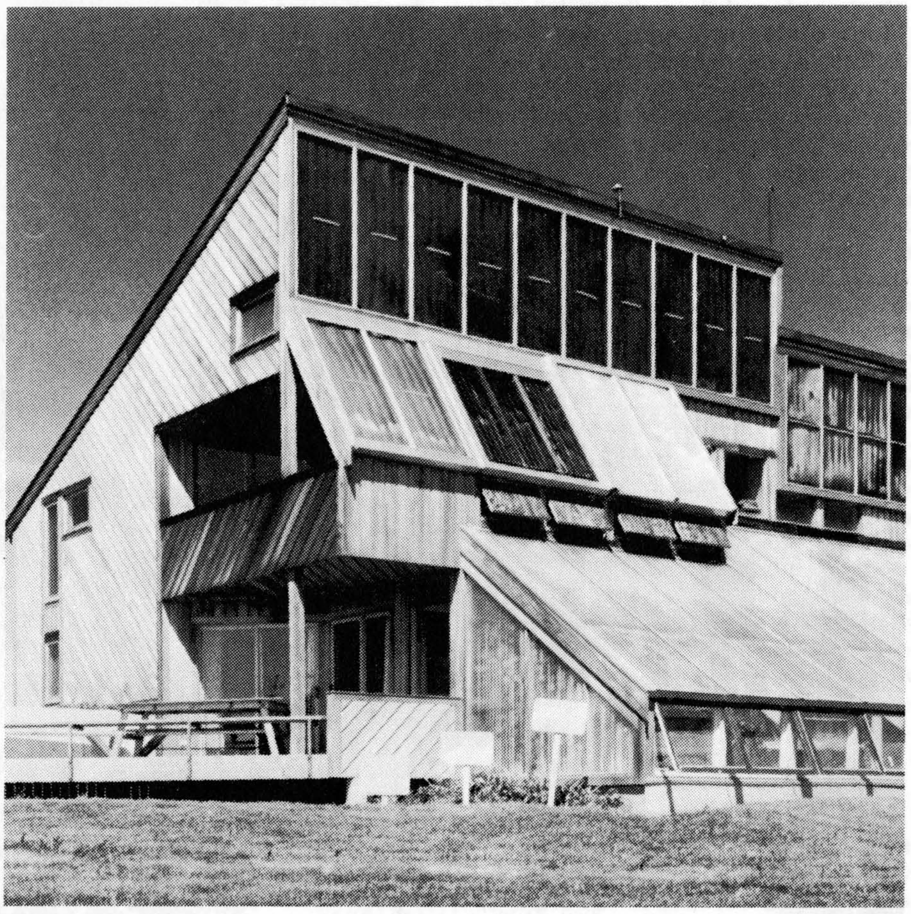
The P.E.I. Ark was officially opened in September, 1976, with considerable fanfare. Present were the Prime Minister of Canada, the Premier of P.E.I. and numerous friends from around the world. Once the early excitement had died away, it soon became evident that the Ark was faced with an almost impossible task. It had been built as an urban demonstration (part of Canada's contribution to the UN Habitat Conference), yet was sited on 180 acres in rural P.E.I. With a very small staff and limited financial resources, the Ark was commissioned to research and develop a wide range of technologies which were to be environmentally benign, resource-conserving and were to make use of renewable energy. The constituency was not only P.E.I. and Canada; the Ark was also seen as a statement of Canada's commitment to third world development.

It was immediately obvious that the Ark was a very successful demonstration, evidenced by considerable media coverage and a high visitation rate even before the building was completed. The site offered unusual possibilities for public education in conserving technologies and renewable energy. However, the symbolic nature of the Ark, touted as representing the "way of the future" and offering to teach others to "live lightly on the earth", has caused difficulties, leading to unrealistic expectations on the part of believers, and a healthy skepticism in others. In 1978, management was assumed by the Institute of Man and Resources, and it has been only within the last three years that sufficient staff have been present to carry out the promised investigations.

THE RESEARCH MANDATE

The mandate of research at the Ark has been redefined to encompass more realistic goals. The introduction and development of solar, wind and wood energy technologies to P.E.I. have been taken on by other programs at the Institute of Man and Resources. This work requires technical personnel and financial resources far exceeding those of the Ark Project. Currently, research at the Ark is directed towards developing ways for Prince Edward Island to become more self-reliant in food.

This means finding ways to replace food imports with locally grown food, produced in a way that sustains natural resources and conserves energy. A broader diversity of food crops produced locally makes the best use of available land and other resources. Food production on the household level also can contribute to regional self-reliance with intensive use of vegetable gardens and home greenhouses. As 40 percent of the



The main building faces south, exposing collectors to the winter sun. The long, low north roof deflects prevailing winds up and over the building.

energy used in producing food is presently consumed by transportation, processing and marketing, home food production represents a considerable energy saving, with economic benefits to the region.

Another concern is the avoidance of toxic pesticides and herbicides in food production. It is becoming increasingly evident that the economic, environmental and health costs associated with the use of these biocides are extremely high, and research into production methods which do not depend on their application is essential.

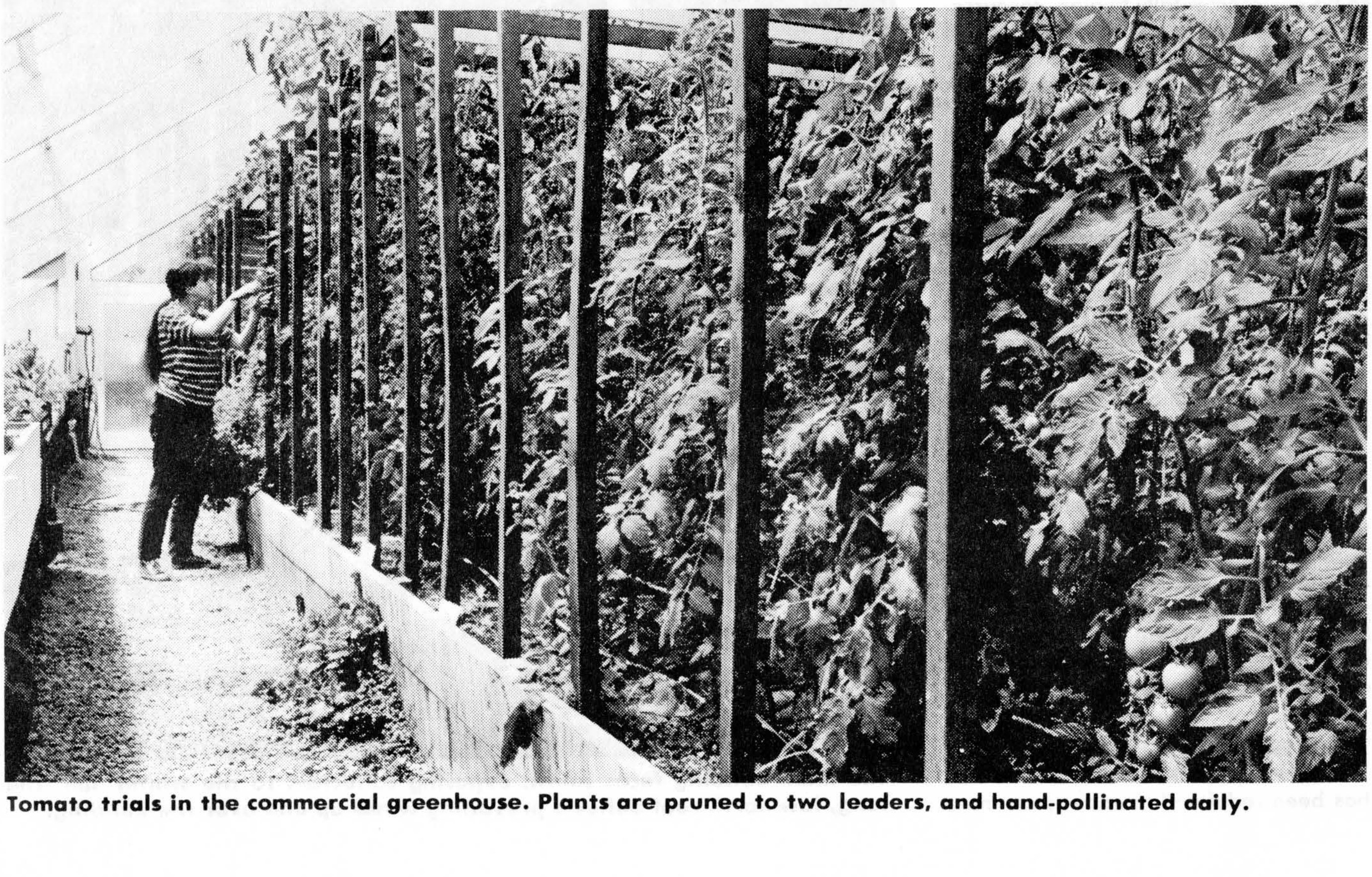
Current research and demonstration projects are therefore directed both to the householder and the commercial grower, and the educational and informative functions of the Ark Project are very important. The projects are aimed at diversifying and strengthening the elements of an integrated food system, based on a local level. Integration is stressed in the research projects, as many of them tend to overlap in positive, or mutually beneficial ways.

This emphasis on the integration of social and ecological systems is reflected in the structure of the Ark itself, which was originally designed as a family home, or "bioshelter". Through shared working space, offices, labs and growing areas, and the preparation and sharing of a daily staff lunch, communication is encouraged and facilitated. A permanent staff member is always available to talk with visitors on tour days, thus ensuring open communication between public and the staff.

A profusion of vegetables, flowers and herbs in the domestic greenhouse.

GREENHOUSE

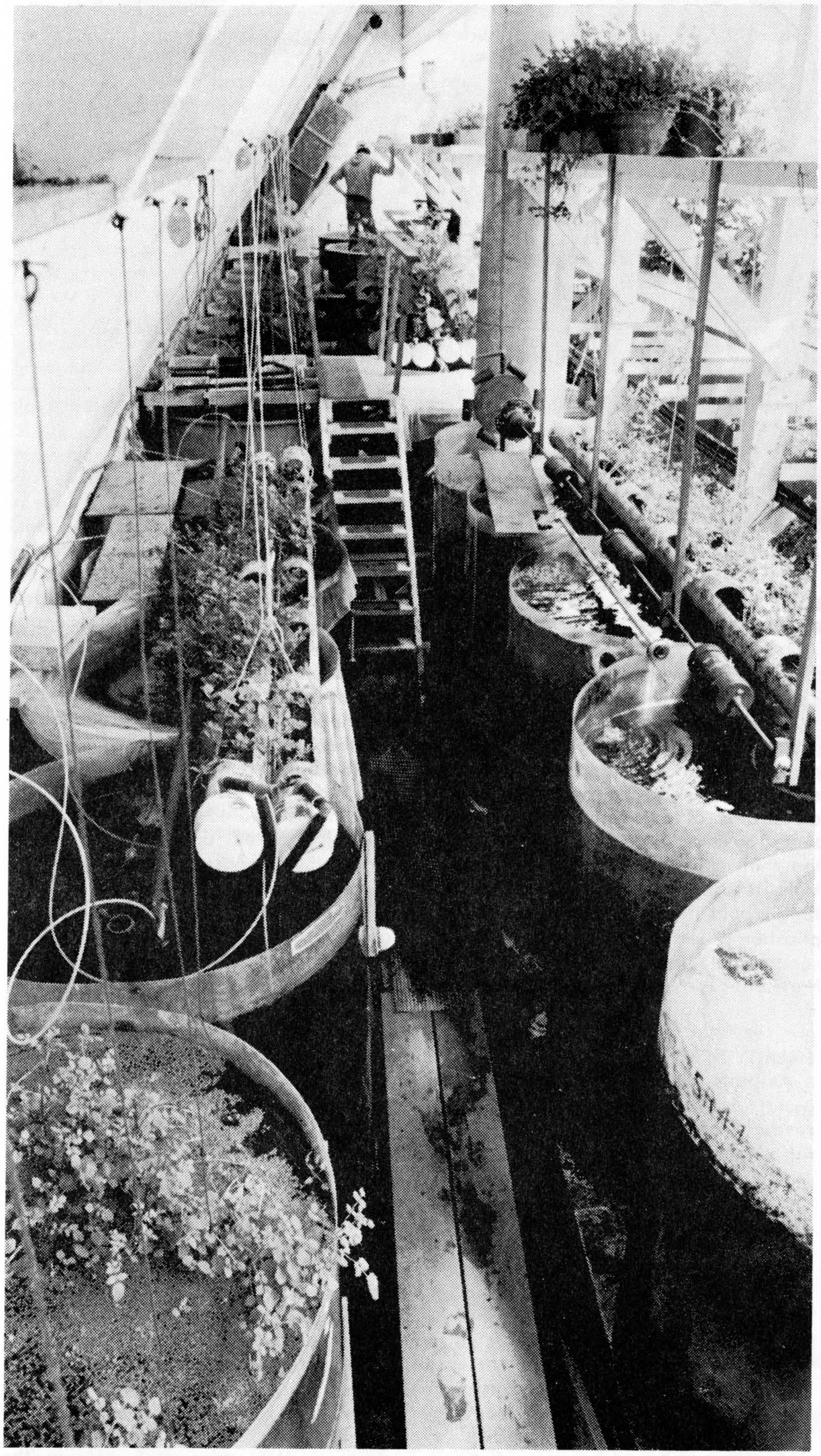
Only a small part of the 180 acre site is currently used by the research project, which comprises two main areas, horticulture and aquaculture. Two solar-heated greenhouses are incorporated in the main building. The smaller of the two is approximately 240 square feet in area. This is open to the kitchen-living space, and demonstrates how a family greenhouse may be used to produce fresh vegetables not only in the winter, but also year-round, for those who may



Tomato trials in the commercial greenhouse. Plants are pruned to two leaders, and hand-pollinated daily.

not have access to an outside garden.

This past year, over sixty varieties of vegetables were grown in the attached greenhouse, along with many flowers, herbs and fruits. In the larger greenhouse (2000 square feet, 100 percent solar heated), two crops of tomatoes are grown annually in deep soil beds, in rotation with a winter crop of loose head lettuce. Many varieties are tested for performance in the environmental conditions of a maritime solar-heated greenhouse, conditions which differ substantially from those found in conventional greenhouses. Fertility is maintained with the addition of compost. Insects are kept in check by a balanced population of beneficial insects. Perhaps the most exciting development in the greenhouse has been the continued use of a native insect, **Aphidoletes aphidimyza**, which provides excellent control over the aphid population. This insect is being studied in some European countries for use as a biologicial control agent in greenhouses, but its usefulness in this role has not been explored in North America.



The Ark's recirculating fish hatchery inside the greenhouse incorporates hydroponic vegetables and provides storage for solar heat.

The results of the research in the commercial greenhouse have formed the basis for the structural design of a new greenhouse now under construction on the site. This 2,500 square foot greenhouse will also be heated 100 percent with solar energy. The new design incorporates wet earth storage for heat, and steel web trusses which are designed to accept a double layer of Tedlar glazing stretched over steel frames. (These components are made locally by a small, recently-formed company specializing in energy-conserving solar greenhouse construction). There is glazing on two thirds of the north roof to allow light levels sufficient for high yields. Testing of the new greenhouse is scheduled to begin this spring, as soon as construction is completed. Two-thirds of the area will be used for horticultural crops and the remainder for a prototype fish hatchery.

AQUACULTURE

The aquaculture unit is an integral part of the large solar greenhouse, as the fish tanks provide about 60 percent of the heat storage. Rainbow and speckled trout, as well as Atlantic salmon, are hatched in the greenhouse from both imported eggs and eggs obtained from brood stock held over in the greenhouse all winter. The water is cleaned as it is circulated through hydroponic-bacterial filters. Bacteria change the toxic fish wastes to usable nutrients for plants such as tomatoes, lettuce, celery and comfrey, which are grown hydroponically. A pilot-scale commercial fish hatchery based on these design principles is currently under construction and will be tested this spring.

A fresh water cage culture program is being co-ordinated by the Ark in which associated growers are raising fingerlings to market size in cages. The Ark hatchery serves as a source of fingerlings for this project.

OUTDOOR HORTICULTURE

The outside gardens test different vegetable varieties for their suitability for growing with organic methods in this region. The vegetable garden has occupied the same site for four years and,

Salad greens ready for harvest in April, inside the shelter of the insulated cold frame.

with the application of lime, compost, seaweed, and clay phosphate, a highly productive and fertile soil has been developed. Several types of cultivation are being practised and monitored, including double digging, raised beds and trench composting. Varying techniques of pest and disease control are practised. A small fruit garden has been planted and several large insulated cold frames are being tested for season extension. There is also a nursery for plant material which will be used for future site development, such as windbreaks.

Spry Point's exposure to strong, salt-laden winds makes it an ideal site to test the resistance of plants to such conditions and their suitability to the shores of the Atlantic provinces. Experiments are being carried out in cooperation with Agriculture Canada, Kentville, N.S., in which various types of hedges are tested for potential use as windbreaks to protect other less resistant varieties of plants from exposure to salt.

Twenty tons of compost are manufactured at the Ark each summer, to provide the fertilizer needed in the greenhouse and the gardens. Measured amounts of spoiled hay, manure and seaweed are layered into piles, which are turned regularly to mix and aerate the material. Estimates show that the finished compost costs $38 / ton (based on $5.00/hour labour costs) and contains 3 percent nitrogen. This is equal in nitrogen value to 600 pounds of 10-10-10 chemical fertilizer which cost $61.00 in 1980.

BIOLOGICAL MANAGEMENT OF PLANT GROWTH

In the laboratory, the greenhouse and the outdoor gardens, research is being done on beneficial soil fungi called mycorrhyzae. These fungi live in close association with plant roots, and assist plants in taking up nutrients from the soil. Both wild and commercially produced strains of mycorrhyzae are being tested by inoculating plants and comparing their growth and yields with controls. It is hoped that eventually these fungi could be used to reduce the application of fertilizer necessary for good commercial yields of agricultural and horticultural crops.

ENERGY SYSTEMS

At this time, the emphasis on biological programs means that no research into wind energy systems is being pursued at the Ark. The initial wind machine, the prototype "Hydrowind", did not live up to its expectations because of design faults. It was dismantled two years ago. The vertical axis Darrieus wind turbine "Hydro-heat", donated to the Project for testing by the Department of Energy, Mines and Resources, was intended to produce heat, not electricity. It was coupled to a hydraulic system which was improperly designed by the manufacturer and has now been moved to the Atlantic Wind Test Site, at North Cape, P.E.I., another of the Institute of Man and Resources' projects. It is in operation there, and plans are to connect it with an electrical generator.

At the Ark, a small Bergey windmill has been ordered, which will be integrated with the air lift pumping system for the hatchery in the new greenhouse.

Other hardware, which was installed on the building when it was first constructed in 1975, is still in operation. The building is heated with passive solar energy, backed up with two wood stoves. Some of the space heat for the building is provided by an active solar system. Thirty-six Sunworks collectors are mounted vertically along the ridge of the building. There have been problems with the control system, due to incorrect initial installation, which have now been solved.

At the Ark, no research is being done into the performance of these solar collectors, other than monitoring and maintaining them. Seven domestic hot water solar collectors produce hot water for the building year-round. Further details about the performance of these systems and the Hydrowind can be obtained in papers available from the Ark Project.

Monitoring at the Ark is done with a Microlog computer. It continuously records data on solar radiation, temperatures (soil, greenhouse, cold frames, outside air, solar panels, water tanks) and oxygen levels in the fish tanks. The computer is also capable of analysing the performance data so that it is available for study. Inside the building, a Clivus Multrum composting toilet is installed to dispose of human and kitchen wastes. Over the years, it became apparent that the material in the Clivus was not decomposing properly. This fall the system was cleaned out, inspected and discovered to have been incorrectly installed. Consultation with several North American distributors of composting toilets produced some ideas on how to modify the Clivus and its installation to improve its performance. These have been put into practice.

The passive solar heat and the wood heat in the building are successful partly because of the heavy insulation, the double-glazed windows, and the partially earth-sheltered design of the building. To improve energy conservation and comfort further, a series of low-cost insulating shades and curtains have been contructed over the large windows in the west wall of the living area. These also serve as a demonstration of techniques which can be used to save energy in an already well-insulated home.

EDUCATION

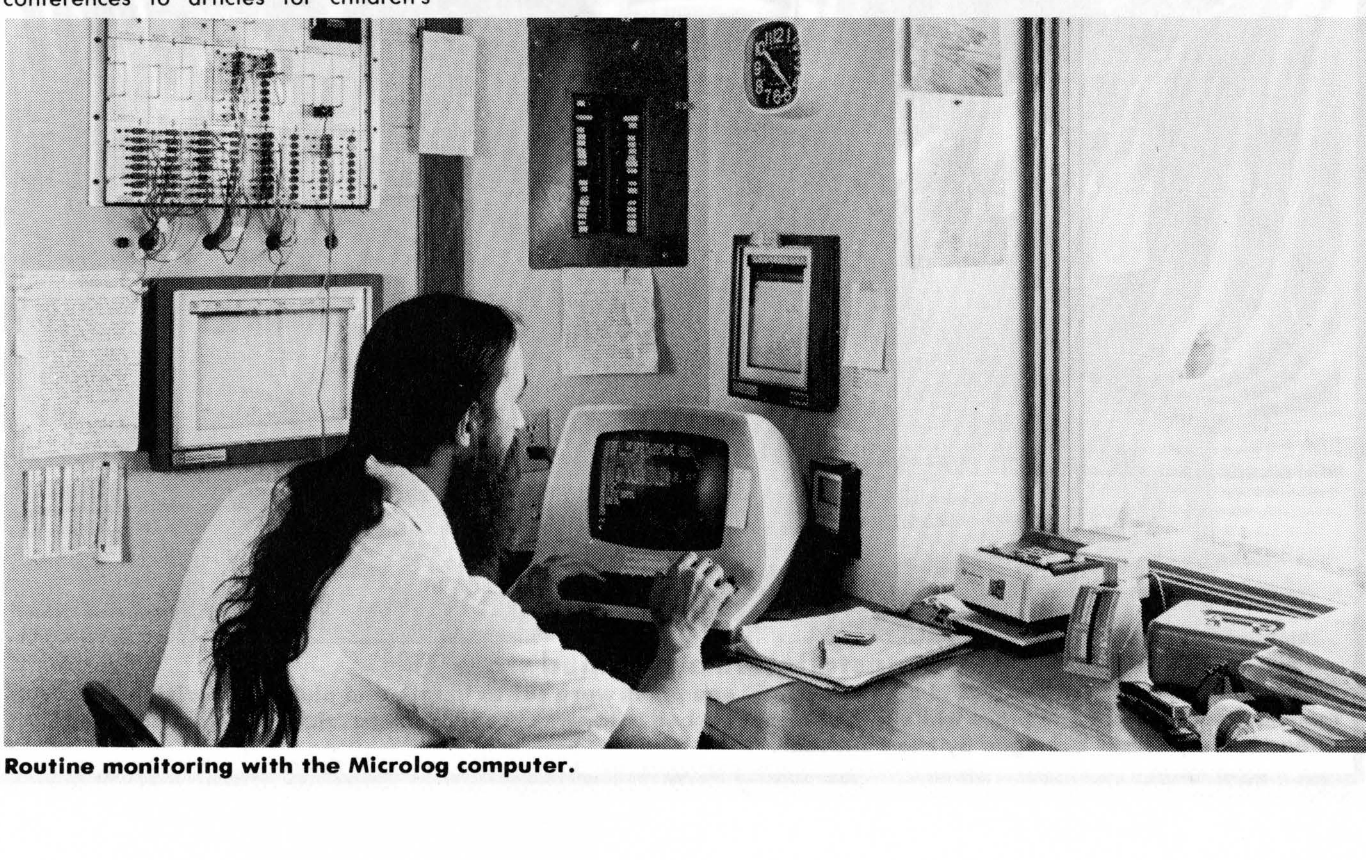
There are many ways in which the information accumulated at the Ark is disseminated. The visitor program makes the project site accessible to the public as each year approximately 5,000 people are given personal, guided tours through the grounds and the building. A series of workshops is offered covering many topics of interest. In the summer of 1980, a course was offered in which Islanders planning to build attached solar greenhouses could make use of a consultant service from the Ark when drawing up their plans. Publications range from research reports prepared for national and international scientific conferences to articles for children's magazines, and are available from the Project.

The resolution of the early difficulties with the energy systems, the management changeover and the careful redefinition of the research mandate has meant that the Ark has come a long way from its beginnings.

The research programs undertake varied approaches to the problems of low-energy, sustainable food production, and answers with immediate practical application are beginning to emerge.

The Ark Project of the Institute of Man and Resources is funded by the Department of Energy, Mines and Resources through the Canada-P.E.I. Agreement on Renewable Energy Development.

Dr. Ken MacKay, Director of the Ark Project, explains some aspects of the research to a group of visitors.

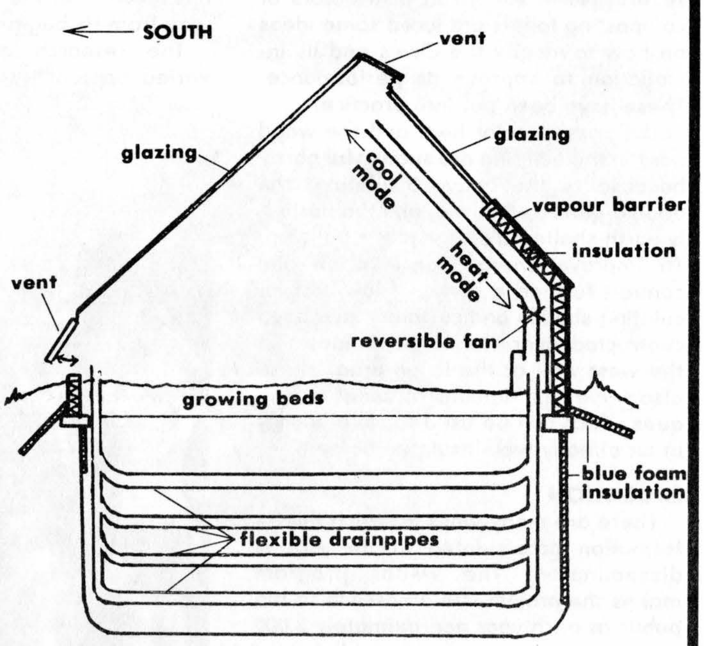


Routine monitoring with the Microlog computer.

How the mud-store greenhouse works

Beneath the greenhouse, a large volume of wet earth (14 feet deep, 30 feet wide, and the full length of the greenhouse) will be used to store solar heat. 4" flexible plastic pipes (the ends of which are still visible) will carry heated air down into the earth. A plywood manifold will encase the ends of the pipes on the north end of the greenhouse, connected to ducts leading down from the peak of the greenhouse. The hot air which collects in the peak will be drawn down through the ducts into the pipes by means of small reversible fans. The heat will be absorbed by the wet earth, and will build up in the store over the summer, the fall and on sunny days in the winter.

To release the heat for use in the winter, air will be drawn through the pipes in the opposite direction. Cold air will be heated in the store, and then circulated into the greenhouse, heating it throughout the winter.



Schematic cross-sectional diagram of the mud store and greenhouse superstructure

Installation of the mud store

A straight-sided pit was excavated by a bulldozer, and pipes were cut to length and placed in position. Ark staff members held the pipes in place while the bulldozer pushed in layers of soil. As long as the pipes are under two feet of earth, they aren't damaged by the bulldozer.

Publications available by mail order from the Ark Project

GREENHOUSE

Management of Solar Greenhouses, by Linda A. Gilkeson, August, 1979 (9 pages). A discussion of the modifications made to the original physical systems in the Ark commercial greenhouse, to create environmental conditions more favourable for plant growth. **$.50**

Commercial Tomato Production in Solar Greenhouses, by Linda A. Gilkeson, June, 1980 (7 pages). The results of the 1979 tomato experiments in the Ark greenhouse indicate that commercial-scale solar greenhouses must be designed to assure the high light levels necessary for commercial yields. **$.50**

Crop Production and Biological Management of the Solar Greenhouse at the P.E.I. Ark, by Linda A. Gilkeson, September, 1980 (7 pages). Three years of crop research show that commercially competitive yields can be obtained within a sustainable system, using biological control and renewable energy. **$.50**

Greenhouse Glazing Materials, June, 1980 (2 pages). Listing of suggested materials, properties, advantages, disadvantages, local suppliers and costs. **$.10**

Arkdex Series. Practical "How-to" fact sheets about growing food with a minimum of dependence on fossil fuel energy and with no chemical fertilizers or pesticides. Knowledge is based directly on research and demonstration projects at the Ark Project; all are written by the staff. Susan Mahoney, Editor. Titles, January 1980:

GH1 Preparation and Management of Greenhouse Soils. **$.25**
GH2 Seeding and Planting Techniques for Use in Greenhouses. **$.25**
GH3 Commercial Tomato Production in a Solar-Heated Greenhouse. **$.25**
GH4 Aphid Control. **$.25**
GH5 Ventilation in the Attached Solar Greenhouse. **$.25**
GH6 Fungus Diseases of Greenhouse Plants. **$.25; Set of 6 - $1.00**

Mud Storage: A New Concept in Greenhouse Heat Storage, by Anthony Caffell and Kenneth T. MacKay, September, 1980 (9 pages). A description of the use of wet earth as thermal storage for a solar-heated greenhouse: concept; simulation on a micro computer; design parameters; and installation experience. **$.50**

Horticultural Management of Solar Greenhouses in the Northeast, by Miriam Klein, 1980 (95 pages). Published by the Memphremagog Group, P.O. Box 456, VT 05855. (Note: not an Ark Project publication). A comprehensive description of the design and management of home-attached greenhouses in the northeast climate of the U.S. and Canada, following biological principles. **$5.50**

1980 Vegetable and Fruit Variety List for Home Greenhouses, (2 pages). **$.20**

AQUACULTURE

Aquaculture in an Ecological Agriculture, by Kenneth T. MacKay and G.B. Ayles, 1979 (58 pages). Background paper for the Science Council of Canada publication, **Agriculture in the Year 2000**. A detailed discussion of an approach to aquaculture characterized by energy efficiency, the use of locally available resources, a small scale of operation and waste recycling. **$6.00**

A Modular Recirculating Hatchery and Rearing System for Salmonids Utilizing Ecological Design Principles, by Wayne Van Toever and Kenneth T. MacKay, 1980 (14 pages). A description of the prototype salmonid hatchery and its performance in the solar greenhouse at the Ark Project. **$1.00**

Solar Aquaculture at the Prince Edward Island Ark, Canada, by Kenneth T. MacKay and Wayne Van Toever, September, 1980 (6 pages). A critique of the prototype recirculating hatchery in the solar greenhouse, with a discussion of the new design for the pilot-scale hatchery presently under construction at the Ark Project. **$.50**

Trout Cage Culture, by Wayne Van Toever, June, 1980 (5 pages). A description of the small-scale fresh water cage culture program at the Ark Project. **$.50**

Cage Design for Trout Cage Culture, by Alan MacLennan and Wayne Van Toever, June, 1980 (2 pages). How to build a small floating cage suitable for rearing fresh-water trout. **$.20**

HORTICULTURE

Compost: A Guide to Making and Using Compost, by Elizabeth Hall and the Ark staff, 1979 (14 pages). **$1.00**

Horticulture at the Ark Project, by June Carrington, June, 1980 (5 pages). An overview of the outdoor horticulture program. Topics include compost, the vegetable garden, biological pest control, mulches, salt resistance trials, the orchard and the insulated cold frame. **$.50**

Vegetable Variety List, 1980, 1981 (2 pages). A list of varieties which performed well in 1979 and 1980 in the Ark Project's garden. **$.20**

Introduction au Compostage, par Jacques Petit, Mouvement pour l'Agriculture Biologique, B.P. 41, Roxton Falls, P.Q. JOH 1E0 (N.B. Pas un publication du Project Arche) Cet publication donne un description des méthodes de préparation et d'utilisation de compost. **$.50**

GENERAL

A Collection of the Ark's monthly columns from **Rural Delivery**, January-June, 1980 (15 pages, includes black and white photographs). Articles include "Winter Salads from the Greenhouse", Transplanting Trees from the Wild", "Greenhouse Tomatoes", "Compost-Making", "Ecological Aquaculture", "Greenhouse Table Grapes", and gardening "Question and Answer" columns. **$1.00**

Owl Magazine, The Canadian Magazine for Children, April, 1980 (32 pages). This issue contains a full-colour artist's drawing of the Ark building, and the articles "Sunpower", "The Ark, a Solar Experiment", and "Dr. Zed's Solar Sprouter". **$1.00**

Solar Heating at the P.E.I. Ark, by Kenneth T. MacKay, 1979 (9 pages). A description of the active and passive solar heating systems used in the main building at the Ark Project, and their performance. **$1.00**

Proceedings of the P.E.I. Conference on Ecological Agriculture, 1979 (196 pages). An edited transcript of the conference proceedings. Speakers were from a wide background (practising farmers, foresters, researchers and chemists) and included, among others, Sam Mayall, Dr. Ross Hume Hall, Winston Way, Robert Parnes and Dr. Stuart Hill. Edited by Martha Musgrove. **$7.00**

PUBLICATIONS ORDER FORM

TITLE OF PUBLICATION	NO.	PRICE	
		$	

In Canada and the U.S.A., please add $1.50 (or 10% of sub-total for orders over $15.00) to defray postage and handling charges.
For overseas, add 25% of sub-total for surface mail; 50% for air mail.
Make cheque or money order payable to: **The Institute of Man and Resources**
Mail order and payment to: **The Ark Project, R.R. 4, Souris, P.E.I. C0A 2B0 CANADA**

Sub-total ______
Postage ______
TOTAL ______

PLEASE PRINT CLEARLY:

Name ____________________ **Street Address** ____________________

Town ____________________ **Province** ____________________

Postal Code ____________________ **Country** ____________________

If you have not ordered any publications, but would like to continue to receive news about the Ark Project, please fill in the Name and Address portion of the order form and return it to us, so that we may update our mailing list. Thank you.

Photos by **Camera Art**, except pg. 6, **D. Johnson.**