Soft Technology

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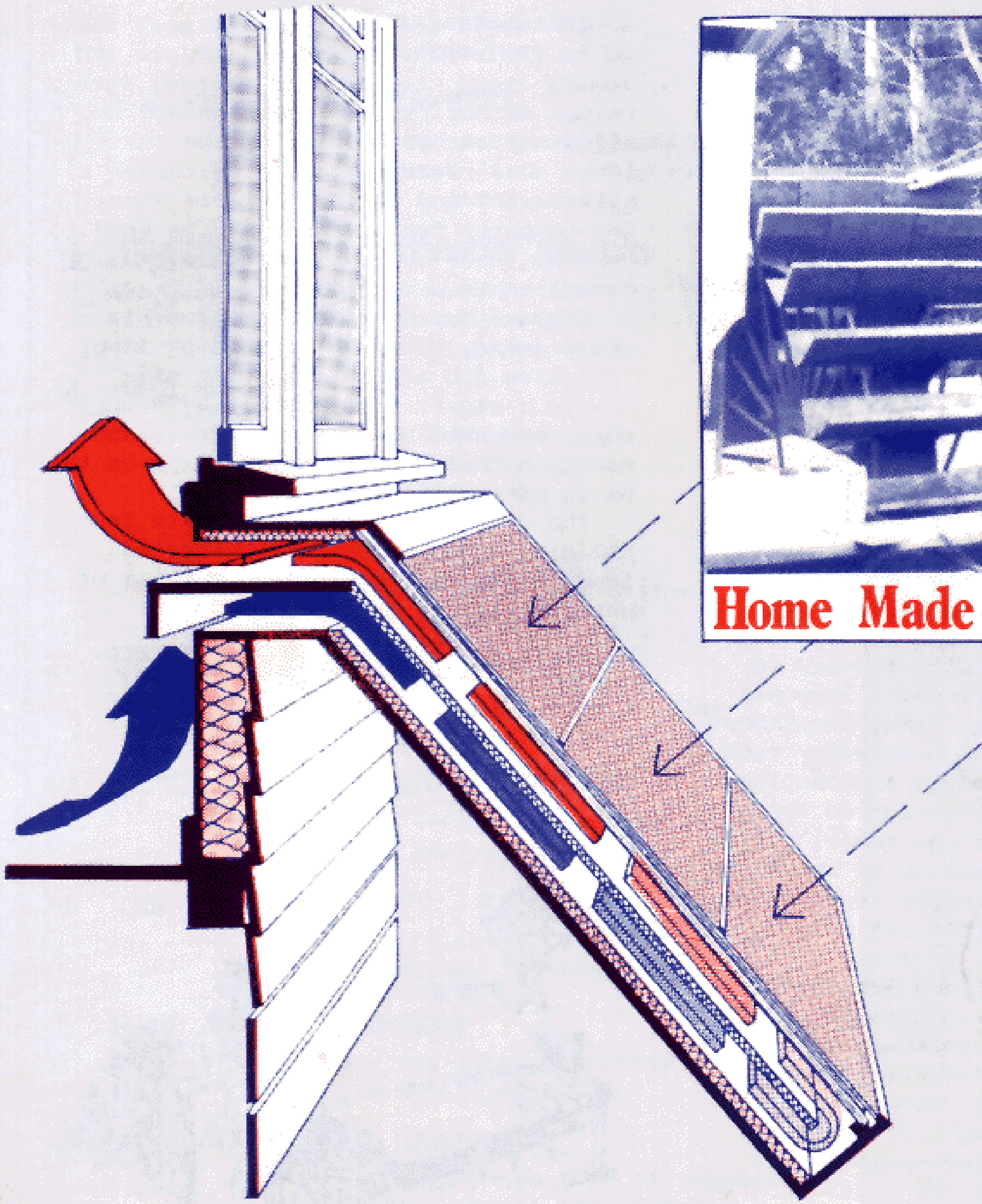

Home Made Water Wheel

* Window Box Air Heater
* Simple Solar Pumping
* A Solar Controller
* Windpower on Rottnest

Editorial

Can Alternative Technology and Societies play a role in solving unemployment and the social problems that are caused by unemployment? No less a person than our Prime Minister, Bob Hawke, has raised this issue with his comments on communities to lower the number of people seeking work. Many people have derided this idea, their main argument seeming to be that these communities will do little to alleviate unemployment and that the objective should be to create more jobs within the present system.

But what are the facts of the matter? I personally have no doubt that a growth in jobs is a thing of the past and that unemployment will only continue to grow. This tendency was clearly shown in a recent edition of "Towards 2000" on ABC Television which dealt with computer controlled robots. One segment showed a car body factory in Italy where there were only 12 people assisting the computer. This tendency is flowing right through industry from word processors to satellite technology. One key reason for the shift to Technology is the high "cost" of labor, but as labor machines continue to be installed then the ability of people to purchase the goods being manufactured will decline.

One answer to increase employment is to reduce working hours for all people, so that we may all earn money to purchase what the machines are producing. But under capitalism, labor is seen as a cost and not a source of demand for goods, so this solution seems highly improbable. (Is this the built in self destructive mechanism for Capitalis The other solution, which I favour, is to turn to Appropriate Technologies and Communities along the line envisaged by M r Hawke. In this scenario, people would choose the Technologies most suited to their needs of food, shelter and luxury items, taking into account such things as our finite resources and the effect of our activities on the environment. Our resources could be turned to Solar, wind and other renewable supplies and computer technology could be used to enhance these systems and relieve us of menial tasks,

Because Appropriate Technology is small scale, it would tend to be labor intensive and at the same time give people a closer relationship with their work, by enabling them to install and maintain their equipment, perhaps on the basis of small communities.

The combination of Appropriate Technoligies and renewable resources can lead to more employment and a sense of satisfaction in the work we do.

David Anderson.

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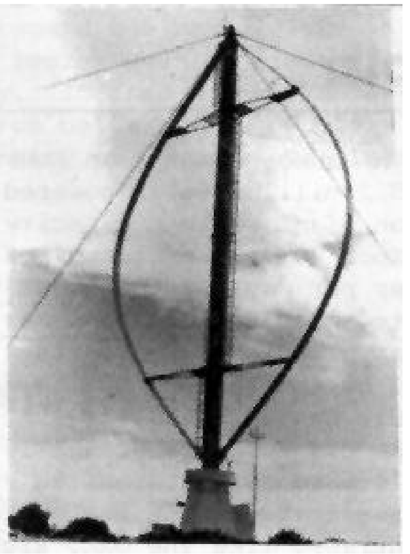

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This issue of Soft Technology was edited by Mick Harris with help from Alan Hutchinson, Tony Miller, Allan Leenaerds, David Anderson, Robert Ashworth, Cris Moss and Dick Cornish.

Comments, contributions and criticisms should be sent to the Alternative Technology Association, 366 Smith St., Collingwood, Vic. 3066.

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Cover Window box air heater and a 2 KW breast water wheel.

Energy Flashes . . .

Arabs go from Oil to Solar

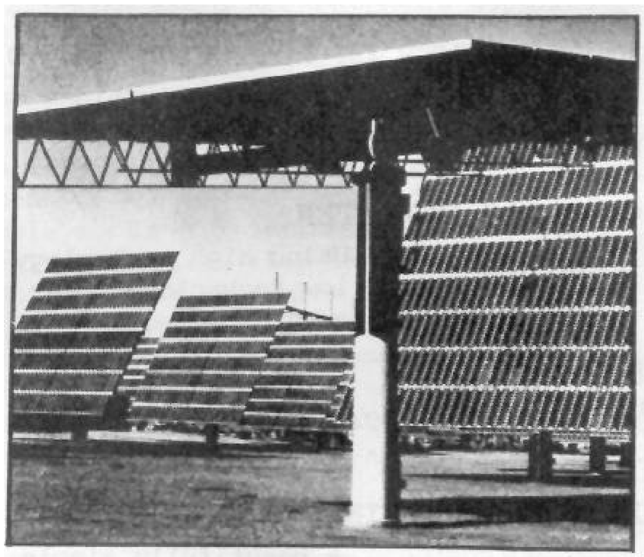
The announcement, in February, that a $8.2 million solar powered desalination plant, with a capacity to produce 80 million tonnes of drinking water per day, is to be built in the United Arab Emirates has met with approval by energy experts. The plant will be the largest of its type in the Middle East.

As oil reserves gradually run out, the demand for alternative energy will increase throughout the world. But many countries, like the UAE, are aware that they must not leave it too long before they set up the infrastructure to produce non-oil-based energy.

The earliest solar project in the UAE was an integrated power/water/food complex, established on Sadiyat Island in the 1960s. As Kettani and Malik explain: "A 90 kilowatt diesel engine is used as the prime mover to produce electricity and the waste exhaust is tapped in fractionating columns to desalinate sea water. Part of the distillate is used for drinking and the rest is used for growing vegetables in greenhouses. The units are more or less conventional in design except that they use translucent covers to reduce the incoming solar radiation and thereby cut the cooling load.

Evaporative pads are used to cool the greenhouses . . . The concept of integrated power/water/food complexes for small isolated communities, which only have access to sea or brackish water and are far removed from the electricity grid, is very useful . . . There are many such isolated communities spread throughout the Arab world."

Gulf News, May '83.



The Worlds largest Solar Cell Power Station

The world's largest solar facility converting sunlight directly into electricity began full daily operation on December 15, 1982. Rated at one megawatt (or one million watts at peak power) the Solar Photovoltaic Power Plant is capable of producing three million kilowatt-hours of electricity annually.

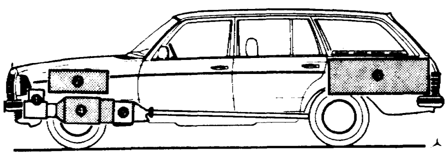
The entire project was completed in 38 weeks. Actual construction of the plant took less than seven months. Conventional power plants generally take several years to complete, The Solar system features 108 dual-axis trackers, each containing 256 photovoltaic modules. So that the modules receive the maximum possible direct exposure to sunlight, a microprocessor system automatically orients the trackers towards the sun for an average of over eight hours daily. The computer-controlled design also allows the trackers to be positioned for seasonal changes in the sun's elevation.

By continuously tracking the sun, arrays mounted on the trackers can generate up to 50% more kilowatt-hours over a year's time than comparable arrays on stationary mounts. The added energy output significantly lowers the average cost of the electricity produced.

ARCO Solar News.

Electric Mercedes

At the Hanover Trade Fair, Daimler-Benz released two experimental Mercedes-Benz cars. One is a pure battery electric with a small emergency two cylinder engine. The other is the world's first limited production hydrogen powered car.



1. Two cylinder petrol engine, 2. Electronic control and charger, 3. Battery, 4. 25kW motor, 5. Automatic gearbox.

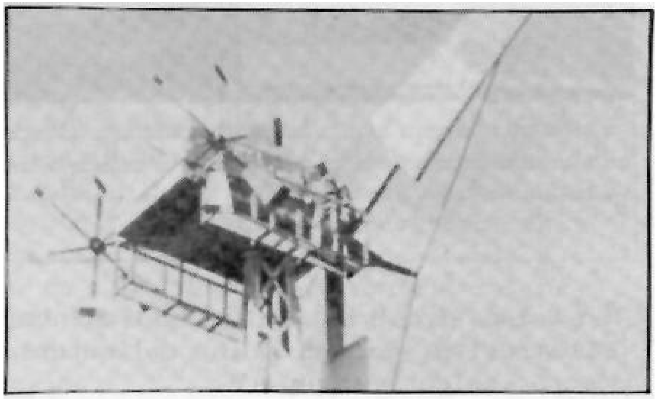
The battery/electric is capable of 80 km/h and has a range of over 100 km under battery power. The two cylinder engine and a limited petrol supply provides an additional '*get-you-home" range of 50 km. Batteries are recharged at any 240 volt outlet using an on-board charger.

Engineers regard the battery car as a significant improvement in electric-car capability. It uses a newly developed nickel-iron battery with double the energy density of conventional lead batteries.

Electric Vehicle News.

Wind from Mars

Mars Confectionery of Australia has launched a wind energy project at its Ballarat plant that it hopes will contribute to the development of wind as an alternative energy source.



The company has erected a wind generator capable of producing 55 kW of electricity which will be used to supply power to its effluent treatment plant.

Excess electricity will be fed back into the main grid that supplies electricity to the factory.

Including preliminary study, windmill, tower, transportation, installation, controls and cables, total outlay was $80,000.

The rotor is tri-bladed and has a diameter of 14.5 m. Each blade consists of fibreglass moulded around a load-carrying beam of laminated wood and shaped aerodynamically for effective stalling.

Energy Scene.

Industrial Design Council of Australia

Finalist Prince Philip Prize for Australian Design 1981

Industrial Design Council of Australia

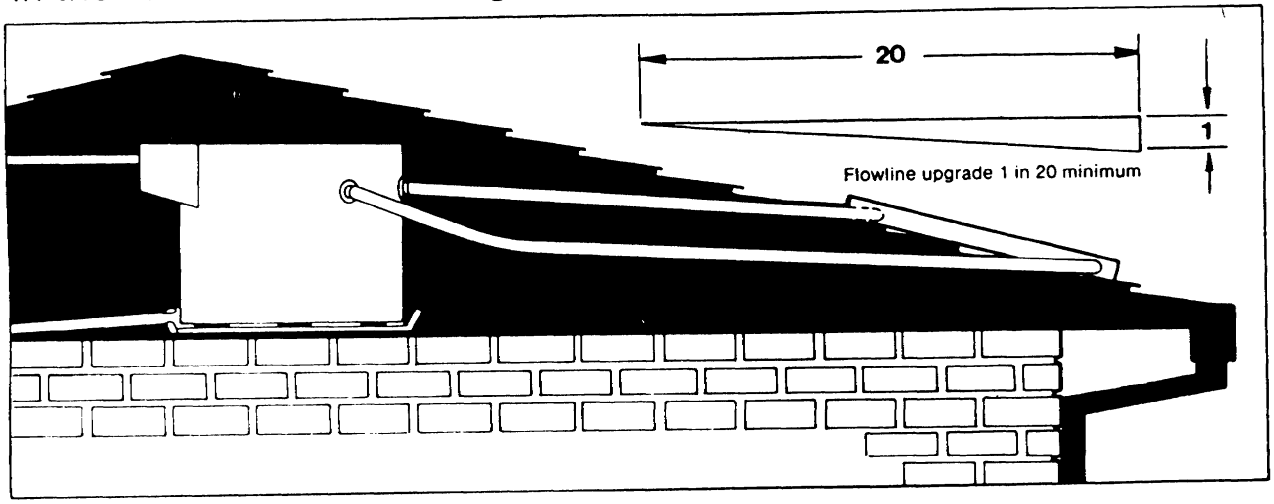
Australian design award.

BEASLEY SOLAR

ELECTRIC BOOSTED

SOLAMATIC Model 5M

Constant Pressure—Thermosyphon—Solar Hot Water System for 'in-the-roof' installation in high or low pitched roofs.



The Solamatic 5M hot water system incorporates unobstrusive, copper solar collectors with 'Amcro' selective surface.

Long life copper storage tank provides constant pressure with minimum maintenance - no pumps, valves or anodes to go wrong.

Patented heat trap enables the solar collectors to be mounted at almost the same level as the storage tank.

This system may be operated as an efficient 'off peak' electric hot water tank, and connected to solar collectors at a later date.

Options on this system include extra fittings for use with wood stoves, heat exchangers which will take mains pressure, and frost protection kits.

Also available is a gas boosted, ceiling mounted, constant pressure tank; and a roof mounted, mains pressure, close-coupled electric unit, with a stainless steel tank.

All the equipment is of high quality, and carries a five (5) year warranty.

In Victoria, Beasley equipment is sold by:

Going Solar

ENERGY AGRICULTURE SELF SUFFICIENCY

320 Victoria Street, North Melbourne 3051

(03) 328 4123

Call in, or send three stamps for a catalogue.

We also sell books, seeds, tools, plants, flour mills, mud brick moulds, seagrass insulation & equipment for beekeeping and for solar electrical systems.

When Lawrie Lang decided to build a water wheel on the creek at the end of his property he found he had an uphill battle. Experts told him it could not be done. The creek did not have enough water, it didn't have enough fall. So he went off to find printed information to help, only to find the little information that was available was inaccurate, contradictory and confusing and more a hindrance than a help.

In the end, ignoring "expert" advice and "authoritative'* publications and working from basic principles, Lawrie found it was possible to generate several kilowatts of electrical power from a breast water wheel on his creek.

Construction

Because fabrication of the components of the water wheel would have been difficult and expensive Lawrie chose to use what materials were readily available He obtained the basic wheel, pulleys and shafts from an old derelict timber mill for $10.00. He bolted on some additional metal work and timber paddles (which were made of old floor boards). This increased the diameter of the wheel from 6 ft. to 9 ft. To increase the speed of the output shaft gearing was used to take the speed from about 12 r.p.m. at the water wheel up to about 3,000 r.p.m. at the generator. This gearing was done in three steps; 8 to 1, 5 to 1 and 6 to 1 giving a total of 241 to 1. The belts running between the gear wheels were made of "Habasit" nylon.

The alternator was "Marcon", 240 volt AX. with a maximum output of 2.5 kilowatts. It gives 1.8 kW when the water wheel is running with a flow of 12 cu.ft./sec. It was specially rewound to tolerate a 50% increase in rated speed.

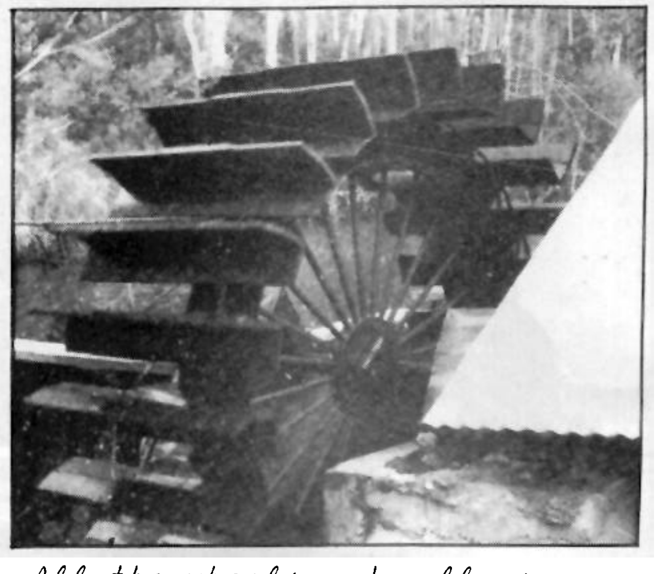
The system uses an electronic governor which varies the speed of the water wheel according to the load. When more power is generated than is needed the excess electricity is used to heat water. Because the water wheel supplies power at 240 volts and runs throughout the year (assuming no droughts) no batteries are needed to store the power; unlike wind and solar electric systems where batteries are essential.

Because he had a limited head of water, Lawrie chose to use a breast wheel, that is a water wheel in which the water enters halfway down the wheel.

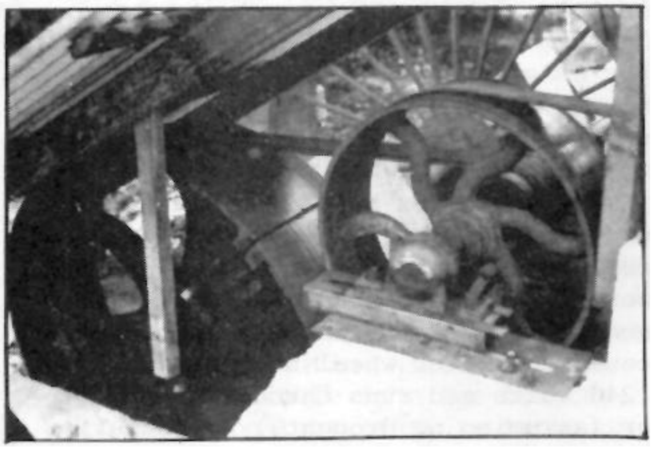
At its deepest point, the dam is about 5 ft. deep. Water enters the buckets about 4½ ft. from the bottom of the wheel; half of its 9 ft. height.

The paddles of the wheel do not have sides, This is because the paddles run through a close fitting concrete sluice. The sluice has a maximum of about 1/8th of an inch between the wooden paddles and the concrete. This minimizes turbulance and water leakage both of which would reduce efficiency. The sluice was made of a coarse grade of cement with the last two centimeters finished with a layer of fine cement rendering. A scraper attached to the wheel was used when the concrete was drying to get the initial shape. The almost perfect shape was achieved by allowing the wooden paddles to actually rub against the newly formed concrete sluice until the concrete and wooden paddles had worn into a perfect fit,

The dam spillway is made from heavy removable boards which are slotted into position, These can be removed to lower the level of the dam in the event of flooding.



All the wheels and pulleys were purchased for $10.00.



The water wheel in action generating about 1.8 kilowatts.

Getting There

The water wheel was the evolution of several years work. The original wheel was somewhat different. However when the initial design proved impractical changes were made until the current design was evolved.

Originally a Dunlite alternator (costing $500) was used, but after burning out twice, this was disposed of. The Dunlite alternator could not cope with continuous running. The replacement Marcon generator which was obtained from Tamar Design has proven much more reliable.

Facts and Figures

The overall system is 65% efficient when it finally reaches the appliances in the house. The cost of the system is as follows:

Steel in paddles of whee1......$300
Marcon alternator.........,....$300
Main shaft pulley 6" x 8"
on 2" shaft...................$ 80
Pulleys, wheel and shafts......$ 10
Concrete for dam and sluice....$300
Governor and control system...$1200
Total cost of 240 volt, 23 kW system, excluding wiring and appliances..$2220.

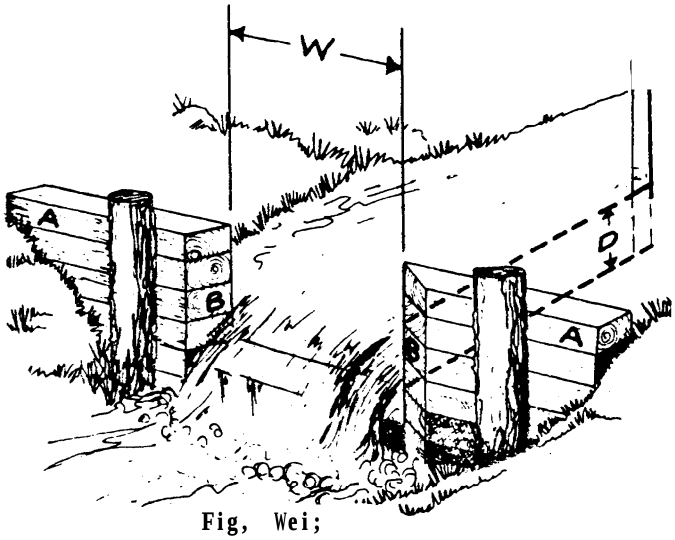
Finding the Flow

To work out how much power you can get from your stream, the first thing you must do is find its flow. This can be done by three methods.

1) The container method is only suitable for small mountain streams and involves diverting the whole stream into a container of a known size and seeing how Long it takes to fill.

2) The Weir method is the most accurate method for medium sized streams. A weir is built like a dam across the stream, which causes all the water to flow through a rectangular notch of known dimensions. The notch should have a width to height ratio of at least 3 to 1 and capable of taking the maximum flow of the stream.

To measure the depth of water flowing over the weir, drive a stake in the stream bed three or more ft. upstream from the weir, to a depth such that a mark on the stake is exactly level with the bottom of notch "B". Measure the depth "D" in inches of water over the mark, and read the volume of flow in cubic feet per inch of notch width from the table. Multiply this volume by the notch width in inches, to obtain the total stream flow in cubic feet per minute.



Fig, Wei;

WEIR TABLE

Depth on stake in inches.	Cubic ft. per min. per inch length.	Depth on stake in inches.	Cubic ft. per min. per inch length.
1	0.4	10	12.7
1.5	0.7	10.5	13.7
2	1.1	11	14.6
2.5	1.6	11.5	15.6
3	2.1	12.5	16.7
3.5	2.6	12.5	17.7
4	3.2	13	18.8
4.5	3.8	13.5	19.9
5	4.5	14	21.1
5.5	5.2	14.5	22.1
6	5.9	15	23.3
6.5	6.6	15.5	24.5
7	7.4	16	25.7
7.5	8.2	16.5	26.9
8	9.1	17	28.1
8.5	10.0	17.5	29.4
9	10.8	18	30.6
9.5	11.7	18.5	31.9

Example: ***A weir is 3*** ft. ***6 in. wide and the depth*** of ***water at the stake*** is ***10*** inches. The flow ***in cubic feet per minute is therefore 42 x*** 12.7 = 533 cfm. ***Once the weir is constructed (easier said than done)*** **it is** ***a simple matter to take frequent readings.***

3) The float method is the easiest but also most inaccurate method of finding a stream's flow. Mark off a section of the stream (at least 10 meters) where its course is reasonably straight and smooth, On a windless day throw the float in the stream and time how long it takes to cover the distances. A bottle partly filled and submerged to its "shoulders" makes a good float. Repeat the procedure several times and average the time. Reduce this time by multiplying by a correction factor of 0.8 for a stream with a smooth bed and 0.6 for a rocky bed. Divide the distance covered by the time taken for the float to *cover* this distance, then multiply by 60 to get meters travelled per minute. Find the average depth and width of the stream. Multiply the width and depth together to find the streams cross sectional area. Next multiplythe speed by area to get the flow.

Source: Harnessing water power for home energy. Dermot McGurgon.

WATERPOWER

When you consider it would cost $5000-$10,000 for a wind or solar powered system of a similar capacity, this water wheel system is very cheap. Water power systems have a number of advantages that cannot be ignored. While solar and wind systems are likely to produce power less than half the time due to unreliability of the sun and wind, a water power system will generate power 24 hours a day, 7 days a week for the whole year. This means

(Continued page 23)

How Much Power Can You Get ?

Once you have worked out the flow the only other thing you need is the head. That is the amount of fall.

There are a number of ways this can be found, You can use a surveyors level and pole, build a small dam (you could do this as part of method 2 of measuring flow). Perhaps the easiest is to get a long length of plastic pipe, fix it just below the water level at what you anticipate will be the upper reaches of your dam. Run the pipe down stream along the bottom of the bed of the stream making sure there are no air bubbles in the pipe. Take the other end of the pipe out of the stream where you plan to have your water wheel, Assuming there are no air bubbles in the pipe, water will continue to flow out of this end of the pipe as long as its height is lower than that of its top end. Lift the pipe out of the stream until water stops flowing. Measure the height of the pipe above the water in the stream; this will be your head.

The power of the stream in kilowatts is the water flow (in meters cubed per second) multiplied by the head (in metres) multiplied by a constant of 9.8. If you want to express this as a formula you can write it like this $P = 9.8\ Q\ H$

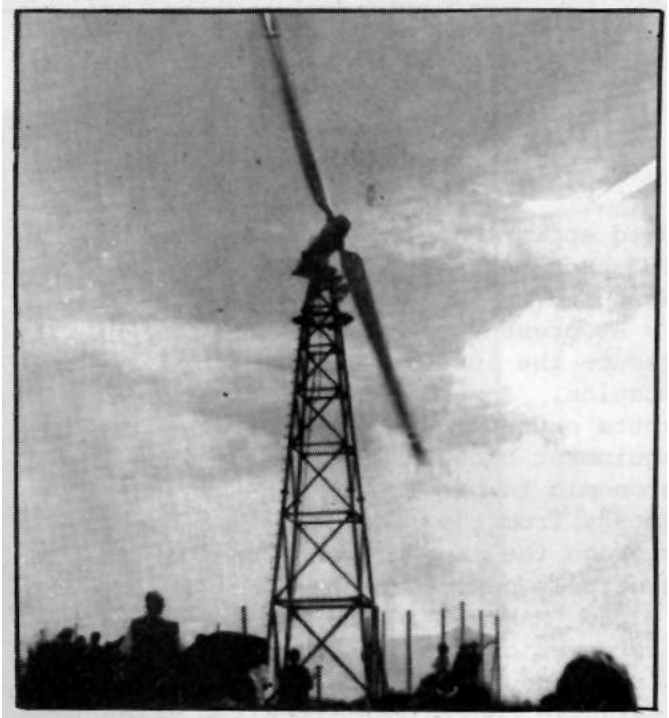
where P = power in kilowatts

Q = flow in meters cubed per head

H = head in meters

and 9.8 is the constant.

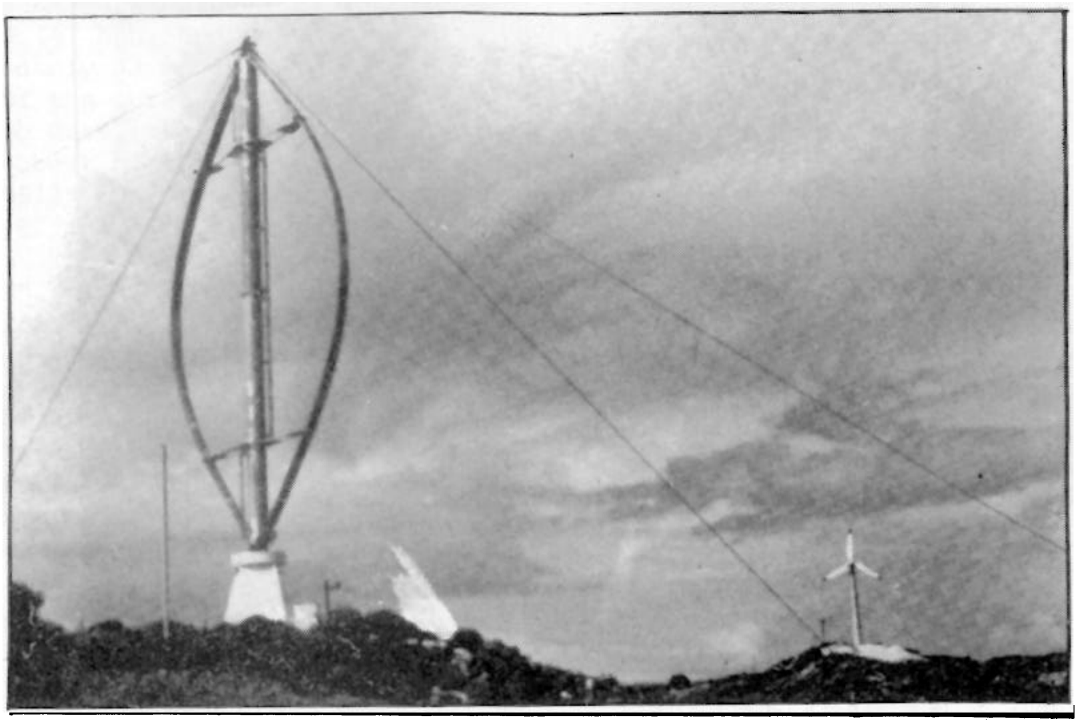
Windpower on Rottnest Island



Over recent years Western Australia has developed what could be described as the most interesting program of Alternative Technology research of any of the states in Australia. The Western Australian State Energy Commission (SEC) looses 50 million dollars each year on its remote electricity generating plants. This massive cost has led to the investigation of renewable energy possibilities. One of these is the wind generators on Rottnest Island.

Three machines are being tested on Rottnest. They are a 50 kW horizontal axis machine supplied by "DAF Indal" of Canada, a 20 kW horizontal axis variable pitch machine from "M.A.N." of Germany and a horizontal axis fixed pitch machine from "Nordtank" of Denmark. The machines feed the Rottnest Island electricity Grid and have carried up to 90% of the Island load.

Rottnest Island is 22km west of the port of Fremantle. It was chosen as *a* site for the wind generators because of suitable wind conditions. It is also typical of remote diesel powered systems and is close to Perth for technical support. The wind generators are loc-



The DAF Vertical axis machine with the Nordtank behind.

ated approximately 2km west of the Thompson Bay settlement on the road to West End.

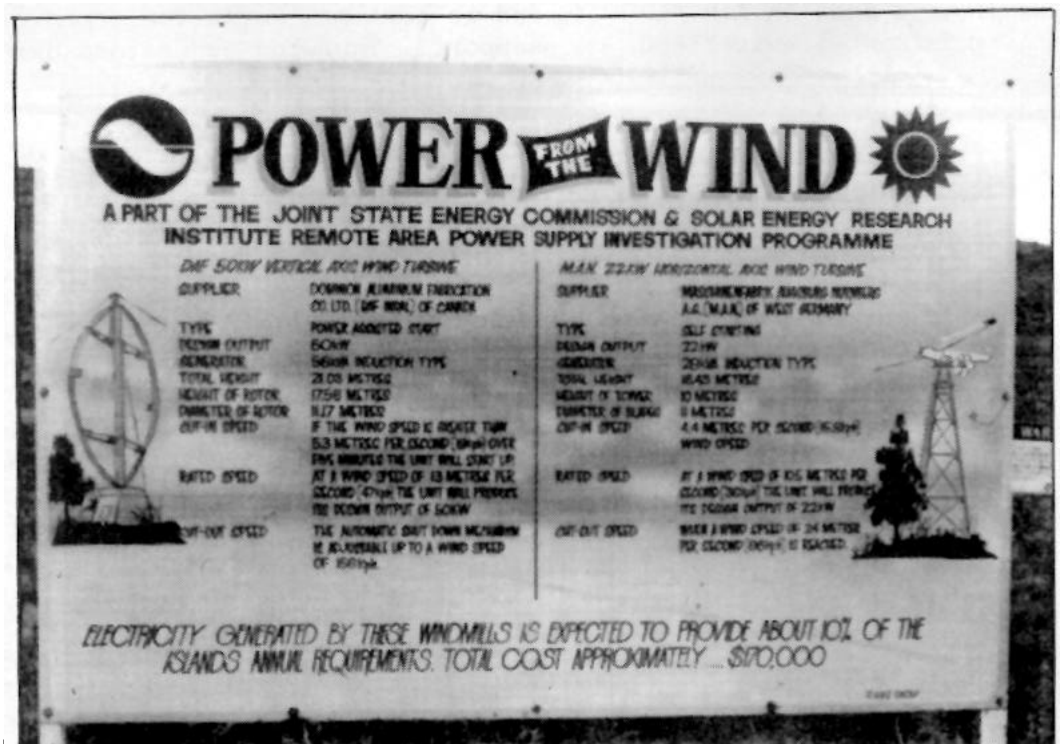
At present the wind generators only reduce the load on the main power station. In the future, if battery costs or the costs of other storage equipment can be reduced it may be economic to provide all the Island's energy from the wind. Without energy storage the maximum contribution is generally no more than 30%.

The "MAN" wind turbine can regulate its power output providing the wind is strong enough. It does this by electro/hydraulic control of its blade pitch. A small paddle wheel keeps the mill facing into the wind. The mill operates at a constant speed.

The "DAF" vertical axis machine also operates at a constant speed. As a vertical axis machine it does not have to turn to face into the wind. This machine needs power from the grid to start up.

The MAN generator was manufactured in West Germany

The "Nordtank" has a tail connected to an electrical system which keeps the wind turbine facing into the wind. It is a fixed pitch machine with two operating speeds. These are 30 rpm in winds up to 7 metres a second (14 knots) and 45 rpm in higher winds. The tips of the blades are aerodynamic spoilers which turn to right angles to the rest of the blades in very high winds (when the machine



This display board gives information on the DAF 50 KW vertical axis wind turbine and the MAN 22 KW Horizontal axis wind turbine.

The information board and output monitoring board for the "Nordtank" wind turbine.

reaches 30% over its rates speed).

The "Nordtank" is rated at 55 kW. It has two generators for its two speeds, a 15 KVA and a 75 KVA. The tower height is 18 metres with a blade diameter of 15 metres. The cut in speed is 4 metres a second (14 kph) the rated windspeed 13 metres a second (47 kph) and cut out speed approximately 33 metres a second (120 kph. Of the three wind turbines tested to date, the "Nordtank" has been the best performer.

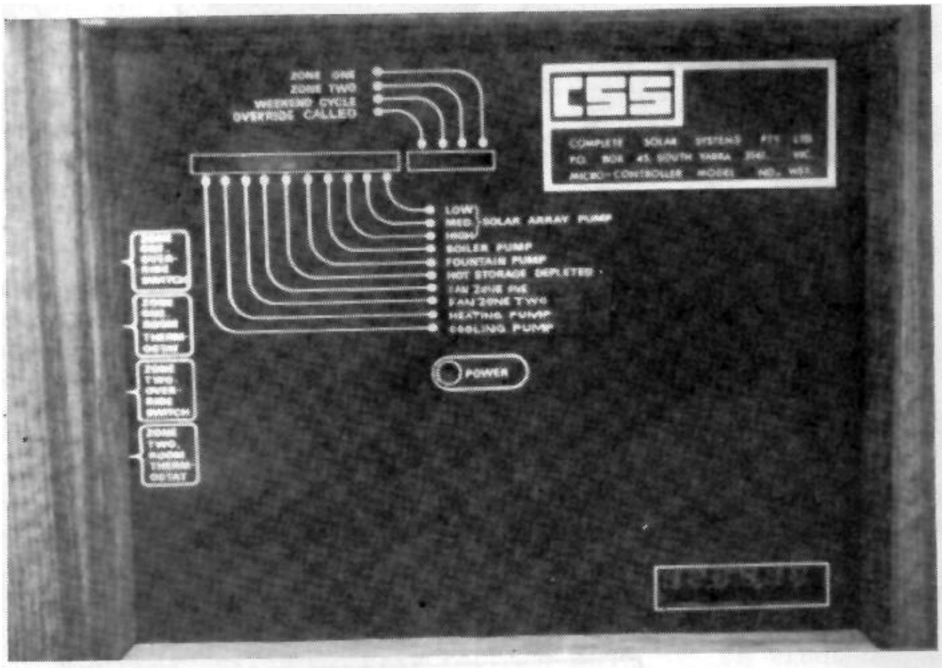
The mills can be stopped or started remotely from the Rottnest power station. The total cost of the "MAN" and "DAF" was $170,000. The cost of the "Nordtank" which was installed more recently was $75,000.

Ongoing research 'is being conducted into the potential of windpower in WA, The S.E.C. encouraged by the government of the day is funding development of a locally produced wind generator. With this in mind it could be worth keeping an eye on what is happening with wind in the west.

Source: State Energy Commission of W.A.

The Nordtank has two generators for its two speeds, a 15 KVA and a 75 KVA.

A SOLAR COMPUTER



THE COMPLETE SOLAR SYSTEMS SOLAR AIR CONDITIONING CONTROLLER

A computer is by no means soft technology, but can be used to control a solar energy system more effectively than by any other method. It does this by following a 'program' that can be complex, without creating a complex and therefore expensive controller. Therefore, with the computer, you can give the system better control, by making the program more complicated, without changing the physical controller at all. As a solar energy system is getting heat from the sun, which may be hot, warm or barely noticeable depending on the time of day or time of year, you need to extract as much heat as possible when it is available, and store it for cooler times, dare I say, "rainy days". Various energy saving devices have been included in this system, without any great increase in cost. This all helps in the major aim of bringing solar power to within the reach of people earning an average income, at the comfort levels they would expect.

The CSS controller is a microcomputer based controller designed to control house heating, cooling and hot water. It can also control a swimming pool if money or ingenuity run that far. It can be used as a data logger so that it can monitor how well the system works under various conditions. This data can be used to fine tune the system and assess how good various 'improvements' are.

We used a microcomputer for various reasons:-

- to reduce the amount of wiring and wiring changes for particular houses;
- to allow more complex and efficient control of a system;
- to allow additions and changes to be made without redesign;
- to log data (this program is under development);
- the cost was no more than similar systems not using microcomputers.

The heart of the system is a SYMI, an inexpensive single board computer with up to 32 inputs or outputs.

Components of the System

There are 17 inputs to measure

temperatures, and each temperature can be displayed by using the keyboard. A. small integrated circuit is used to measure temperature. Of the 17 inputs, ten are remotely sited sensors, either near the tanks, pumps and valves in a pit in front of the house, or on the roof of the carport near the collectors To cut down on wiring, these ten sensors are connected to remote sensing units which can run up to ten sensors each in turn. Each sensor is checked in rotation, and only one 2-wire connection is required to go back to the computer.

There are also ten outputs which, via solid state relays, run pumps, valves and motors. There are some other inputs, which can read the position of switches.

It is hoped to develop a data logger, which would record temperatures and switch changes.

The computer features a day of the week clock, which gives the time of day for every day of the week, 1 to 7, plus hours, minutes and seconds. This is used to allow different areas of the house to be heated at different times. The bedroom area can be heated during early morning and evening and the living area during the day, shutting off when no-one is in the house at a particular time of day. Four zones are allowed, each with two operating times per day. There is a separate weekend cycle with different times allowed.

The required temperature of each zone is set at thecontroller, which acts as a thermostat. The system will attempt to cool down to a temperature 8°C above the temperature set or heat to the temperature set.

The Solar House at Beechworth

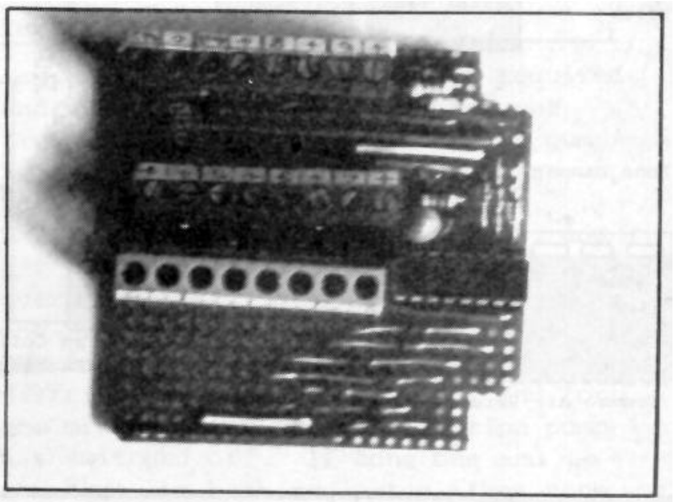
The controller is installed in a house in Beechworth, which is an area well suited for this system, as it is hilly, cold in winter, cool on summer nights and hot and dry on summer days. The house is on the side of an east-west valley, facing north. The water storage tanks are below the garden at the front of the house, and the collectors are on the carport roof, facing north.

The house uses passive solar techniques in construction and is well insulated. It is divided into living and bedroom areas for heating and cooling, which cuts down on the amount of heating and cooling required. The heating or cooling for the zones is switched on by the clock, but can be overridden by switches.

How the System Works

There are three different functions in the system, Heat Collection from Solar Collectors or Wood-burning Stove, Evaporative Cooling and Air Distribution, all controlled by the computer.

The controller controls these functions with a program that simulates the action of the thermostats, relays etc. that would be present in a conventional system. However the ease and cheapness of programming allows the designer more flexibility, and less complexity in the wiring. Inputs, such as temperature sensors,



A remote sensor card.

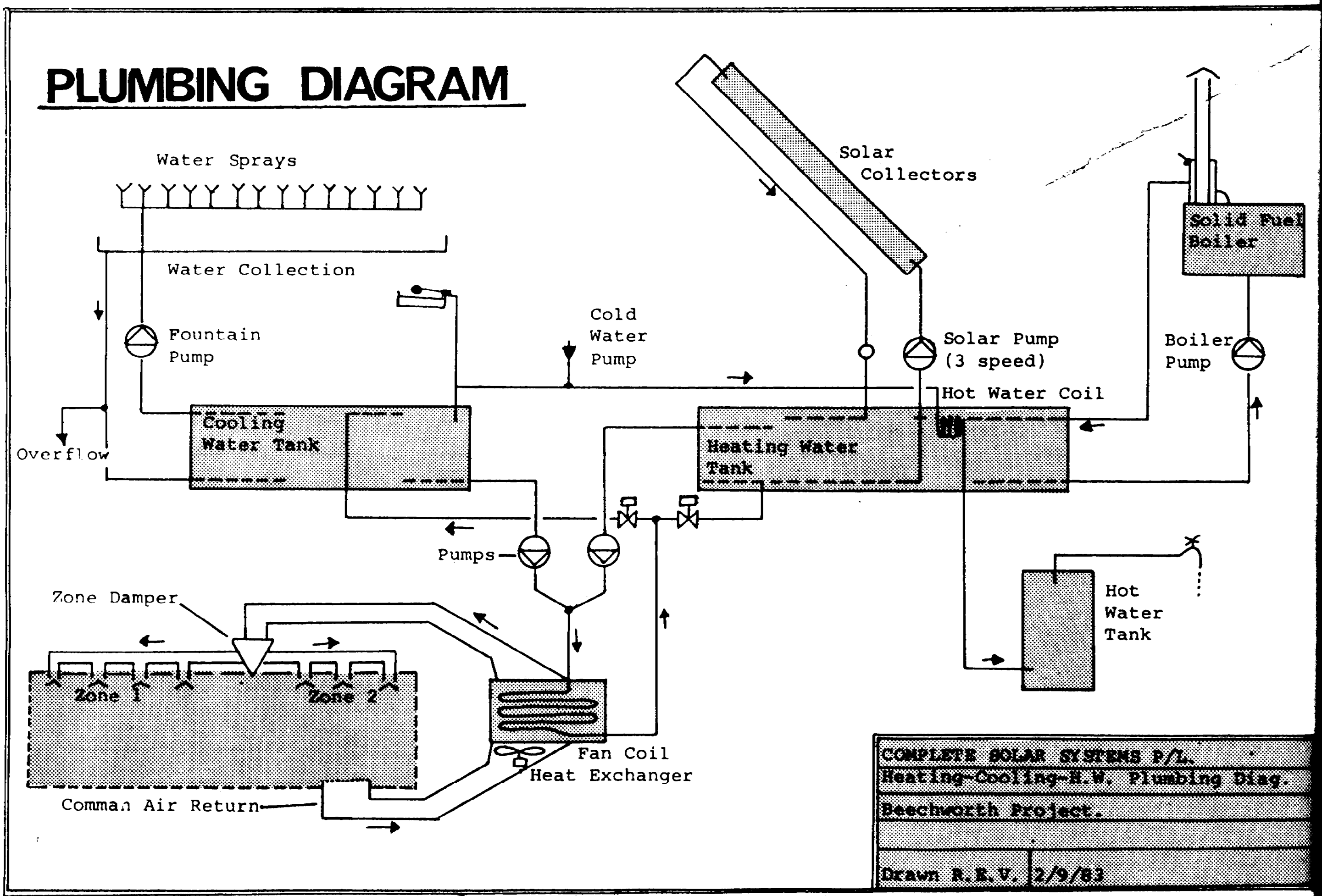
and outputs, generally solid-state relays used to operate pumps and valves, can be the same for different applications. It is easier to make changes later on, and repair is simpler. The values of various temperature differentials can be changed from the front panel, as they are stored in its memory, The temperatures at various points in the system can be read also.

Description of the System

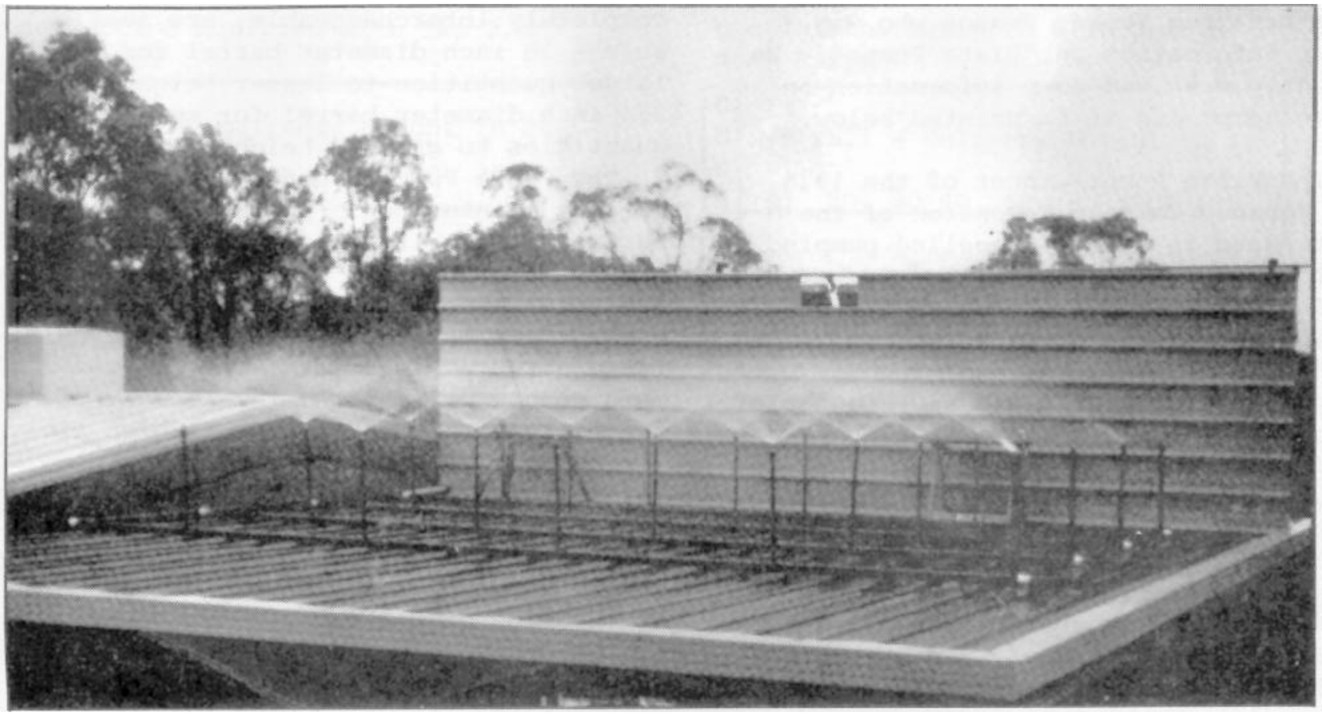
The system has three parts, Heat collection from solar panels or slow combustion stove, Evaporative cooling using water sprayed on the carport roof, and house air conditioning.

Heat Collection

This is the 'solar' part of the system. The sun heats the water in the collectors. A differential thermostat senses the temperature difference between the top of the collectors and the top of the tank, and sends a signal to the controller when a usable difference is found. The controller, via its program, turns on the three-speed pump, on high speed, via a solid-state relay, A three-speed pump is used to match the water flow in the collectors to the temperature difference across the panels, so that



A simplified plumbing diagram for the heating and cooling system of the solar computer controlled house at Beechworth.



The roof sprinkler system cools water evaporatively.

usable heat can be collected in cloudy conditions.

Wood-fired Slow Combustion stove

The slow combustion stove is a back-up for cold winter nights. If the temperature of the flue is 16°C more than the bottom of the heating water tank, the boiler pump is switched on, and water is pumped around the coil in the flue. If the flue exceeds 95°C the beeper on the computer sounds once a minute, and the pump is turned off. This is to avoid problems with cavitation in the pump, and the softening of fibreglass lining in the tank,

Evaporative Cooling

Cooling is achieved by spraying water onto the roof of the carport at night and collecting it in the guttering. It is then returned to the bottom of the cooling tank. The purpose of this is to cool the water in the middle of the night, and use it in the middle of the day to cool the house. A wet bulb temperature sensor measures the humidity, and if the temperature is at least 4°C below that of the top of the cold tank, the fountain pump is started, spraying water onto the top of the roof.

Temperature Distribution

When heating or cooling is required, and a zone is within one of the set times, an associated distribution pump is set on, the heat/cool valves are set, and the zone damper is set, Water is pumped around a fan coil, and air is heated or cooled by passing over the pipes. It then passes into one or the other zones of the house. The fan operates 1 minute after the distribution pump has started, and for one minute after the distribution pump has switched off. If zone one and zone two are both requested, then zone one is catered for first. When its

(Continued page 30)

A Plata Pump...

In Soft Technology No. 9 we printed a letter from Yvonne Benson who was after information on "Plata Pumps". We recently received some information on these pumps and it is printed below.

The Plata Pump, winner of the 1975 UDC Finance Company Invention of the Year Award is a self-propelled pumping system.

The Plata Pump produces an extraordinary pressure of water, several hundred pounds if required, from a very moderate input. With a reasonable throughput of water, the Plata pump will lift from 100 to 500 gallons of water an hour to heights from 300 to 60 feet respectively. These figures indicate the average working range. They in no way state its limits. Performance is affected by several variables, and certain combinations of these variables will produce figures well outside the figures given.

The power from the shaft can be used for

(a) pumping a large quantity of water to a moderate height or
(b) pumping a smaller quantity of water to a greater height.

Two alternative sizes of pumps, completely interchangeable, are available - 1½ inch diameter barrel for larger quantities to lesser heights, 3/4 inch diameter barrel for smaller quantities to greater heights.

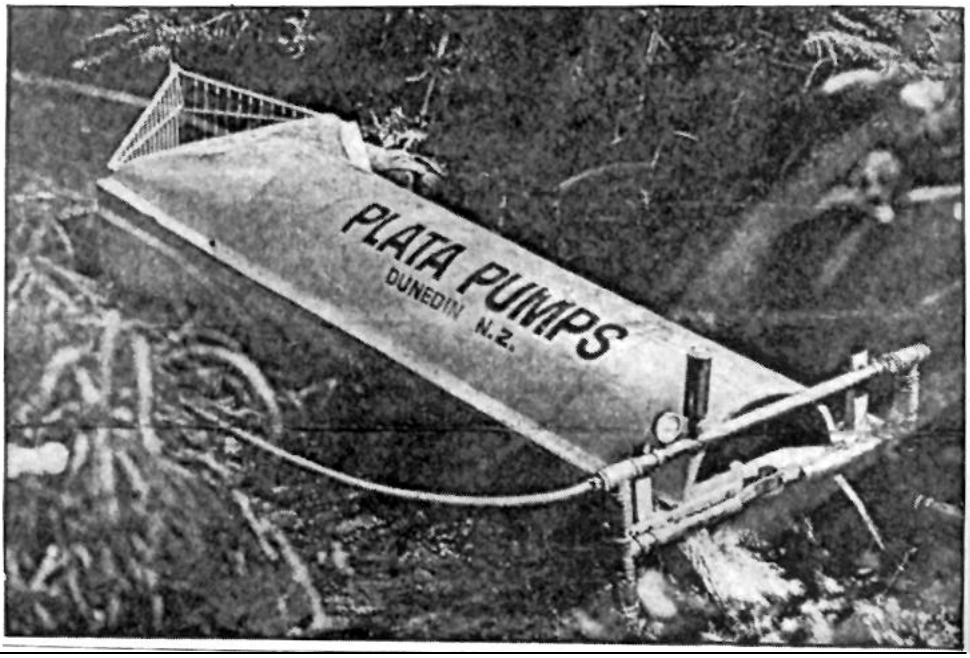
The Plata Pump is constructed for minimum maintenance, The propeller section casing is moulded in fibreglass. Bearings are water lubricated and require no attention until the bushes need replacing. The pumping unit is constructed in brass. The only maintenance will be the replacement of the piston cup washers from time to time.

The unit is supplied complete with intake hoses fitted with filter ends.

To achieve the best performance from the Plata Pump you need to know
1. The slope of the stream or watercourse
2. The flow of the water in cusecs
3. The delivery height you require.

Once you have this information you can work out the output you can expect.

Technical Specifications:
Length 9ft. 8 ins (unit) plus grille 1ft 6 ins
Width 4ft, 2 ins.
Height 1ft. 11 ins.
Weight 309 lbs.



The "Plata Pump" can pump small quantities of water to great heights or large quantities of water to lesser heights by use of a self propelled pumping system.

Delivery in Gallons Per Hour Using One Turbine Equipped with Two 3/4" dia. Pumps

CUSECS	9" Fall - Delivery Height in Ft.							
	10	20	50	100	150	200	250	300
	Gallons Per Hour							
1	16	15	14	11	8	6	-	-
2	36	33	29	22	15	11	7	5
3	Not Advisable							

Delivery in Gallons Per Hour Using one Turbine Equipped with Two 1½" dia. Pumps

CUSECS	9" Fall - Delivery Height in Ft.							
	10	20	30	40	60	80	100	125
	Gallons Per Hour							
1	110	83	57	-	-	-	-	-
2	174	137	101	67	47	-	-	-
3	Not Advisable							

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P.O. Mallacoota, 3889.
Phone (051) 58 0329

Tariff: $70 - $154, Pets welcome

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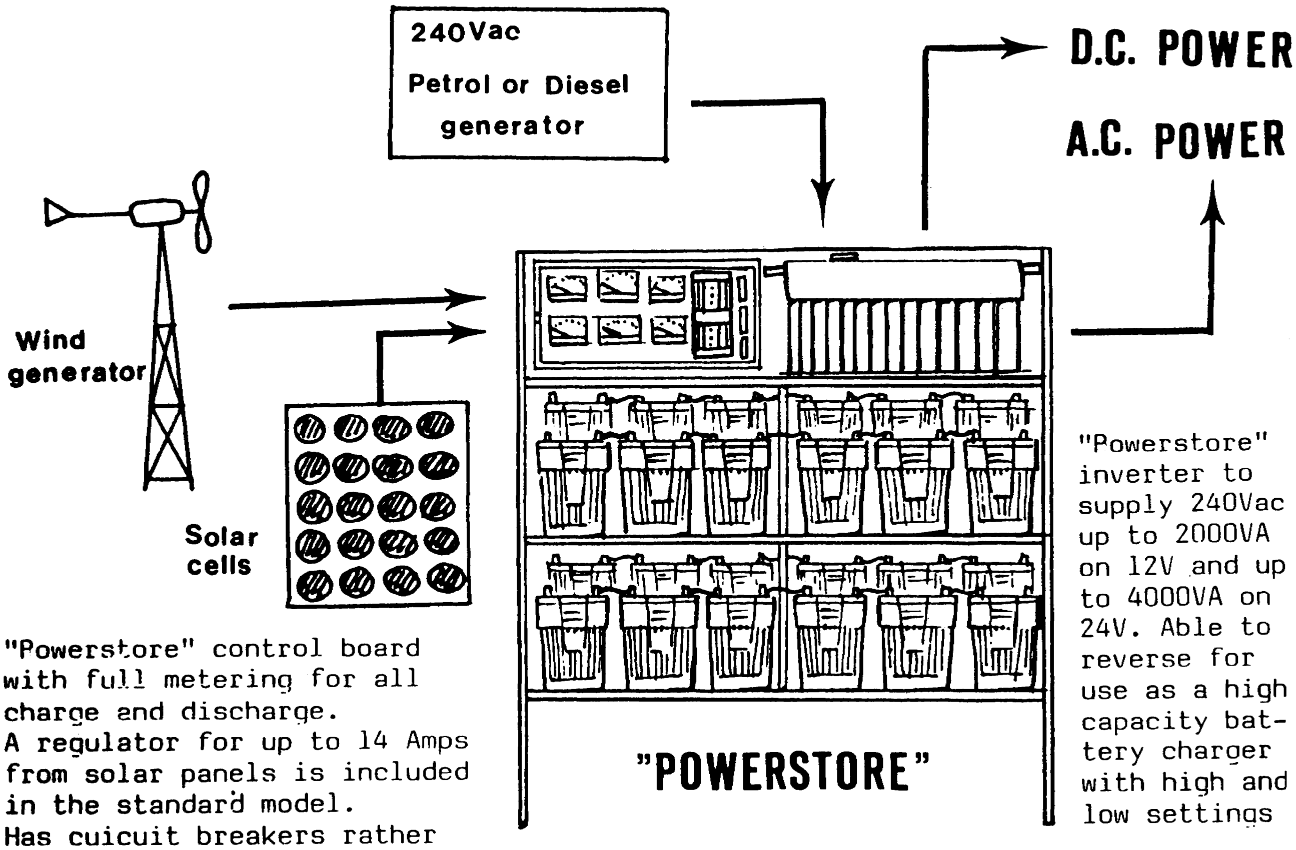
JUST CONNECT IN YOUR GENERATOR, SOLAR OR WIND

Our "Powerstore" systems are designed to run lights and appliances such as washing machines, blenders, refrigerators, etc. Send for our price list now.



"Powerstore" inverter to supply 240Vac up to 2000VA on 12V and up to 4000VA on 24V. Able to reverse for use as a high capacity battery charger with high and low settings

"Powerstore" control board with full metering for all charge and discharge.
A regulator for up to 14 Amps from solar panels is included in the standard model.
Has cuicuit breakers rather than fuses for maximum overload protection.

Room underneath the rack for extension of battery storage at a later date if required.

Double-banked home lighting batteries with built-in hydrometers for easy reading. All battery wiring and connectors included and set in a heavy duty painted steel frame with timber shelves.

These powerstorage systems are available in a kit form for easy transport anywhere in Australia and because all the wiring is supplied with the right connectors, installation is a simple matter with only a screw driver and spanner required. You can start off with a generator and add solar and wind when you want.

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NEWCASTLE, N.S.W. 2300,
AUSTRALIA.

Phone :
(049) 2 2515

Solar Pumping made Simple

Solar electric and solar heat pumps used in developing countries often have excellent performance, because of their sophisticated components. However, when trouble arises the pump can remain out of order for a long time due to lack of trained repair staff. As a result it is useful to have a pump which is unlikely to break down and easy to fix if it does. With this in mind, this pump was developed.

How It Works

The pump uses water and air, working alternately, to pump water. A tank is needed which is big enough to contain the volume of water corresponding to the users daily requirements, In order to gain high enough temperature to gain high enough temperature to run the pump the tank is put in an insulated box with glass cover. When the sun heats it up, the air in the tank expands and part of it escapes through a pipe (fig, 1). As the tank always contains a little left over water ('remaining after previous operation) the water vapour produced by the solar heating, helps force excess air out, which can be seen bubbling in the water at the lower end of the pipe. At the end of the day the tank cools off and the bubbling stops. The water is drawn up the pipe and into the tank as the air cools, the moisture condenses and air contracts.

The following morning, the user removes both corks to drain the pumped water and store it in another tank, or to use it directly in an irrigation system. He replaces the corks, shutting the tank in preparation for a new cycle. Note that both the tank and piping must be thick enough to resist atmospheric pressure,

Since it is this atmospheric pressure which causes the pumping, it is impossible to raise water through heads of more than 10 metres (rather 8 to 9m in practice), unless two or more tanks

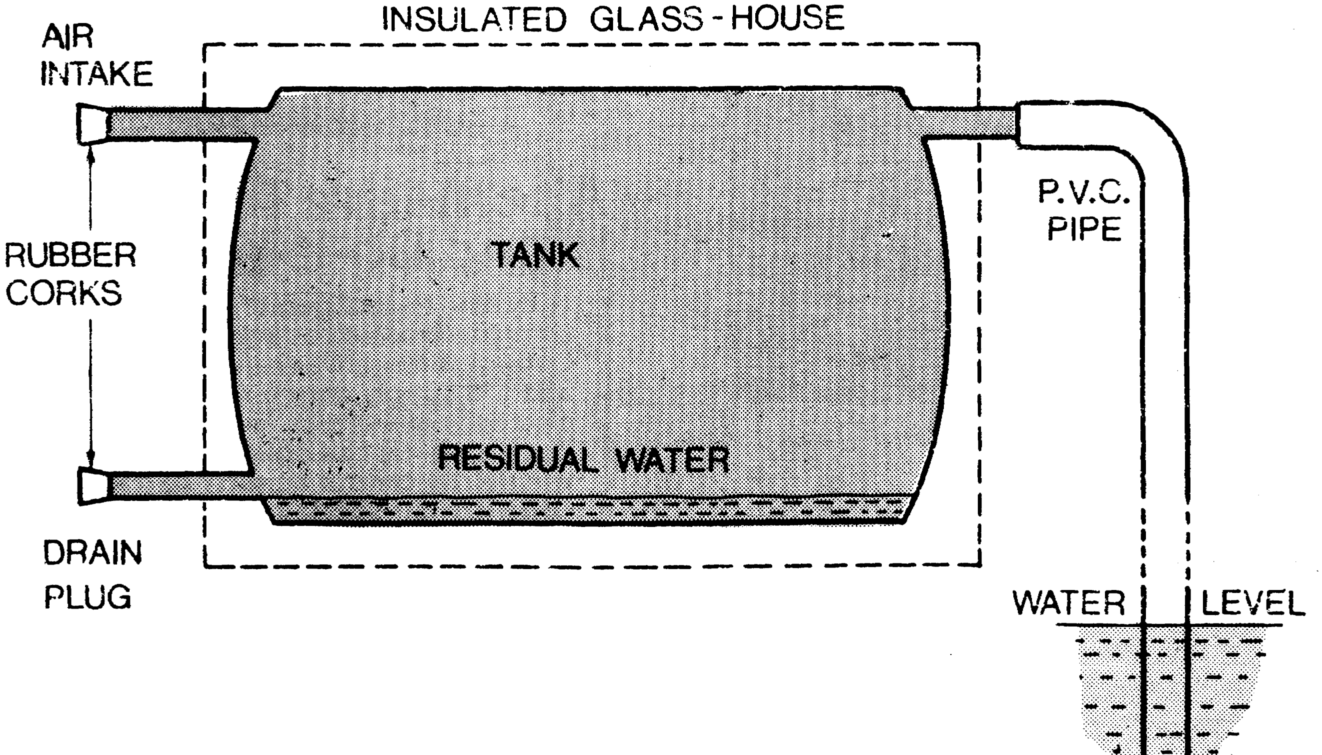
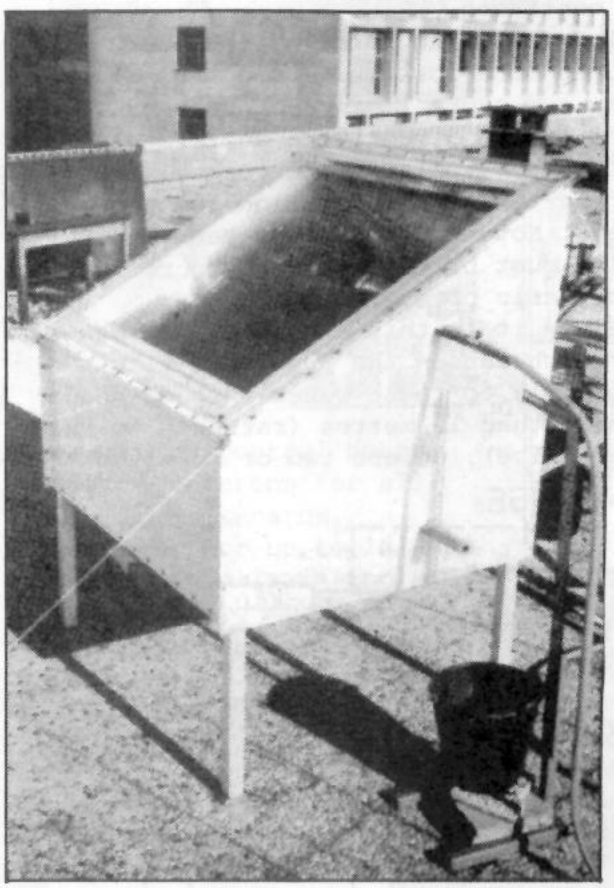


Fig. 1 Schematic representation of the system.

are used in succession. However, it is possible to carry water over a much longer horizontal distance, for instance in an irrigation system situated by the side of a river. Although the efficiency of this pumping system is about fifty times lower than that of an ordinary pump, maintenance problems are kept to a minimum due to the fact that there are no moving parts in the simple mechanism.



The prototype solar pump under test.

Prototype and Results

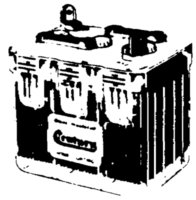
On the roof of a laboratory building in Lyon University, a small prototype has been built (fig. 2); the water is pumped from two floors lower down. The tank is made of iron, 3mm thick, and contains 274 litres of water, Its external surface is made selective by a layer of adhesive nickel oxide. The thermal insulation consists of a plywood box, fitted with 9cm of polystyrene and a thin layer of aluminium foil. The window is made of two panes of glass and one external pane of perspex (area 1.14m^2).

In tests, the maximum temperature obtained for the tank was 147°C; the most usual temperature was around 130°C. With heads under 7m, the tank can be filled to about 85 percent of its capacity in good weather conditions and 90 percent in excellent conditions. For heads between 7 and 8m, this rises to 75 percent approximately, falling rapidly if the head increases.

There is no reason why a tank for a pump of this type should not be at least several thousand litres. On the other end of the scale a 44 gallon drum could be a good size to work with. You could also experiment with a small scale pump (say built from a tin can) just to see how the principle works.

This information came from Appropriate Technology Magazine, Vol. 10, No. 1, pages 15 and 16 written by Dr. Roger Bernard. You can get more information by writing to them at LT. Publications Ltd., 9 King Street, London, WC2E 8HN, UK.

LEAD ACID STORAGE BATTERIES



This article hopes to give an insight into the use of lead-acid storage batteries with wind and solar supplies.

Energy capacities of batteries are given in Ampere--hours (Ah) - the amount of current they will supply for a given time. But the capacity depends on many factors, such as temperature, altitude and load current. For example, a battery capable of giving 1000Ah of energy when 5Amps is drawn from it will only give 600Ah if the load current is 30A.

In general batteries are used in two ways: float operation where they are kept fully charged and cycle operation where they are discharged and recharged. Batteries used to supply domestic power and charged from wind generators or solar cells are cycled, due to the intermittent nature of both loading and supply. Cycled batteries have a shorter lifetime than floated ones,

Industrial wind/solar installations often use two batteries where one is charged "off-load" while the other supplies the load.

Charge voltage should be limited by a regulator to 2.25 or 2.35 Volts per cell, or in a 24 cell battery, 54-56.4V. Charging at greater than 2.35V per cell leads to "gassing" which causes excessive water loss.

Modern sealed cells are fitted with vent plugs which allow gas (hydrogen) to escape but not liquid. They also prevent entry of a flame front to remove chances of an explosion. Vents should not be removed.

Certain maintenance procedures are required at least every 3 months:

* inspection of plates for cracking and buckling;
* topping - up of electrolyte with pure water;
* inspection of containers for leakage;
* cleaning of containers;
* checking of connections.

If a battery is left discharged for a long period, sulphation of the cells may result, causing increased internal resistance, This is revealed by:

* gradual darkening of the negative plate;
* black scale on positive plate;
* decreased specific gravity.

Sulphated cells are very difficult to revive.

Dick Cornish

References -

A.P.O. Engineering Instruction M5020.
Lead Batteries & Auxiliary Power Systems - Symposium Papers. Australian Lead Development Association.
Lead - Acid Batteries. Hans Bode (John Wiley & Sons)
Battery Chargers and Testers, Charles R. Cantonwine (Chilton Book Company).

THE ATA REPORT NEWS Events and Activities of the Alternative Technology Assn.

The middle of the year brought with it some of the busiest behind the scenes activity and some of the most interesting meetings. The behind the scenes work involved the solar workshop which has taken more time and effort than we ever imagined. However after much work, we are now almost ready to go. We have secured funds and the plans have been approved by the local council. The site has been cleared, leveled and prepared for the pouring of the slab. By the time you read the next report in Soft Technology we will have something real to report.

The meeting in June had a theme of "show and tell" with members bringing along their bits of equipment to demonstrate and explain. These included a home-made wind generator made from a novel combination of bits and pieces, a bicycle trailer, a high efficiency fluorescent light (which blew up), photos of an add-on solar greenhouse and a high efficiency heater element for a solar waterheater.

The August meeting included a film showing the waterwheel featured in this issue of the magazine, an explanation of how you can repair and recycle a damaged solar cell panel, rides and demonstration on a "Silent Power" electric delivery van, a look at the latest polysilicon solar cell and a novel heat exchanger system using steam.

At our next meeting members can look forward to film of the Rottnest Island wind generators, the Meekatharra Solar Power Station, solar energy research in Western Australia, as well as a demonstration and talk on inverters. See you there.

The june meeting included (from left to right), an add-on solar greenhouse, a bicycle trailer, a novel wind generator, high efficiency fluorescent lighting and a high efficiency solar water heating element.

Wind Power Overseas

The Victorian Solar Energy Council recently ran a seminar on 'Electric power generation from Wind'. They had two speakers - Bent Rasmussen, very down to earth, practical chief engineer for ELSAM in Denmark (like the SEC) and Rob Clarke, who manages Special Industrial Systems in Wodonga (who make windmills) and has just come back from a world tour of wind energy installations.

Rob Clarke talked first about the Dutch and Danish governments' wind test centres, that issue performance certificates (necessary to get the 50% subsidy in Denmark) and made the point that Denmark was one of the few places where people were buying windmills because they actually needed them. One interesting design point was the use of fixed yaw (i.e. the windmill permanently faces one direction) to reduce the excess blade stresses induced by quick changes of direction.

Most other substantial use of wind generation occurs where there is heavy government subsidy, like California. In typical American grossness, they've set up large wind farms each with hundreds of windmills of every conceivable design stacked cheek to jowl. For example, Jess farm at Altmont Pass has some 300 windmills in the 30-50 kW range. These can make a good profit because of heavy state subsidy and guaranteed buy-back arrangements with the power utilities.

Bent Rasmussen described the Danish

experience where they have already got about 1000 wind generation installations giving a total capacity of 24 MW. The average small windmill is 15m in diameter, 20 metres high, 3 bladed wood or fibreglass blade mounted upwind of a 7-55 kW induction motor.

People buy wind generators there, because Denmark has no indigenous energy sources and are vulnerable to world

energy price fluctuations, there is a 30% subsidy and they can sell power back to the utilities at half the price they buy it. For connection to the grid, the authority wants unattended automatic operation under remote control from their load despatch centres and the appropriate voltage to feed directly into their high voltage grid. They have done a very thorough job of investigating wind power. They've produced a wind map for the country, studied what happens when a blade comes off and have a national breakdown reporting system so that design changes can be made to improve the reliability of machines,

Integration of a large wind generation capacity into an existing system provided by fossil fuel power station leads to problems due to the unpredictability of the wind, Base load generators take a long time to start up or stop and so are used to supply the constant 'base load' power, You can't start and stop these every time the wind changes. So the wind can really only be used to fill peak requirements and in the middle of the night it is either stored by pumping water in the hydro schemes back up or is used for town based heating systems.

In respect to local use of wind energy, due to our large fossil reserves, long transmission distances, there was considerable 'it'll never work here' mumblings from the SEC bods there.

Alan Hutchinson.

ooo**???**ooo

Are there any 'Soft Technology' readers who would like to become involved in promoting, developing and manufacturing Appropriate Technology equipment?

I am interested in hearing from such people, with the view of becoming involved in this field.

While experience and knowledge would be a great help, the main qualifications are enthusiasm and a commitment to Alternative Technologies.

If interested and you would like to discuss my proposal further, contact -

David Anderson
65 Regent Street
Elsternwick 3185
Ph. 523 8670.

WINDOW BOX
H EATERS

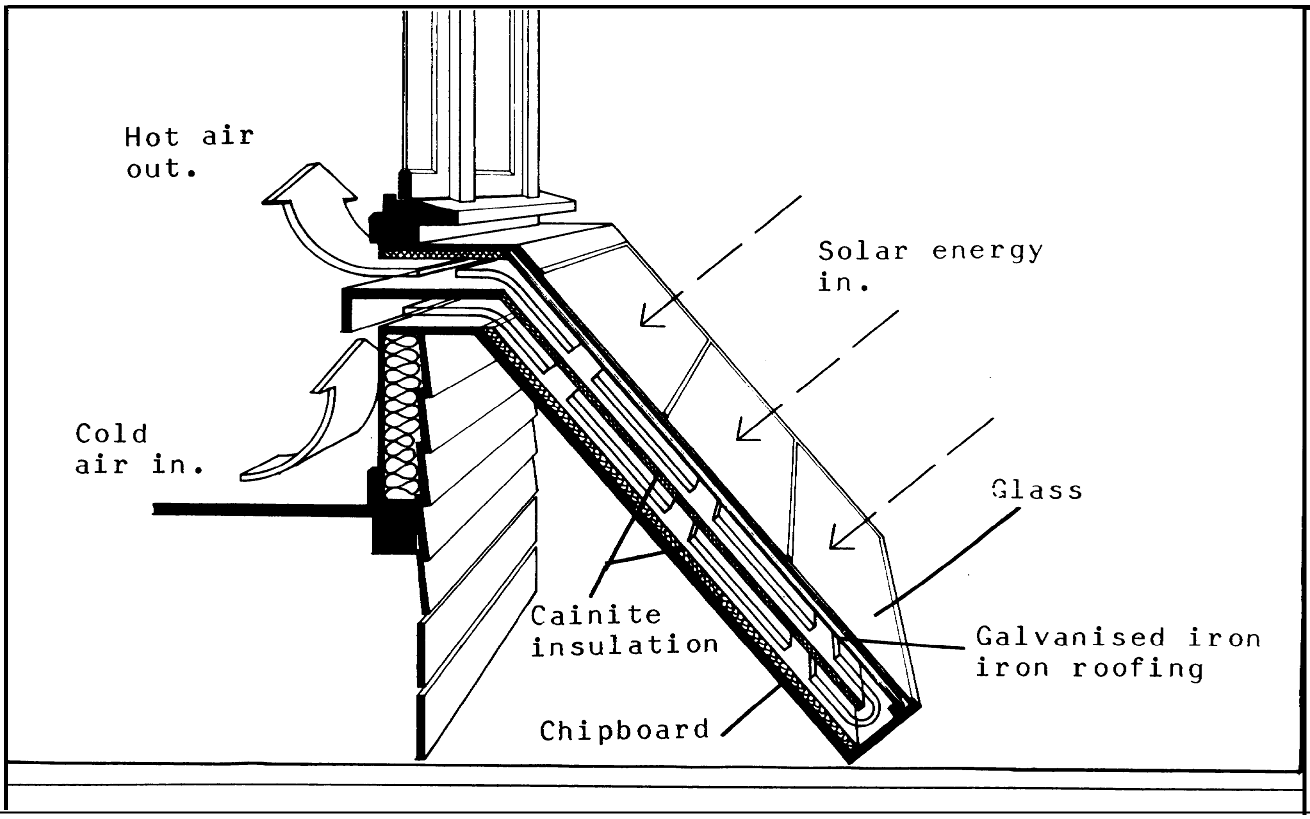
A window box air heater can be a cheap, simple and efficient way to help stay warm in winter, It can be built to any size depending on your needs. You can also choose whether you wish to fix it permanently into place or design it to be removed in summer when it is not needed.

A window box air heater is one of the simplest forms of solar heater, Basically all it is is an insulated wooden box with a glass top and a sheet of blackened metal inside. The sun shines through the glass top and heats the blackened metal sheet, This in turn heats the air in part of the box which then rises by itself up through, an opening into your house. At the same time cooler air is drawn in and in turn heated.

The collector was built with the aim of low cost in mind. The basic box was made of pine board and chipboard. This was lined with cainite sheeting which acted as insulation. Roofing iron painted with flat black paint was used as a heat absorber. The glass was second hand window glass.

Cost

Both the roofing iron and glass were second hand. The timber used was new, The total cost of the collector which was approximately 1 meter by 1.5 meters was $80. This included the cost of nails, glue, screws, sealant, etc. which would often be available without having to be specially bought. This cost could be reduced substantially if second hand timber was available.



Construction

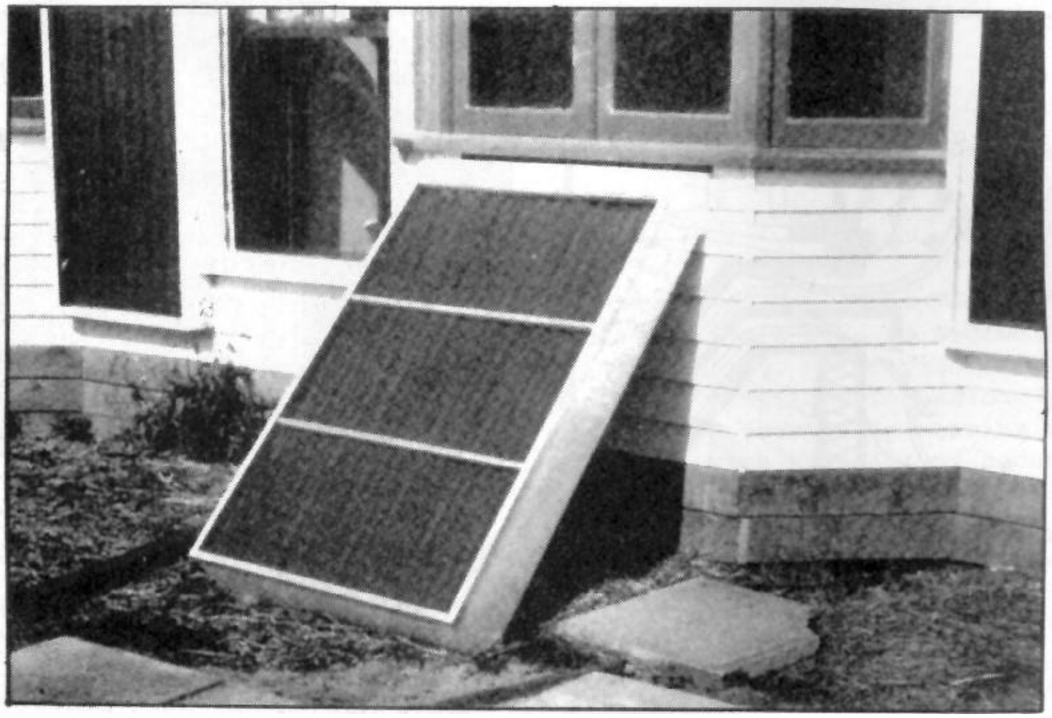
The first step involved the construction of the basic box from pine board and chipboard. This was lined with cainite insulation, Wooden spacers were fitted and a sheet of cainite fixed in place to separate the hot and cold air channels More spacers and insulation were fitted and the blackened roofing iron fixed into place. Wherever possible, joints were glued and fixed with screws to ensure rigidity. Any cracks or potential cracks were sealed with silicon sealant or wood filler.

Window glass was fixed over the top of the box and sealed with silicon to prevent the entry of any moisture. In the case of our collector we positioned the panel to fit in under the established window as the window was not of a type which would allow us to fit the collector in the window frame. Hinged pieces of timber can be closed to stop any air flow into the house when there is no sun.

How Well It Works

On a sunny winter day the room in which the collector is fitted becomes comfortably warm. This isn't to say the collector alone is responsible for this. The room faces north with a considerable window area. However you can be sure the window box air heater is an important part of the room's heating. The air rising out of the collector on a sunny day is quite hot. Output temperatures of the collector have been between about 38°C and 70°C. The collector was mounted at an angle of approximately 48° making the collector most efficient at collecting winter sun.

While a window box collector is not a complete answer to one's heating needs it is a cheap, easy to build and effective supplement to one's winter heating needs. Considering the current increasing costs of electricity and gas, a heater of this type could be a good investment.



The window box air heater in position under a conventional window.

WATER POWER (Continued **from page 10)**

Lawrie Lang stands on the dam wall near his water wheel.

you can have a much smaller power system. For example a 2 kilowatt water power system could be roughly equivalent to a 4 kilowatt solar electric system. With a water power system you can often generate 240 volts AC, which means you do not need an expensive inverter. Also because power is likely to be available 24 hours a day all year round you don't have to use storage batteries. Not needing storage batteries and an inverter substantially reduces your costs.

Small scale water power is potentially one of the best sources of domestic electricity if you have a suitable site. It only takes a moderately sized stream to supply a significant amount of power. Even if this is only seasonal, it could still be well worth while investigating.

MICK HARRIS

solar computer (Continued from page 17)

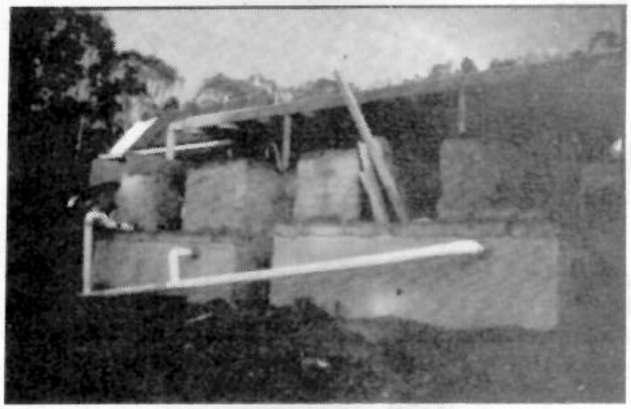
demand is satisfied then zone two is catered for. If zone one requires more heating or cooling then the controller will switch back to zone one whether zone two's demand has been satisfied or not.

Summary

Using a computer allows you to control a system more closely than before, and gives you greater flexibility and understanding of the system. A system of this size needs an automatic controller for safety as well as operational reasons, It can provide energy saving features, such as zoning and time switching, for no extra cost. It is adaptable to other systems and can be developed as a data logger, so that temperatures and times of switching can be studied with a view to further improvements to the system. This can be done with minimal extra cost.

For more details, you can write to Complete Solar Systems, P.0. Box 45, South Yarra, 3141, or phone Chris Moss on 527 3909. We can assist in the design of solar houses and specify parts for solar systems.

Controllers have been neglected in favour of better collector design, but can contribute a fair amount to energy saving through a better use of available resources. We believe this is the most advanced microcomputer system so far developed. We charge $1200 for it including delivery and installation, programmed to your requirements.



Cool/Warm water tanks at the house.

BOOKS

THE BOUNTIFUL SOLAR GREENHOUSE

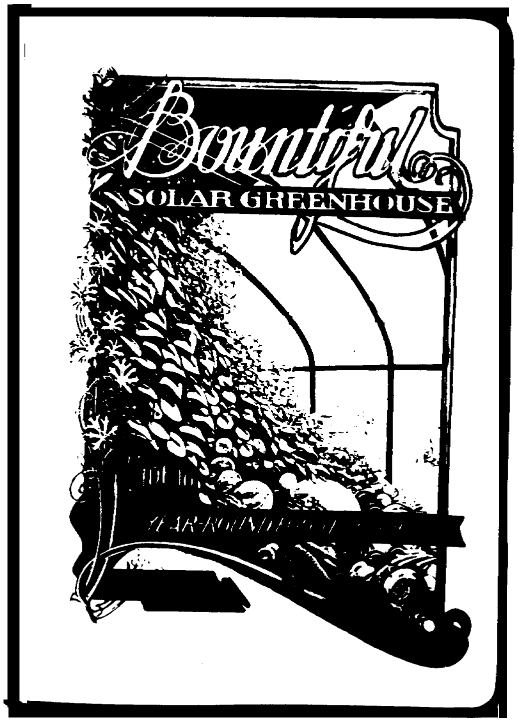
By Shane Smith, John Muir Publications. $11.95

The use of hot houses and green houses for the growing of plants under controlled conditions is not a new idea, but the recent energy crisis has encouraged people to look for more efficient methods of plant production.

Shane Smith's book 'The Bountiful Solar Greenhouse' attempts to shed some new light on a subject which has been extensively covered by many books and articles in recent years.

Reading through this well written and exhaustive book it becomes clear that the author has extensive knowledge and experience in this field. The book covers many aspects of solar greenhouses and has sections on theory, design, suitability of crops, plant propagation, pests and other problems.

It discusses the three areas of greenhouse experience - domestic, commercial and botanical, with most of the information presented in a clear and straightforward manner. The fact that this is an American publication means that some of the information is not applicable for Australia. Unfortunately the author concerns himself largely with the growing of food crops which may limit the book's value to many domestic solar greenhouse builders.



Only two chapters deal directly with greenhouse design and operation, the remaining eight chapters are about the care and cultivation of plants. Also the photographs in this book are small and difficult to interpret, but fortunately there is a good sprinkling of clear precise diagrams which are very helpful.

At a recommended retail price of $11.95 this 220 page book is good value for anyone interested in self sufficiency, but does not offer much information on state of the art solar technology, or on the growing of ornamental plants.

Copy supplied by Second Back Row Press.

Self Sufficiency in the Eighties

By Mario & Lesley Zolin

George Allen & Unwin $19.95

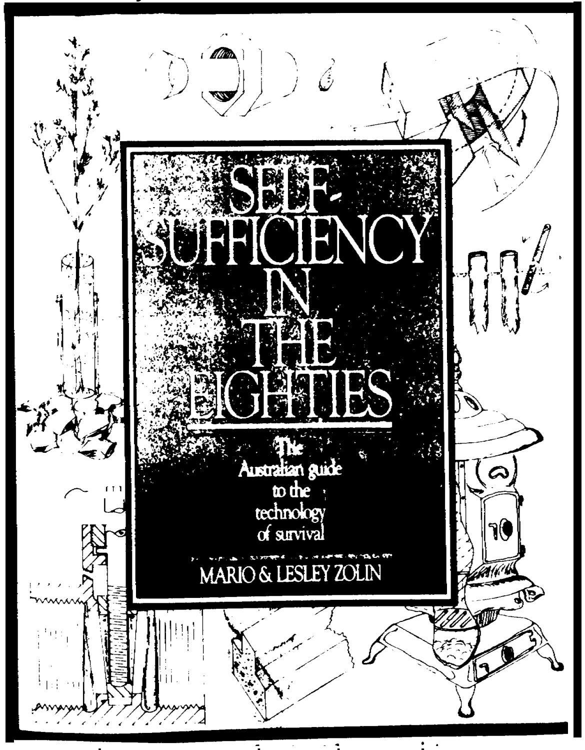
When you feel you are losing control of your urban environment, or the “International Situation" seems to be at a new crisis point, head for the hills, seek mastery over your own patch of turf, independence from the rest, and prepare to ride-out Armageddon.

This seems, in paraphrase, to be the depressing philosophy underlying the Zolin's book.

If the concept of losing control of my destiny was so threatening, I feel I would be better employed campaigning against nuclear proliferation, than heading for the bush.

As for the content, it is an anecdotal but challenging account of engineering solutions to the problems of water supply, fencing, shelter, food and energy in a rural environment.

The Zolins are particularly challenging and thought-provoking in the areas of alternative technology: they debunk wind generators, photovoltaic cells and even solar water heaters; describing these as toys for the trendy middle class.



In the sense that these items have acquired a status value beyond their obvious usefulness, I am forced to agree, particularly when they get on to the topic of the mud-'brick homestead with cathedral -ceilings.

However, just as the obsessionals go bush to regain control and mastery of their environment, so the romantics must have their aesthetic follies.

One can only hope that the Australian wilderness is large and forgiving enough to accommodate both groups. Recommended reading if you want to re-examine your values.

Michael Gunter.

Editor's Comment

I can't help feeling the need to comment further on the Zolins book. What can you say to someone who tells you wind, solar and water are not viable and recommends a diesel engine as a method of getting power, What's more, the way in which these alternative forms of electricity generation are discussed is often shallow and inaccurate. As a reader I quickly became tired of being told that I was a naive, ignorant trendy to even consider alternative energy.

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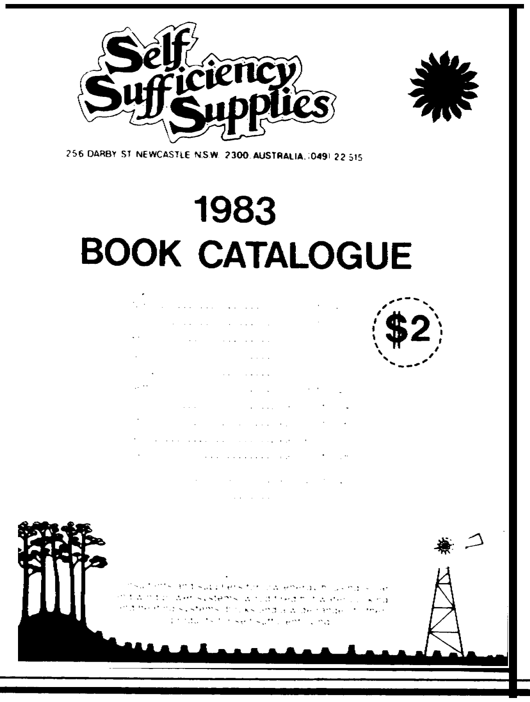
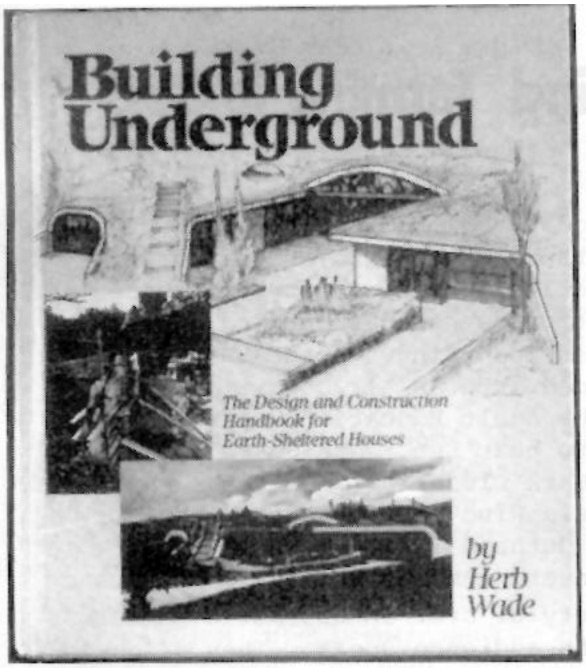
Self Sufficiency Supplies has produced a comprehensive catalogue of books and products. All books (which are sorted into subject areas! include a short description. If you are considering buying books of equipment of the type Self Sufficiency supplies it would be worth getting hold of a copy of the catalogue. It's 28 pages long and costs $2.00. Self Sufficiency Supplies is at 256 Darby Street, Newcastle, N.S.W. 2300.





BUILDING UNDERGROUND

By Herb Wade. Rodale Press. $38.95.

I have had an interest in Underground buildings since seeing a cellar at the Swan Hill Folk Museum and as an integral part of houses in Germany.

This book goes much further of course and refers to whole living areas either full or partly underground.

The first point that must be made is that this is an American book and much of the information is irrelevant to Australia.

For anyone contemplating building an underground house, the technical information is good and covers every aspect, walls, plumbing, electrical systems, heating and cooling, etc. Also included is useful, but to me not common, information as such things as the energy intensity of solar radiation, and how water is held or flows through soil.

Even for anyone building aboveground houses, there is a lot of useful information and if you are thinking of building a cellar, as I am, then details on such matters as waterproofing are really relevant.

My criticisms of the book include that it is written for USA conditions. Maps and climate conditions are useless to us. Also the need for underground housing may not be as relevant with our milder climate.

The initial cost of underground housing, with its waterproofing and need for strength due to the weight of earth, would seem to be rather high and not be for people wanting a cheap form of housing. Of course long term maintenance would be low, offsetting initial costs, but you would still need the money, From a Do-It-Yourself point of view, with the need for excavation and concrete pouring, it's unlikely that it would be useful to the self builder.

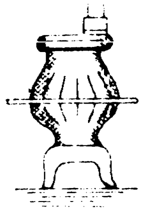
Finally, the cost of the book at nearly $40-00 could only be justified if you were actually going to go underground, otherwise borrow it from a library.

David Anderson.

Copy supplied by ANZ Book Co.

The Letters Page

Hot Water from Pot Belly Stoves



We recently received this letter from Peter Kurz of the mudbrick flats at Mallacoota. He mentions an observation he made in the flats that could save some trouble and disappointment for other A.T.A, members.

All the Potbelly Stoves in the flats are fitted out with hot-water jacket in the first part of the flue to assist the solar hot water system. This works really well and it is easy to feel the hot water rising up one pipe and returning cooler down the other pipe. HOWEVER 1 potbelly had provisions for a heating coil to be installed inside the stove (it is a Masport Pittsburgh Stove) and therefore I changed the installation and hoped for higher gain, as the coils are in contact with the flames.

This stove is a disappointment, as the water-coil robs the heat from the flames and rather being a secondary function of the stove it dampens the fire; further because of the coil going around the inside of the fire-box the wood often rests on the coil and because it is not touching the grate, more often than not, the fire goes out altogether. There is little heat from the stove, it does not noticeably heat the water more effectively, and the stove keeps stopping.

My advice is to stick with the water-jacket in the flue. The water-jacket is stainless steel and I bought 8 from Survival Technology (725 5550) for $85 each.

With love,

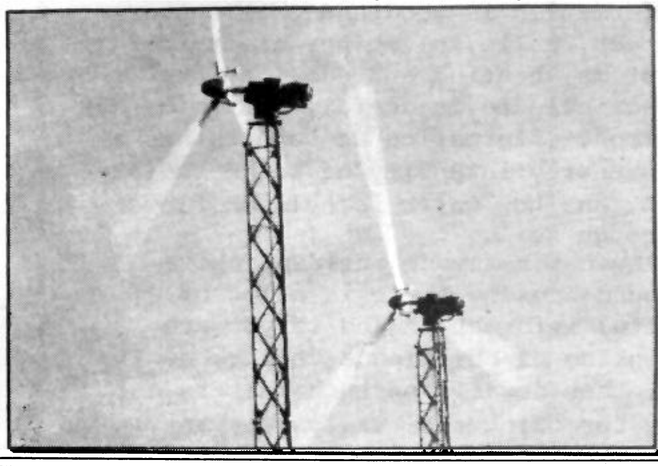
Peter

Wind Farming in Tasi

Today/being Sunday 19/6/83, I and 26 other N. Western Tasmanians travelled across country to Launceston to attend a seminar on wind energy. It was inspiring. About 80 people crowded into an air conditioned bubble at the Adult Education Centre in York St. to hear Sen. Jean Hearn (ALP), Dr. Mark Diesendorf (CSIRO and Australasia Wind Energy Association) Dr. Hugh Outhred (Uni. of NSW), local engineers and business persons plus a variety of over enthusiastic members of the audience speak, They all said good things about windpower and hopefull things about its role in our future.

Immediate concern is that the HEC agrees to pay a fair price for energy fed back into the grid. The proposal on King Island is for 90% of diesel saving costs to the HEC. 'Wind Farms' in America are feeding energy into the grid and getting from 4-6c/KWH and the point was made that the Mars Bar 55Kw windmatic in Ballarat is already hooked into the Australian grid so the precedent has been set.

The proposal for a Federal Gov. sponsored wind farm in Northern Tasmania was also discussed at great length. The



idea is to purchase 6 to 10 different models for experimentation with a view to developing a Tasmanian based industry. Denmark has 1000 generators up and going and plans for 60,000 by the end of the century. Why not in Tasmania? It seems feasible to plan for about 20% of energy production to be wind energy. Any more and the economics does strange things. The hydro stations if operated at a low capacity incur overheads for full capacity for example.

So with existing hydro dams, a good whack of wind generators, increased use of insulation, solar hot water heating and sensible use of wood fires Tasmanian energy needs are assured.

The Bell Bay power station uses about $1 million in oil each week. It is hoped that energy fed back into the grid in Northern Tas. can be paid for by the HEC at 90% of cost of oil saved, This would be money that stayed within the country.

The meeting spent time discussing possible environmental effects of wind power, Aesthetic? noisy? kills birds? alters temperature? None of these seem to be of major consequence except perhaps the aesthetic aspect.

Anyway, Mick, I don't know why I'm telling you all this. Had to tell some-one, Senator Walsh made an appearance and now seems to support the idea of supporting the idea. Perhaps the time is right to put pressure on Labor to reopen CSIRO wind energy research! The Frazer Gov. withdrew funding.

Ideas to put aerogenerators on exist-ing electricity pylons appealed to me.

Yours,
Rick Martyn

Water Batteries

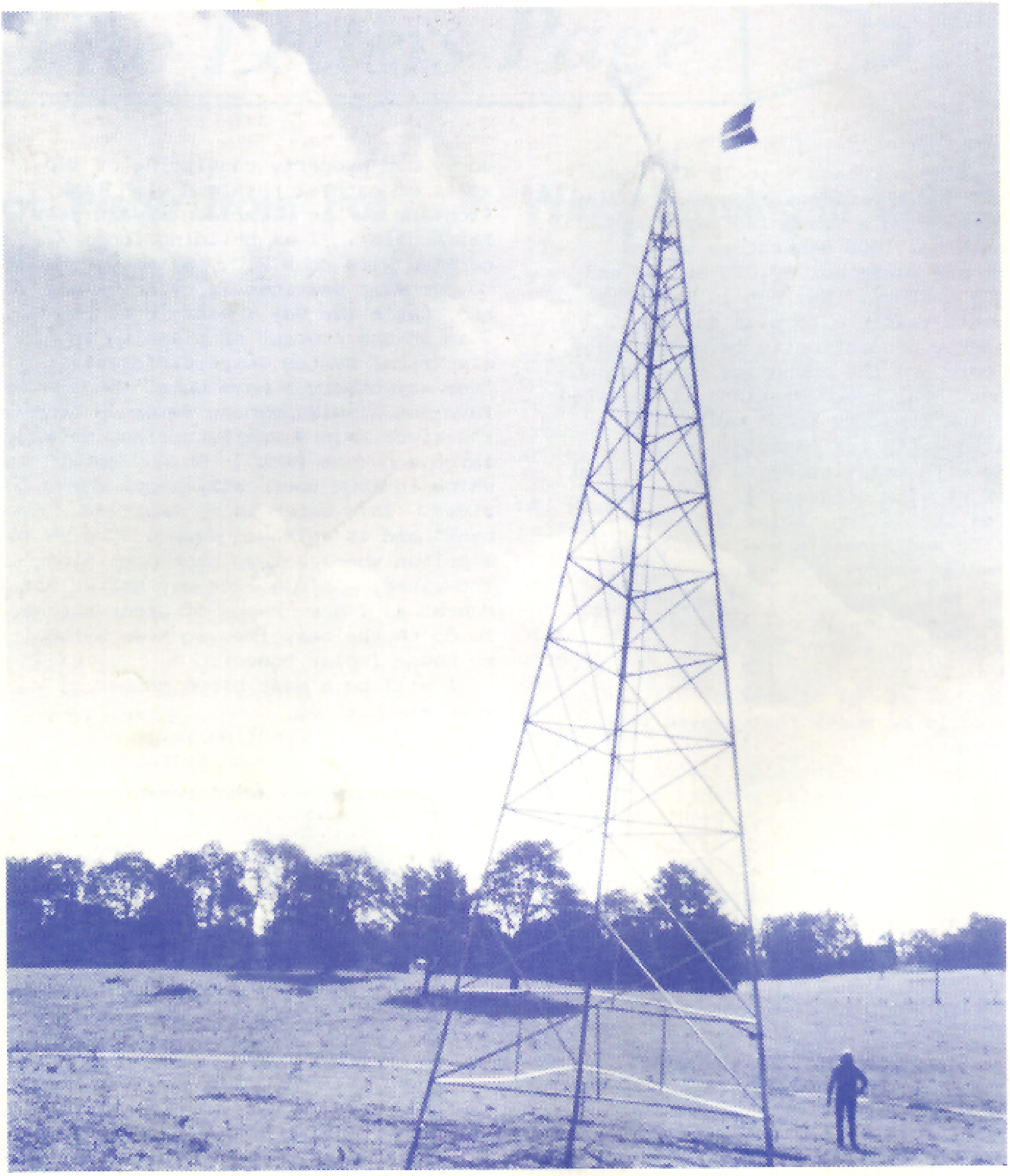
Dear ATA,

My interests vary as widely as the subjects dealt with in Soft Technology. My situation is that I am building a fire proof and weather proof of under-ground house and glasshouse and sheds on my own property consisting of 100 acres of natural bushland with 1 km frontage to the Nicholson River (near Bairnsdale). I am building from scratch with no SEC, my only linkup to domestic services is my drive-way and that's the way I want it to be.

I am in the process of planning an electrical system quite different from any others I have seen. It involves slowly pumping water up from the river, via a small turbine, to a large concrete tank (30,000 gal.) which is 100m vertically above the river. This water is my "battery bank" and is released down a 3" pipe to a pelton wheel set up back down along the river. It's a long way off at the moment as I have heaps of other things to do in the meantime, such as build my house (solar house).

I will be a most proud member of your association.

Thanking you,
John Hermans.



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