soft technology

Technology for a Sustainable Future No 53 Oct–Dec 1995 $4.95

Inside:

- Solar roof tiles
- A water-powered pump
- Build your home with 'good' wood
- Hydrogen fuel cells
- Battery-charger buying guide

Earthworms: turning waste into profit

Convert your mower to solar power

Micro-hydro in the tropics

New ATA Saver Packs

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Technology for a Sustainable Future
No. 53 October to December 1995 $4.95 (rrp)

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soft technology

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Editorial

Dear readers,

There have been a few changes here at the ATA office. Our latin-dancing, wit-wielding, chocolate-addicted Editor, Claire (Bear) Beaumont, has a new job. However, she is not far away, and will continue to lend her many talents to the magazine.

Soft Tech is now co-edited by Lance Turner and Michelle Douglas, who solemnly do swear to build on the good reputation the magazine has earned in the past. Appropriate technology is an area that is constantly developing and expanding, and we will endeavour to make Soft Tech reflect this change.

Some readers have indicated they are interested in 'green' enterprises. In this issue we look at the rapidly-growing earthworm industry. Jo Humphries heard about the benefits of earthworms on the radio and decided to start her own earthworm farm. All it took was a bit of land and a little know-how, and she soon had a small business that was not only financially successful, but helpful to the environment.

Hugh Spencer lives at the Cape Tribulation Tropical Research Station in northern Australia. During the wet season there is limited sunlight, and solar panels do not generate enough power to meet the station's energy needs. But one thing there isn't a shortage of is water. By adapting a *li'l Otto* micro-hydro system, Hugh has made the dull, humid wet season much brighter.

And now a word or two hundred about a future rise in our cover price.

Yes, our cover price is going up again! While this won't affect subscribers, those who buy the next issue of Soft Technology off the shelf will have to pay an extra 55 cents. This decision was not made lightly, and we would like to explain why such action is being taken.

Our main consideration in making this change is yet another increase in paper prices. It is the second rise in the past six months. Economists shake their heads sadly and tell us that this is penance for the wicked excesses of the eighties.

During those so-called 'boom' years, papers mills over-produced. When the recession hit at the end of 1988 we were faced with a paper glut. Consequently paper prices fell dramatically and some manufacturers went out of business. Since business started picking up in late 1993, paper manufacturers have been scrambling to meet demand. The current shortage of paper has given them an opportunity to try and redress the losses of those last lean years. While no one begrudges them their dues, and the sudden rise in paper prices has been good for the environment insofar as it has encouraged publishers to reduce wastage, it has hit the publishing world hard.

Many publishing houses, the Alternative Technology Association included, have tried to cover rising costs by increasing advertising rates. These and other measures have helped alleviate the problem but still more needs to be done.

We hope that we will eventually be able lower the price of the magazine again in the future. In the meantime, we appreciate your understanding.

Lance Turner

Michelle Douglas

ENERGY FLASHES

Aid for nuclear plants in North Korea

The Australian Government has exceeded its domestic hot water outlay by 10%' in its aid funding for North Korea's two nuclear power plants.

North Korea recently refused to allow international inspectors into its nuclear plants, sparking fears that its reactors were being used to produce plutonium for nuclear arms. Assurances have been made that, because the new reactors will be inspected, they will be safe and will not produce plutonium.

When it was suggested that it might be more beneficial to Australia to present it with Australian-made solar hot water units, the Foreign Minister, Gareth Evans, said that solar technology could not substitute the reactors' generating capacity and that, in any case, solar would not work in North Korea.

South Korea, however, buys solar units to the tune of A$1.5million annually from *Solahart,* which has negotiated the establishment of a factory there. Unlike Australia, South Korea uses a fossil fuel levy to finance its solar water heating scheme.

- Canopy, April 1995

CyberTran

The Idaho National Engineering Laboratory (INEL) is developing *CyberTran,* a revolutionary new computer-controlled light-rail vehicle which uses 95% less energy than standard high-speed rail at its ideal capacity.

Savings are derived by cutting the size of the train, thereby reducing its weight. The CyberTran uses one basic design that can be adapted for capacities ranging from six to 32 passengers per car. The cars may be run together or independently, according to demand. During off-peak periods, they are distributed throughout the rail system, ready for rapid use.

It's light weight obviates the needs for a heavy duty guideway - which accounts for up to 80% of the total cost of conventional rail systems.

The CyberTran currently exists as a working prototype. However, the city of Boise, Idaho, is considering a test installation. In the future, the Cybertran will be targeted at inter-city travellers, as its time over a 100-300 mile route is comparable to that of a commercial airliner when check-in and boarding procedures are brought into the equation. It is also three to five times as fast as an automobile. CyberTran's versatility may also make it useful in linking the growing urban sprawls.

***- Rocky Mountain Institute, Spring* 1995**

Electric bobby-mobiles

The Hampshire Constabulary in Britain is trialing an electric car. The Ford *Escort Ecostar* is to be used for routine police work.

The van is part of an ongoing effort by Ford to assess the role of electric vehicles in urban life.

The Ecostar is powered by Ford's sodium sulphur battery. It has a range of 160km/h and a top speed of 110km/h.

***- Electric Vehicle News, Autumn* I995**

Toshiba recycles hard plastics

Toshiba, the Japanese electronics giant, is currently developing a way of recycling hard plastic waste into fuel, salt and soda.

Their prototype system produces more than 200 litres of fuel from 250kg of plastics in eleven hours. Importantly, it has overcome a major problem often associated with the recycling of plastics - the costly and time-consuming practice of separating chloride and non-chloride plastics.

This development can be seen as a response to increasing pressure on industry from the Japanese government to keep electronics out of the solid waste stream. Electronics companies in Japan will soon be required to help municipal governments dispose of bulky electronics goods discarded by consumers, such as refrigerators and washing machines.

***- UK Financial Times,* August 1994.**
***- EcoReDesign Newsletter,* Vol One No.2**

Is Hollywood becoming rainforest-friendly?

Hollywood sets are often made of lauan, a rainforest wood. *Rainforest Action Network* and other groups have been campaigning hard against this practice for the past three years and seemed to have made it big time. *Trapped in Paradise,* a 1994 movie from Twentieth Century Fox, contains a note in its credits advising that rainforest timber was not used in the production of the film. So far, six major studios have agreed to reduce or eliminate the use of lauan in their productions.

- Earth Island, Spring 1995

Fuel from micro algae

Scientists at the Hebrew University, Jerusalem, have discovered 'green gold'. They have found a way to grow the green micro alga, *Dunaliella parva,* and convert it to a liquid fuel.

Dunaliella parva has a high protein content, which can be converted to hydrocarbons (fuel) when heated.

The micro agae can fix greater quantities of carbon dioxide per unit of land area than higher plants like trees and sugar cane. Unlike other biomass crops, which require agricultural land, it can be grown on desert land, salt flats and closed bays. It has been estimated that it can raise productivity of desert land 70-fold to more than twice that of a tropical rainforest. The alga grows rapidly - under laboratory conditions it has a doubling time of less than two hours.

Experiments using 400m^3 ponds indicate that an energy farms of 100 acres could yield at least 2000 tons of liquid fuel annually.

An economic feasibility analysis has determined the total cost of the oil produced to be US$26 (approximately A$35) per barrel, if a 20% markup is included.

***-Modern Power Systems,* 17.07.94**
***- Reric* News, December 1994**
***-APACE Newsletter,* April-June 1995**

Solar assistance scheme for country Victoria

A solar assistance package is now available to country Victorians. The Renewable Energy Assistance Program (REAP) is an incentive scheme aimed at promoting the use of solar and windpower in country areas. The program can provide up to $3000 for a new or upgraded renewable energy power supply system, where costs of connection to the grid exceeds $10,000. REAP is coordinated by Energy Victoria.

For further information on the REAP program contact the Energy Information Centre, 115 Victoria Parade, Fitzroy 3065. Tel: (03) 412 6886

- Energy Victoria News, Autumn 1995

Development of wind generators in Europe

Siemens Power Transmission and Distribution Group (EV) has teamed with the Danish utility *Elsam*, along with Copenhagen and Manchester Universities, to develop a new electronic control system which will dispense with. the need for a number of large electronic components in windgenerators.

The system will be installed in what will be the largest wind power plant in Denmark. The plant, which is due to commence operations in 1996, will have 40 wind generators with a total rating of 24MW.

- Media release, 27/&/95

Cement kilns double as incinerators

The Queensland Cement Limited (QCL) Group is incorporating waste disposal with the production of cement. Cement kilns burn at 2000°C, just the right temperature for incinerating waste materials which are difficult (or inconvenient) to recycle and usually dumped as landfill. Not only is 99.99% of the waste destroyed, but using the waste as fuel means that smaller amounts of coal and other fossil fuels are fed to the kilns. QCL has been running the program with waste oils and fuels for twelve months and hope to add waste plastics and tyres to the program within two years.

- Media release, 19/5/95

Monash to design solar-powered refrigerators

A research team from Monash University's School of Engineering, Gippsland Campus, has been granted $220,000 to develop a commercially viable, passive solar-powered absorption refrigerator. The initial design will focus on low-maintenance refrigerators for vaccine storage in the remote areas of Asia, Africa and the Middle East.

- SEIAA Newsletter, June 1995

Green Heating Quest

RMIT's Centre for Design is conducting a Green Heating Quest to find sustainable solution to home space and water heating.

The Quest is a two-year, collaborative, multi-disciplinary research project aimed at encouraging tertiary students and industry to promote efficient design and reduce greenhouse gases. Tertiary student will be asked to incorporate it in their 1996 curricula.

The project will involve not only on the technical side of energy efficiency and renewable fuels, but also the design, marketing;, legislative and social aspects of environment-friendly heating technology.

- ERDC Media Release, 17/7/95

Island nation sinks into the sea

The two-island nation of Trinidad is reliant on its oil, and not just for exports. Heavy exploration of oil and gas may well be contributing to the island's slow slide into the ocean.

Removal of fossil fuels has been causing land subsidence in drilling sites around the world.

- Earth Island, Spring 1995

Plastic from plants

Carnegie Institute scientists are developing a method of cultivating biodegradeable plastics in living plants.

They have successfully inserted a bacterium into mustard plants to create PHB, a naturally occurring, biodegradeable plastic that is similar to polypropylene - a petroleum-based product. It is estimated that plant plastics will be available in about six years.

- Earth Island, Spring 1995

Travellers go solar

More and more bus shelters, parking ticket machines and speed warning signs in Germany are solar-powered. Installing PV systems is much cheaper than connecting street structures to the local grid, and they pay for themselves within two years. The Frauenhofer Institute for Solar Energy in Freiburg has been at the forefront of developments in this area. The institute is currently developing a solar-powered timetable which will use a radio link to tell travellers when the next bus is due.

- New Scientist, 22/4/95

Windpower has competitive edge

Zond Systems of Tehachapi, California, has won a contract to supply 100MW of wind energy capacity to Northern States Power, a company based in Minnesota.

The reported bidding price was 3 cents/kWh. This is a levelised cost over 30 years. If the federal production tax for wind is taken into account, the actual levelised cost works out to around 3.6 cents, which is comparable, if not cheaper, to coal-driven power.

- NSP Press Release, 21 June I995

Study into Australia's waste

Researchers at Melbourne University have calculated the total amount of waste generated in Australia per year as 4.5 billion tonnes.

According to their study, 14 million tonnes of solid waste go to city landfills annually while mining, agriculture, forestry and energy production produce as much as two billion tonnes of solid waste over this period.

The community also generates an additional two billion tonnes of liquid wastes and half a billion tonnes of gaseous wastes per year.

The researchers concluded that savings accumulated by reducing the flow of consumer wastes to landfill were relatively small, and that conservation might be better attained by other means.

- ALC Environment Update, July 1995

PRODUCTS

The **ZAP** power system uses electric motors to help you pedal up those hills!

Assisted Manpower

ZAP -Zero Air Pollution

With city streets becoming more clogged by traffic and polluted every day, reducing the size of vehicles must be the way to go. If you are into electric-powered vehicles, ZAP Power Sys*terns* of the **USA** have an electric power-assist system for bicycles. The electric energy required to operate the motor is stored in a gel cell type lead-acid battery of either 15 or 30 amp-hour capacity.

The battery is used to drive dual electric motors, each with a nominal power rating of 300 watt (500 watt peak) Power is controlled by a three-speed selector switch. The motors act as generators when descending a slope or slowing from a high speed, thus providing some power back to the battery.

rrp US$499 plus shipping.

For further information contact ZAP on ph:1 800 2514555 fax:(707)824 4159 or write to 117 Morris St. Sebastopol, California 95472.

Sparta motorised bikes

Sparta Cycles Australia have released their range of Sparta motorised cycles designed and manufactured in the Netherlands. There are two basic models, the *Rabbit* and the *Grand Tourer,* available.

Power is provided by a single-cylinder, 30cc, two-stroke internal combustion engine operating on unleaded or super petrol. The output; power available is around 195 watts and the engine is started with a hand pull cable or an optional electric start.

The engines have electronic ignition for reliability and the bikes can achieve speeds of around 20 to 25km/h. Fuel consumption is 80 to 100 kilometres per litre (230 to 285 miles per gallon).

For more information call Sparta on ph:(03)9563 5813

rrp $2500 for the Rabbit, $2300 for the Grand Tourer.

Automatic pot-plantwatering

Agromatic Corp P/L has come up with an innovative system, designed and manufactured in Australia, for growing and automatically watering potted plants. Using *Auto Pot, the* potted plants are placed in trays which can be arranged in layers. Water is delivered to the topmost tray from the mains or an overhead tank. Use of a tank allows the addition of nutrients or other chemicals.

In each tray or pot container is a valve which controls the level of water in the tray by filling it to 35 mm and then turns off, not turning on again until the tray is completely empty of water. This gives a damp and drying out alternating cycle of watering that the manufacturer claims will promote exceptional growth.

You can design your own Auto Pot garden as a wall or room divider, using a single level or stacked in multiple layers. You can start with a small installation and add to it later.

Agromatic also offers a design consultancy for the interior decoration of commercial projects ranging from motels to shopping centres.

For further information contact Agromatic on ph:(03)9720 8288 or fax:(03)9720 8213.

Get the power!

Running three-phase machinery on single-phase power can be difficult, if not impossible, without modifications to the electric motor.

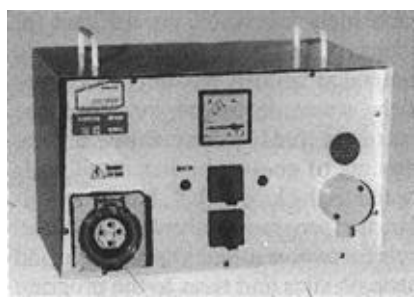
Alternative Power Systems has a range of phase converters which convert a single-phase supply to a three-phase supply. For low power requirements, use of a converter should be cheaper than having three-phase power installed.

There are 22 models in the range, varying in size from 0.37kW to 37kW. The smaller units will run from a standard domestic supply, while a larger, dedicated single-phase supply will be required for the bigger units.

All of the converters supply the three-phase power via a standard 415V industrial socket.

For more information, ph: (047)82 6311 or fax:(047)82 6134.

rrp is $795 for the 0.55k W converter.



Run three-phase machinery on single-phase power.

Green cleaning

Citro-Clean, by *Westmac Manufacturing Company,* is a multi-purpose cleaner based on natural organic extracts, including Australian, citrus oil. No petroleum based solvents or detergents are used.

Citro-Clean can be used on clothes as a pre-wash, for mopping floors, ovens and cook tops, shower recess and wash basins and all manner of general cleaning.

Westmac produces a range of other cleaning agents which are used in the cleaning industry. They also plan to package and release more of these cleaners to the general public in the near future.

rrp $5.95 per litre

For further information contact Westmac on ph/fax:(059)66 2505.

Healthier gardens

Is you garden looking sick and you don't know why? Well, *Natural Garden Health Solutions* may be able to help. They have started the *Green Rain* service for restoration of garden health.

The service starts with a soil test and evaluation of soil and plant health and effectiveness of past watering policies.

The garden revitalisation program involves regular applications of natural nutrients based on foliar kelp and use of biological controls or safe natural pesticides if initially needed.

The service guarantees a return to a vigorous, natural garden health with thicker, healthier foliage and more abundant flowers.

For further information ph:(03)9739 7007 or fax: (03)9882 3838.

New *loos*

The well known manufacturers of cornposting toilets, *Clivus Multrum* in Bentleigh, VIC have come out with a new range known as the *EnviroLet*. This new range of four models are compact, attractive appliances and are in addition to their four other Clivus model.

The units are made from durable, easy to clean ABS plastic. When the lid is lifted all that can be seen is a white disc. The compost cover opens only when the seat is pressed down.

No worries here with Westmac environmentally sound cleaners.

The units range in capacity from two to four people for normal residential use. Some units come with an automatic mixer while others are manually operated. There is also a model for areas without electric power.

rrp from $1550 for a complete system.

For further information contact Clivus Multrum on ph:(03)9557 6943 or fax:(03)9557 4786.

Horticulture & Agriculture

Australian correspondence schools provide over 190 distance education courses, ranging from horticulture, agriculture and permaculture to healthy buildings, herbs and fitness.

Many courses are accredited and Austudy approved. Study time required ranges from 60 to 2500 hours and prices from $275 to $5950. A free 80 page handbook can be posted on request.

For further information please contact John Mason Ph: (07)55304855 or Iain Harrison at Ph: (03)9736 1882 or fax:(03)9736 4034.

Environmentally safer cats

While owning a cat is not the most environmentally friendly thing that you could do, if you just can't live without that furry friend, then there are ways to help reduce its impact on the environment.

Baramil Holdings is offering cat litter made from recycled newspaper. The manufacturer claims that the material is efficient and economical, less material is required per litter tray and it lasts longer compared to other materials.

The used material can readily be disposed off as garden mulch or household refuse. The material comes in 2 1/2 and 15 kg packs.

rrp $1 to $1.20 per kg.

For further information contact Peter Farley on ph: (03)9740 7564 or fax:(03)9740 7584.

Duct Cleaning

Heating and cooling ducts pick up a lot of dust in the course of a year's operation. The accumulated layer of dust on the ducts impedes heat transfer and increases the cost of heating and cooling. Cleaning the ducts also results in a healthier environment in the home.

Dust Busters Australia Pty Ltd use advanced cleaning methods, recommend cleaning at three yearly intervals and provide an extended guarantee for the fan motor on completion of duct cleaning works.

Prices vary with the size and length of ducts.

For more information contact Dust Busters on ph: (03)9879 3399.

Solar Pump in a plastic pipe!

Bruno Wittwer of **B/W** Solar in **WA** has developed a solar powered piston pump. The pump consists of a double acting piston in a pipe sheath, with a foot valve attached to the bottom. The drive connection to the solar powered motor can be extended up to a depth of 54 metres so that the pump can be operated in a borehole or in the general transfer of water eg. from dam to tank.

The motor for the pump is powered by a solar panel mounted on a solar tracking frame developed by Bruno. This tracker does not use any **CFC** gases and is environment friendly, making use of electronic light sensors instead. Bruno claims that the tracking frame will withstand cyclonic conditions. There are two models of pumps and they can be installed with equipment for operation at various depths.

rrp $2715 to $7965

For more information contact Bruno Wittwer on ph/fax:(09)3418711

Sunsaver Mark II

Sunsaver Mark II is a solar hot water system designed and produced in one piece thus reducing joints, seals and gaskets. This reduces the problems of leakages and heat loss.

The units are produced with a one piece moulding of polyethylene, insulated with polyurethane, and has an acrylic collector cover. The plastic construction provides long lasting durability and corrosion resistance. Installation is simplified with fewer joints to be installed.

rrp is $1241.50 for the electric boosted unit and $1151.50 for the unboosted unit, For more details contact John Partridge on ph: (089)84 4332 or fax: (089)84 3338.

Recycled jeans

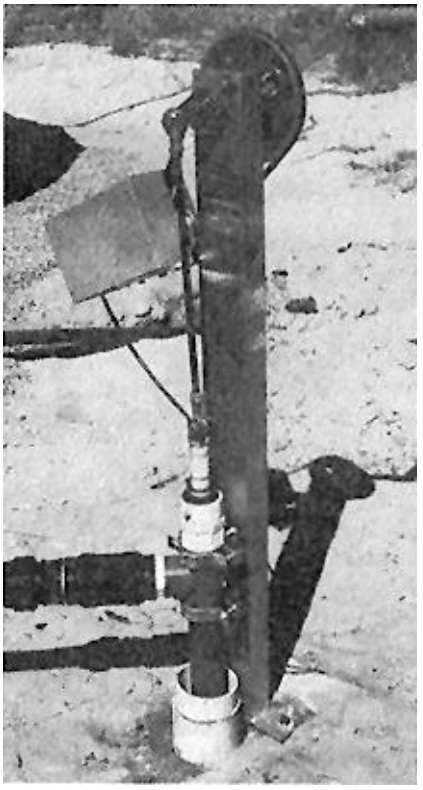
Armani of Italy is using a process whereby old jeans are recycled by breaking the fabric back down to fibre and re-processing the fibre back into denim material.

The 'new' denim does not need re-dyeing since the colour from the old material is retained. This avoids the pollution from the traditional dyeing process.

The old material does not need to be disposed of, less cultivated land is needed and use of agricultural chemicals is not required. Less water and energy is used.

rrp $180 (projected estimated cost)

For further information contact Denise Jones on ph: (02)2315399 or fax: (02)231 5499.



Simple but effective - the *B/W Solar* plastic pipe pump.

Healthier eating

A group of 'greens' has joined together to promote the use of organic food, detergents and other products that are free of synthetic chemicals. For $25 a year you can become a member of The Green Line and enjoy discounts off list prices, rebates for bringing in business, and be paid for your efforts in promoting membership and sales.

The present list of products on offer fills nine pages and the list is growing. So if you are into organic food and want to do your bit for the environment, you can join up, help to spread the good news and bring down prices by increasing volumes.

For more information contact Rosemary Long or Nick Selemba on ph: (03)9889 2299 or fax: (03) 9889 1399.

Solar powered airstrip lighting - pilot activated

Aerocom Lighting are supplying fixed/portable lighting systems for use in airstrips in rural areas. The lights are powered by solar charged batteries and the lights are activated by a signal from the plane as it approaches the airstrip.

The lighting units can be used for runway lighting, hazard lighting and windsock lighting.

The signal to operate the lights start a thirty minute lighting cycle and there is the option for the pilot to shut down the lights after landing.

The units cost $665 each and a typical landing strip or aerodrome would need 24 to 28 units.

For further information contact Bill Lane or Peter Doherty on ph:(054)41 7029 or fax: (054)41 7148.

Techni-Ice

If you use a frozen bottle of water or salt solution to cool your esky, cooler or cooler bag, then an alternative being offered by *Global National Australia Ltd* should be of interest. Supplied in the form of a flat sheet of cells containing a polymer, Techni-ice will keep your esky cold just as well as ice, without all the mess and possible leakage. The sheets are frozen in your freezer just like an ice bottle, and can then be placed in the bottom of the Esky and wrapped around individual containers.

Techni-ice doesn't just act as a cooling device, however, as the sheets can also be used as heat packs by immersing in hot water or heating up in a microwave.

For further information, ph: (03)9890 9346 or fax:(03)9897 1107.

rrp $6 per sheet of 24 cells, excluding p&p, with quantity discounts available.

Techni-ice is a great substitute for messy crushed ice.

The *Prima Sol* solar-powered camera

Review by Lance Turner

Photography can be a great hobby, and with the huge range of cameras on the market today, it is an easy hobby to get into. But, like many hobbies, there are a number of costs involved. Some of these are not only financial, but also environmental.

Among these costs is the replacement of batteries. With the development of the 'point and shoot' style of camera, virtually all cameras require the use of batteries. *Canon* has sought to address the issue of the throw away battery with the release of the *Prima* Sol solar-powered camera.

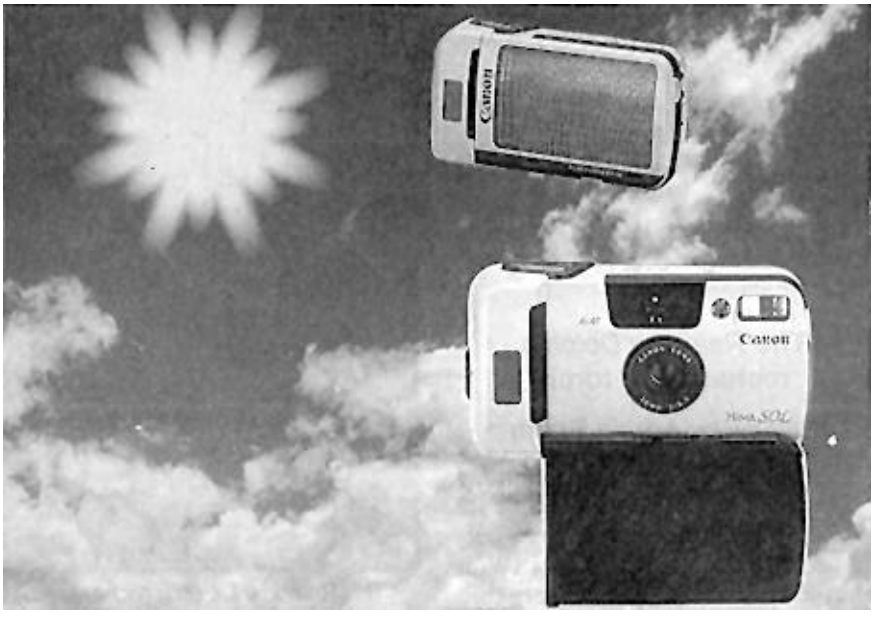
This unit is also one of the point-and-shoot brigade, with one big exception. All of the cameras functions are powered from an inbuilt lithium-ion battery that is recharged entirely from the built-in solar panel/lens cover on the front of the camera.

Like most computerised cameras, the Prima Sol has a built-in LCD panel that shows the state of charge of the battery as well as the amount of charge coming from the solar panel. This information is conveyed in the form of a simple bargraph that is easy to read and can be understood at a glance.

Taking some shots

The front of the camera is completely covered by the solar panel, while the back of the unit looks more like a conventional camera, with a view-finder window and a few small buttons on the side.

To take a photo, you flip open the solar panel to expose the lens. Once this is done, the camera 'wakes up' and the motor-driven lens moves out into the normal active position.



Completely powered from the sun, the Prima Sol is a step forward in camera technology.

The Prima Sol really is a point-and-shoot unit and there is not a lot to tell about its operation. You just aim at your subject, depress the fire button partially and wait for the green light to come on to tell you that the camera has focused and is ready. When this happens, you press a little harder and the camera will take the shot and wind the film on for the next one.

This camera does have a few handy features, one of those being the anti-shake feature. If your hand is shaking too much for the shot to be taken, the green light will flash until the camera is stable enough. Another useful function is the flash-override button. You just hold it down while taking a shot and the flash won't fire.

All solar

As mentioned earlier, the sole source of power for the camera is the small amorphous panel built into the flip-down lens cover. This panel is a bit more high-tech than the conventional amorphous job, as it has two active layers instead of one. This allows it to convert more of the incoming solar energy into usable electrical power.

The camera also has a temperature protection feature whereby the panel will flip up to an angle of about 30° if its temperature exceeds 55°C. This will prevent the camera from overheating and possibly ruining the film.

According to Canon, the solar panel can charge the inbuilt battery from completely flat in around eight hours of full sunlight. Unfortunately, for the two weeks that we had the camera we had no really sunny days, so testing this was not possible.

The battery is supposed to be able to take around 120 photographs on one charge, half of these with the flash being used. This is one aspect I did test, however the result was inconclusive as, after ten minutes of firing the camera with the flash enabled, I got bored waiting for the battery to go flat and gave up. It certainly produced at least 100 shots with the flash being used in all of them. Not many people could flatten the battery on this camera in one day.

Overall impressions

I think the camera deserves to be very popular, not only for the features it gives, but for the complete elimination of the need to replace batteries. The only gripe I had with the camera was that the view finder seemed to be a bit too much toward the centre of the camera, making it awkward to get my face behind it.

Also, for me at least, the recommended retail price of $399 is a bit steep. If you have the money and are in the market for a simple-to-use and environment friendly camera, the Prima Sol should definitely be on your short list.

The *Rainbow Dolphin* rechargable torch

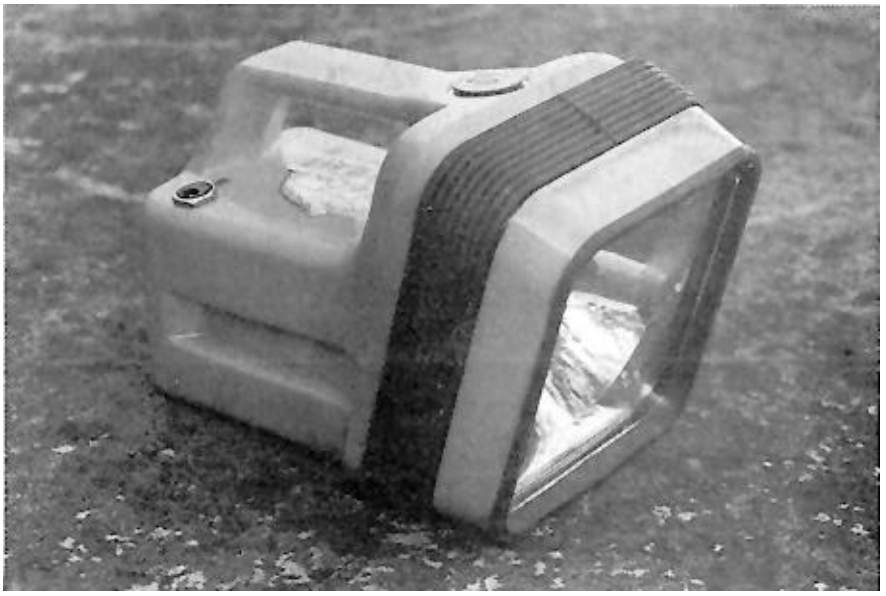
Review by Adrian Braun

Camouflaged under the ubiqitous guise of the *Dolphin* torch is a product which offers far more than its nine dollar exterior normally promises. With the *Rainbow Dolphin* rechargable torch, *Rainbow Power Company* has again exhibited its knack for designing innovative no-nonsense products from commonly available bits and pieces.

They have replaced the disposable six volt battery with a more environmentally sound rechargable sealed lead-acid battery *(Apollo* 6V 4AH) which is charged via inbuilt circuitry.

However, it is the intelligence of the inbuilt charger which is perhaps the most important feature of the torch. The charger is specifically designed to optimise. the life and efficiency of the sealed lead acid battery and charges the battery in two stages.

Initially, it charges up to 80% of the battery capacity at a normal rate - indicated by the dual colour LED glowing orange. Charging then continues at a low charging rate, indicated by the LED turning green. The charger also monitors ambient temperature and modifies the charging profile to suit extremes of temperature. *Soft start* circuitry switches current to the globe less abruptly, thereby extending the globe's life



The Rainbow Dolphin rechargable torch - making a good product even better.

It is these features which make the torch almost impossible to overcharge. With a versatile input voltage range of 10.8 to 35 volts, the torch is ideal for renewable energy sources or mobile applications.

After testing a demo model for quite some time on a sailing boat with a 12 volt power system, we concluded that one should become part of the boat's permanent inventory. What sold us was that the torch is self contained (except for the lead required for recharging), It has plenty of grunt (about 6-7 hours of usable light), is virtually fool proof and we're avoiding the cringe we experienced every time one of those throw away lantern batteries was bought.

On the down side, the torch's self contained versatility is somewhat compromised if you are reliant on 240 volt AC as a power source for charging, you'll need to buy an additional adapter. Also, Rainbow Power's modifications, which include an externally mounted socket and indicator LED, sacrifices the Dolphin's useful ability to survive inadvertant dunkings. If Rainbow were to remedy this problem, I reckon they'd have a near perfect torch on their hands, especially for boat owners.

All in all, we rated the torch fairly highly and believe it's $99 price tag is reasonable considering the the quality of the lead acid battery, the sophistication of the charger and the fact that the torch pays for itself in unbought disposables.

Available from Rainbow Power Company Ltd, 1 Alternative Way, Nimbin, NSW 2480
Ph:(066)89 1430 fax:(066)89 1109.
Dolphin is a registered trade mark of Eveready.

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The Solarex Solarstate™ SRX-6 voltage regulator is an industrial quality shunt regulator which controls battery charging in small and mid-sized photovoltaic power systems.

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• Simple installation	• Time saving
• Controls up to 5.5 amps	• Suitable for use with all modules, especially MSX77 & 83
• Shunt regulation technique	• Extremely reliable & efficient - No RF interference

2088 PUMP

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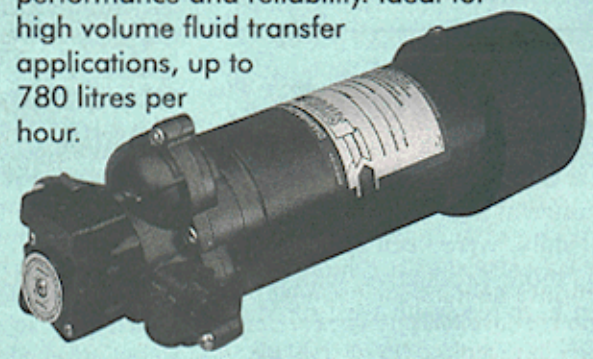

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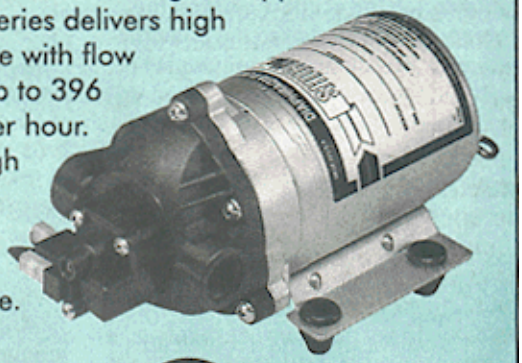

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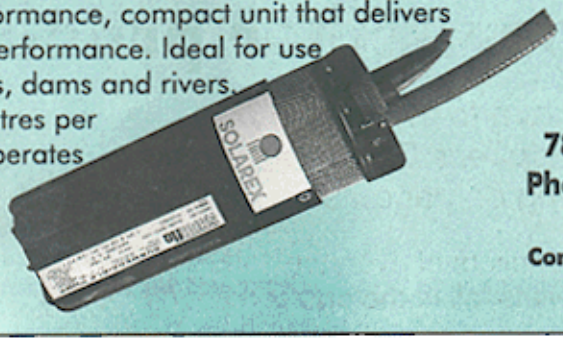

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Farming Earthworm

Many people have expressed interest in ventures that are not only positive for the environment but profitable for the pocket. The following extract, taken from the book Farming for Pleasure and Profit *by Jennifer Wilkinson, looks at a rapidly growing industry.*

Jennifer Wilkinson

ALTHOUGH a city girl, Jo Humphries took to country life like a duck to water. She and her husband Geoff, an environmental health officer with the local shire, were keen to do something more productive with their seven hectares south-west of Melbourne.

Jo heard a radio program about using earthworms to improve pasture, and she thought that maybe the worms would enrich the shallow soils on their property. Geoff could see the potential for worms in reducing the mountains of food and garden refuse collected in each shire.

Making a start

Inspired by these concepts, Jo and Geoff started *Earthworm Organics.* They decided to begin on a small scale and expand later if necessary. The first task in 1991 was to build a roofed area, about the size of a large shed, to shelter the worms from the elements and meet the expected water requirements. Jo thought that if the business didn't succeed at least they would have a big shed for a party.

Beneath the roofed area Jo and Geoff constructed rectangular beds from concrete blocks to contain the worms. They decided that the most accessible size for the beds was 2.5m by 1.5m, and two rows of blocks provided the perfect height. The twenty-eight beds were laid out in four rows, and each had an earthen base to allow drainage. Before the worms were introduced, a thick layer of stable manure and straw was spread in the beds, and other animal manures were added on top. The material was then watered.

Choosing the right worms

Through her research, Jo discovered that the worms that improve soils for broad-acre farming are a different species from those best suited to converting organic waste, and that species vary from region to region. However, all worms are good for aeration, digesting decaying organic material, producing castings and (dispersing nutrients. The three types of worms for cornposting are red worms, the so-called Indian blue, and tiger worms, which particularly love pure manure and can be identified by their striped body. Jo says that the three types work well together and do not interbreed.

Breeding

Early in 1992 Jo and Geoff brought their worm stock from a recommended supplier. They initially bought 50,000 red, blue and tiger worms and placed them in a few prepared beds, covering the top with carpet to provide a dark, moist environment.

Worms are extremely fast breeders and, if conditions are right, they can double their numbers every few months. They are hermaphrodites, but they pair up to reproduce and, as they do, a jelly-like substance forms around them. In this mucus the eggs are fertilised. Then the worms simply slither out leaving their ball of mucus behind, and from this capsule between one and

Jo Humphries farms three species of earthworms: red, blue and tiger.

twenty tiny worms later emerge. In the decaying manures of the worm beds at Earthworm Organics there are a myriad of tiny capsules. Jo says that the worms lay eggs from three months of age but they don't finish growing until they are a year old. Each worm can live for many years.

Manure

To keep the worms breeding, Jo continually adds more manure to the worm beds. She says a mix of different manures is best and, although her own farm animals provide some, she has to go to local fanners to keep up the supply. Her favourite sources of manure are an egg farm and a horse stable nearby, for she knows that the supplies of manure from both are drench-free. Most stock drenches break down quickly, but manure from animals drenched with ivermectin can kill the earthworms. Too much poultry manure can overheat the beds, so Jo adds just a sprinkling, except in winter, when she uses it to warm them. She says that worms breed best when the compost is between 20°C to 30°C. Old hay and straw are also good as they provide cellulose.

Earthworms prefer pH to be around neutral. Jo has never had trouble with acidity, and the pH has increased to 9 without any noticeable harm to the worms. Moisture content, however, is more critical, and she keeps the bed material moist enough to have a friable texture. She says that if it's too wet there is no air for the worms, and they need oxygen like other animals.

Rapid growth

In the first year of operation the worms multiplied prolifically, and Jo and Geoff filled all the twenty-eight beds. In addition to building up their own stock, Jo sold 100,000 worms in that time through both mail order and deliveries to nurseries in the nearby towns. In 1993 sales increased to a couple of hundred dollars a week.

Packaging is critical and to prevent the worms overheating and drying out Jo and Geoff chose lidded polystyrene boxes. However, despite the effective insulation properties of these, they prefer to send interstate mail-order boxes

WORMS FOR SALE

Centrally located in the Melbourne suburb of Richmond is a retail store with a difference – it specialises in earthworms. Believed to be the first of its kind in Victoria, *Worms 'R' Us* has been received favourably and its three staff have set themselves the task of changing the status of the humble worm forever! Having already proved a successful formula in Adelaide, where there are now three outlets, plans are already in progress to open shops in the remaining capital cities, as well as expanding across the Tasman to New Zealand.

Why worms? Well as Graeme Lewis, Manager of the Melbourne store points out, 'The earthworm is so unlike humans because it's *obsessed* with putting on weight!'. With their voluntary labour, organic waste can be turned into environment-friendly products. Recycling waste to create a product is the philsophy of this particular retail business. Its aim is to promote and encourage an inexpensive, compact method of organic waste management, which can be used by individuals or applied on a commercial level.

Worms 'R' Us is the retail division of International Composting and Waste Management Pty Ltd, a business which originally started as a baitworm breeding operation in a backyard ten years ago. The retail network specialises in worms (the composting varieties), and all manner of practical worm products. Products are locally made, often by community groups. The Melbourne shop has recently commissioned the TAFE at Torana Remand Centre to manufacture its plantation pine vermicompost bins.

Predictions are that the area of vermiculture will continue to grow for the next five to ten years, as it has in America, where vermiculture is now a billion dollar industry. Success has also been enjoyed in France and India. The current demand in Australia for worms and castings far outweighs supply. Whoever thought the earthworm could generate money?

Well it can, and to this end Worms 'R' Us is eager to help others set up their own business or assist them with their waste management problems. They have devised a special buy-back contract in which they guarantee to purchase at least the price of your initial investment over a certain period of time with no limitation on who else you can supply. Advice is free! In terms of setting up waste management schemes there are now worms around the country happily munching on the waste of sewage plants, abattoirs and mine slag heaps – investments which are profitable to both parties.

But success is not only for the 'big boys', there is the story of the recent effort of a school to raise funds through the breeding and selling of worms and castings which netted them approximately $1500.

With increasing community awareness of the importance of composting, federal government schemes such as Landcare, and new local initiatives, the advantages of recycling with worms have never been more relevant. In the near future legislation will ensure that users pay for their rubbish, putting the onus on individuals and organisations. Trials in Adelaide are using a computerised collection truck which weighs and records the rubbish – the heavier it is, the more you pay!

This type of environment lends itself very nicely to entrepreneurial pursuits; people take action when the hip pocket is hurting. And while there will always be individuals happy to compost, there will be as many who will want it done for them. That's why the potential to develop a supply industry is enormous – just think of the restaurants, gardens, councils, nurseries, essentially any number of places which produce organic waste, and you have a market. Australia's vermiculture knowledge and products are already being sought by Japan, Singapore, and Korea.

But whether you compost for fun, or embark on making your (environmentally sound) millions, be sure to thank the worm!

– Miranda Brash

by refrigerated freight, and at each nursery delivery point Jo replaces any unsold boxes with fresh ones. The returning boxes are revitalised with more manure. The worms are packed in vermicompost, and large boxes contain 1000 worms and small boxes about 500 to 600. They sell for $20 and $15 respectively, and Jo says they are perfect for people who want to introduce worms to their compost heap, or as a breeding box for fishing bait. She also packages small tubs of worms and vermicompost.

Uses for earthworms

Most boxes of worms are bought to accelerate the cornposting of kitchen and garden scraps. The couple believe that when domestic rubbish disposal increases in price, everybody will be turning to home cornposting. Other worms from Earthworm Organics end up on farms to break down farm waste. Jo sold several thousand worms to one farmer, who added them with chook manure to piles of spoiled hay in order to convert it into fertiliser for his pasture. Earthworms are also used to compost dairy effluent and stable straw. Castings are another saleable product from the worm farm. Jo packages them in 10-litre bags. These wholesale for $8, which she says compares favourably with other fertilisers and potting mixes.

Contented entrepreneurs

While Jo spends about three days a week working with the earthworms, she says that they don't really need day-to-day care. She admits that carting manure is not the most pleasant job in the world, and is quite physically demanding, but she loves to be able to work from home, and she can always take off time if she needs to. Earthworm Organics has covered its small capital investment in two years and, most importantly, Jo and Geoff are happy to be involved in a venture that helps the environment. ☼

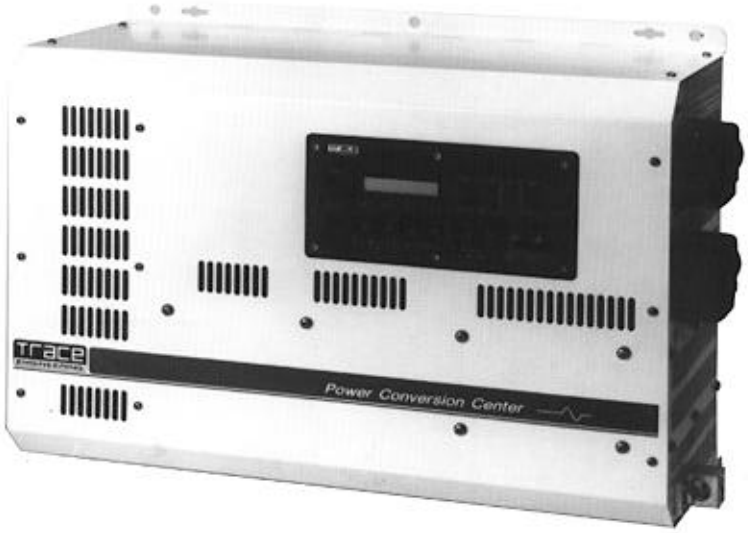
Extract from the book Small Farming for Pleasure and Profit *by Jennifer Wilkinson. Viking, rrp:* $19.95.

Jo's daughter, Kate, empties food waste into a compost bin filled with home-grown worms.

Interactive Sinewave Inverters from Trace Engineering

The Trace 24 and 48 Volt, 3,300 Watt interactive inverters are a leap forward for owners of generating sets, providing super quiet inverter operation and excellent fuel efficiency. They are so smart that they continually monitor the system load and status to decide whether the power should come from the genset or the inverter and can even let the inverter add to the genset output to cope with those larger loads. Not only this, but it also acts as a fully automatic battery charger with a powerful 100 Amp charger for 24V version and 50 Amps for the 48V version.

The unit has heaps of features built in to allow the installer to customise the whole system operation on site. All control and metering is via a front panel LCD menu panel.



Features include:

- *Quiet times to ensure that the peace is not disturbed by the genset.*
- *Battery charging rates and maximum battery charging load on the genset.*
- *Genset control functions, such as number of cranking time and warm-up time.*
- *Standby power drain as low as 1 Watt.*
- *Ultra low audible noise.*

Modified Square Wave Inverter/Chargers

Trace have also introduced a whole new range of inverter charges in a bright new package. Building on the thousands of inverters supplied over the years, Trace have packaged their best features into these compact new units. Three new models have been released - 12 Volt - 1500W, 24 Volt - 1500W and the powerful 24 Volt - 2400 Watt unit. each has a 10 selectable charging facilities built in, with the familiar 3 stage charging method of float, boost and equalise regimes.

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Solar Roof Tiles

Michelle Douglas

With their complex support structures and large solar panels, conventional photovoltaic arrays are often regarded as bulky and obtrusive. This is of particular concern to people who want to use sustainable energy to power their home, but who are worried about the aesthetic implications of installing a large array on the roof of the house. Such systems also represent a significant conceptual hurdle for architects.

In Switzerland, a team of design specialists, tilers and plastic manufacturers found an innovative way to overcome these problems: a photovoltaic module which doubles as a roof tile.

Now produced by the Swiss firm *Newtec*, the *Solar Tile* weighs around 6kg and covers the area of five normal tiles. These solar modules can be mounted directly onto conventional rafters and battens so that they overlap with the roof tiles. They can be integrated into most sloping roofs as they require a minimum angle of only 20 degrees. Naturally the angle of the roof, as well as shading, will effect power generation. However, at its peak a tile can produce as much as 36 watts.

Features

The photovoltaic cells are enclosed in a laminate 'sandwich' composed of a *Tedlar* plastic backing and a toughened glass covering. The overall laminate is only about five millimetres thick but strengthened supports under the tile mean that it can carry the weight of your average tapdancing tradesperson. The tiles are weather resistant and storm proof according to SIA 160, which allows for hailstones, snow, and gale-force winds.

The frame is made from recyclable acrylic plastic (PMMA) which is highly UV resistant. The headlock at the bottom of the tile creates a smooth, weatherproof join.

The electrical connection is located on the back of the tile. Each tile has an identical connection, enabling flexibility of configuration. As well as allowing for easy installation, the plug-in system eliminates short circuits and incorrect polarity. A bypass diode also protects the solar tile and enables the system to continue functioning if some

Above: *Solar Tiles* are unobtrusive and are easily integrated into the architectural concept.

of the tiles are in shade. Unlike conventional systems, if by chance anything does happen to the electricals, the connections can be accessed from within the roof space.

Installation

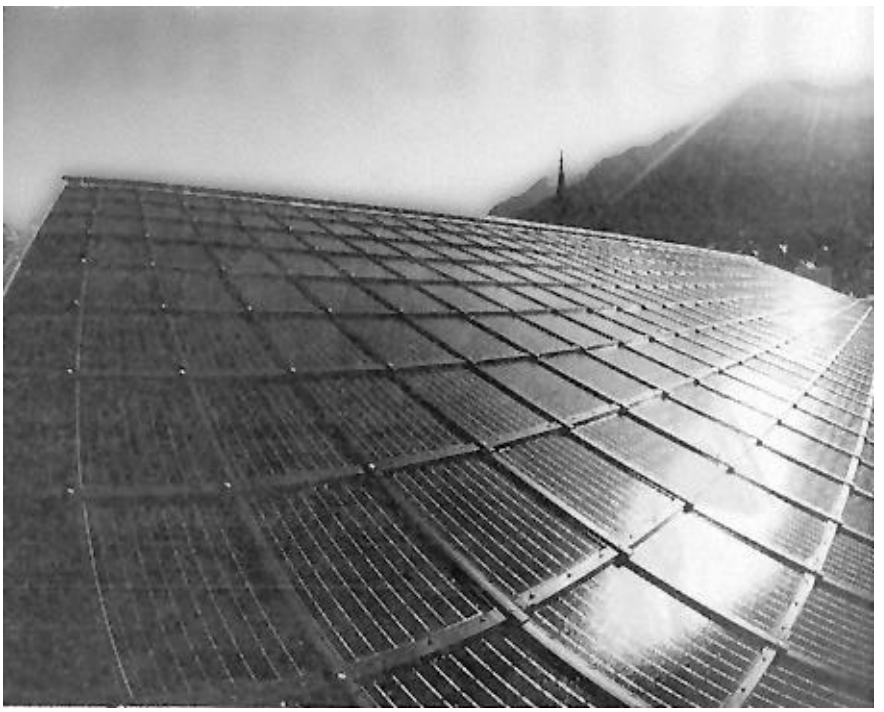
No materials or tools other than those usually used by electricians or tilers are required to install the tiles. Connection is carried out by a trained installer. A qualified electrician is needed only when making the final connection to a power conversion device, such as an inverter for a grid-connected system.

Added benefits

Aesthetics are clearly not the only benefits to be gained by the solar roof tiles. Direct installation of the tile is also more cost effective than setting up an array on a roof top, as it displaces material and labour that would otherwise have been required.

Because the tiles are free of moving parts, they require little maintenance. Guides on the frame direct rainwater over the surface of the tiles preventing a build up of dirt. This means the tiles need only be cleaned with warm water once a year.

The tiles are not only suitable for housing but can be used wherever there is roofing. They can be fitted to new and existing sheds and industrial buildings, medium and large size plants -up to several kilowatts - and are suited to both grid-connected and stand-alone systems. They can also be used as sunshades.

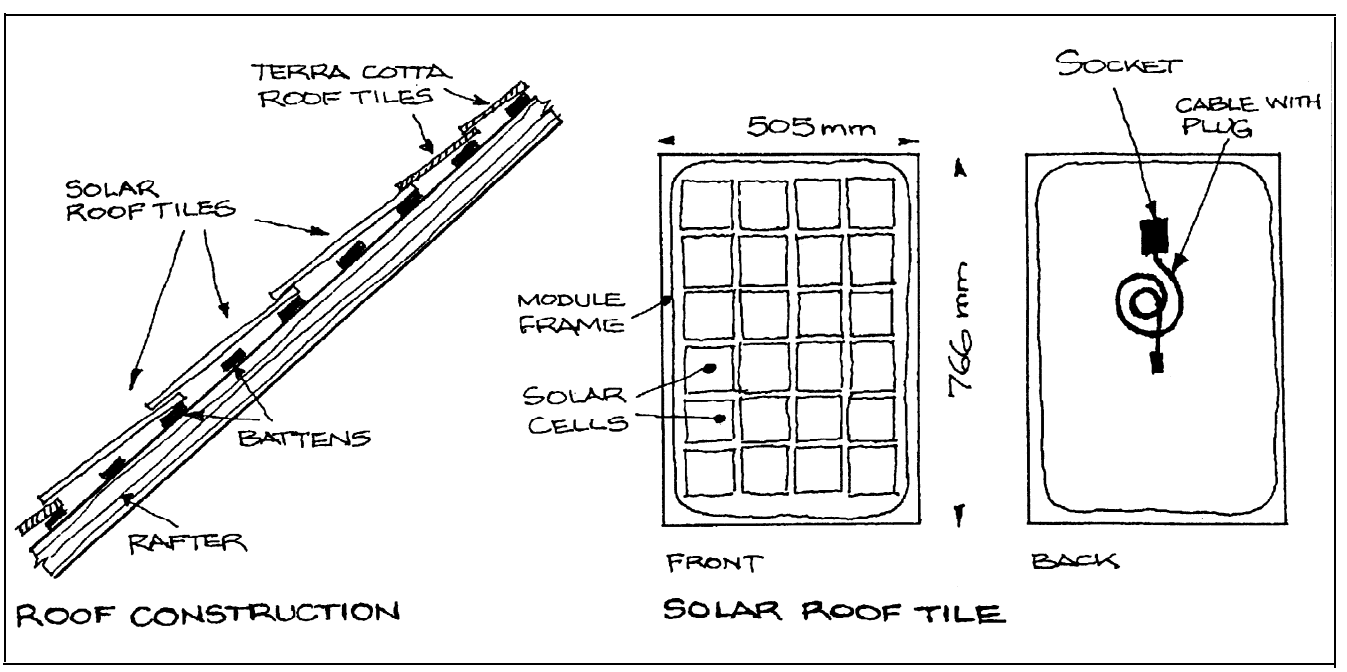


The tiles can be fitted to most sloping roofs.

Performance

The tiles have performed well over a three year period in Switzerland. Condensation problems occured during development but these have been overcome by ensuring effective internal air circulation within the roof.☼

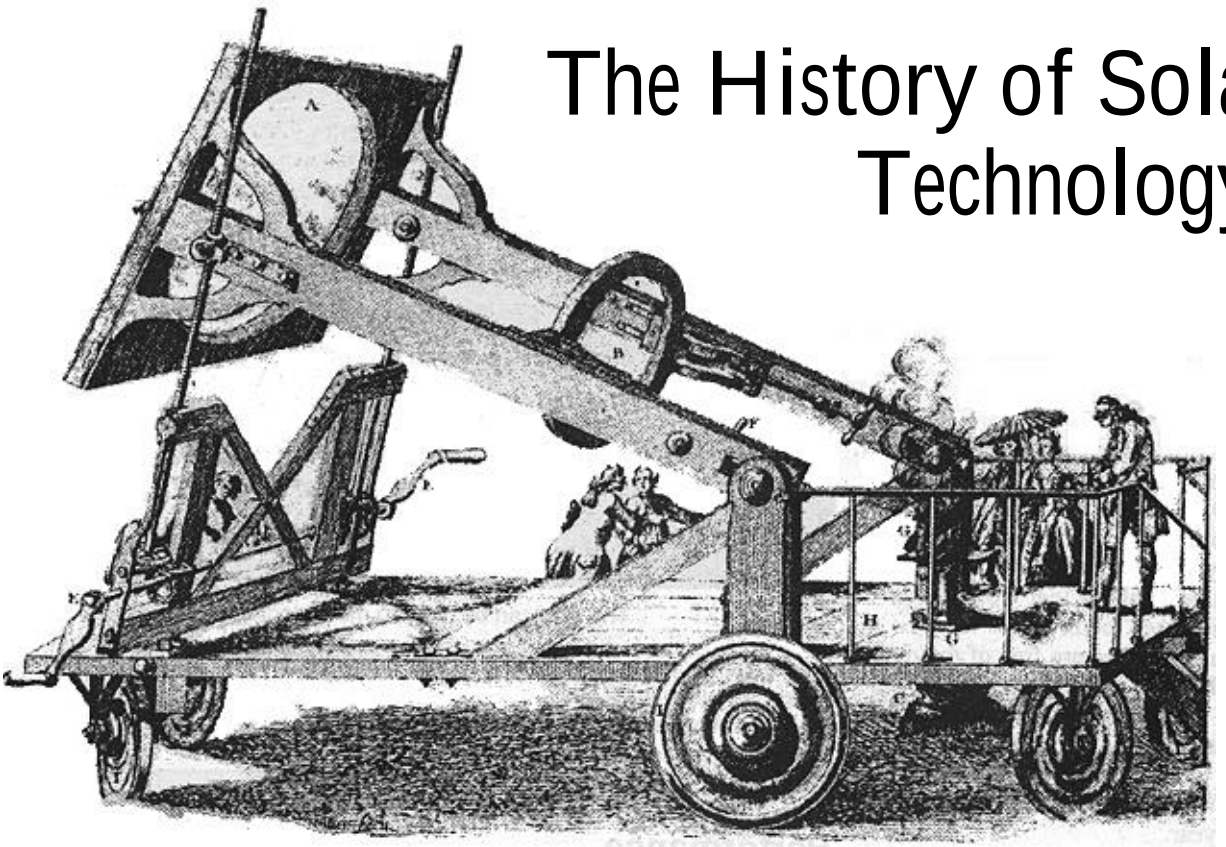
Solar Tiles have recently become available in Australia through *PV Pacific Solar*. Readers who would like to make enquiries should phone Peter Erling on (02) 427 5887.



Design from CADDET Technical Brochure no. 9

OUR DARK PAST:

The History of Solar Technology



Erika Charola

SOLAR power's history is curiously reminiscent of that of world peace: distinguished by everything that got in the way. So many things have impeded its development, that it is often forgotten that solar energy technology and wind power pre-date today's most common energy generation methods by centuries. Notwithstanding an all too promising start, solar energy has remained only marginal as a source of power.

Above: Artist's impression of Antoine Lavoisier's spectacle.

Powerful beginnings

Banking fraud and warfare notched up the fast recorded uses of solar ray concentration in Western society. Debts recorded in wax tablets were mischieviously melted away using glass in 'Aristophane's *The Clouds,* dated 448 B.C. In the third century BC, under a cunning plan devised by Archimedes, the Greek defence forces set fire to the distant sails of the Saracens. Involving many small mirrors set into a curved plane, this was the first recorded use of a parabolic dish.

In 77 BC, Pliny the Elder, a multi-skilled Roman statesman, recorded the burning of dead cells using focussed light rays: the Classical precursor of laser surgery.

The Dark Ages were just that when it came to the use of solar power, and it was not until the Renaissance that interest in solar energy was reborn. In 1615, de Caux built a solar water pump. It utilised pressure changes caused by air that had been expanded by the sun's heat.

During the ensuing century, a parade of Frenchmen used solar ray concentration to boil water, set off canons, burn wood and melt metal before gasping crowds. Antoine Lavoisier used St Gobain lenses to focus rays to melt platinum at 2000°C and Georges Buffon used mirrors to concentrate heat to burn wood and melt lead and silver.

Coal takes the limelight

Ever-decreasing wood supplies in Europe lead to the replacement of wood-fired systems by industrial coal furnaces - a step which required only minor adjustments to existing machinery. The mobility and apparent long-

term viability of coal in seventeenth century France led to the decree of universal coal mining rights. This endorsement of carbon's supremacy by the legislature meant that miners' rights overrode those of the landowner, and that the energy path steered away from water wheels. These were the other major energy production option in Western Europe at the time, and it has been estimated that there were as many as 500,000 units in actual operation.

Coal-fired technology propelled an exponential rise in Britain's iron production over the next hundred years and pushed her steamships across the waves. Seventy-five per cent of the world's sea-faring tonnage was also moved by coal-powered carriers.

This display of 'progress' had industrialists so transfixed, that John Ericsson's construction of a solar steam engine in 1861 could not distract them from their fossil-fed enterprises. The engine ran on steam which had been formed by heat exchangers. They, in turn, were fed by hot oil running through pipes, segments of which lay at the focal point of a solar collector.

Oil and other big deals

By the mid-nineteenth century, gas lighting systems were in place in Europe, and oil pipeline networks had been built in America.

Mere invention was no match for the baby petroleum giants which had just discovered the primacy of supply over demand. Rockerfeller's *Standard Oil* Co. forged distribution networks and parcelled out free oil lamps in the Far East while its competitor, the *Royal Dutch* Co., exploited its status as a coloniser to locate refineries at oil well sites. Standard Oil *Co.* and *Pennsylvania Oil* also instigated the *Association of Petroleum Producers.* This was the first step in organising the market so that companies would be prevented from running each other into the ground.

Meanwhile, back at the lab, Edison brought the incandescent bulb into the world. The year was 1878. Electricity had already been studied in detail for a century, and evidence of its forces pondered since ancient times..

Despite a reluctance to invest on the part of large companies, small solar projects kept researchers busy. In 1913 Frank Schumann was making the Eastern Sun Power Co. Ltd solar steam engine, which was used to pump water into an irrigation system. The venture was prematurely ended due to the First World War. Churchill wanted a guaranteed oil supply that gave Britain independence from the US and the fields were cleared for the oil race.

Overproduction at this time became the norm in keeping with the Western capitalist tradition of expansion. Prices fell and the cartels eventually signed for price stabilisation and distribution rights in 1928.

Electricity and government

So great was the ensuing haste to electrify Europe and the United States, that various voltages were installed ad hoc.

Countries such as France, which was experiencing economic difficulties, were kindly provided with capital by *Germany's Allgemeine Elektrische Gemeinschaft* (AEG), which was owned by steel magnates in control of the coal mines.

In America, *General Electric* absorbed smaller rival concerns, and concentrated on proliferating household appliances. The US also provided funds to allow rapid electrification in other countries.

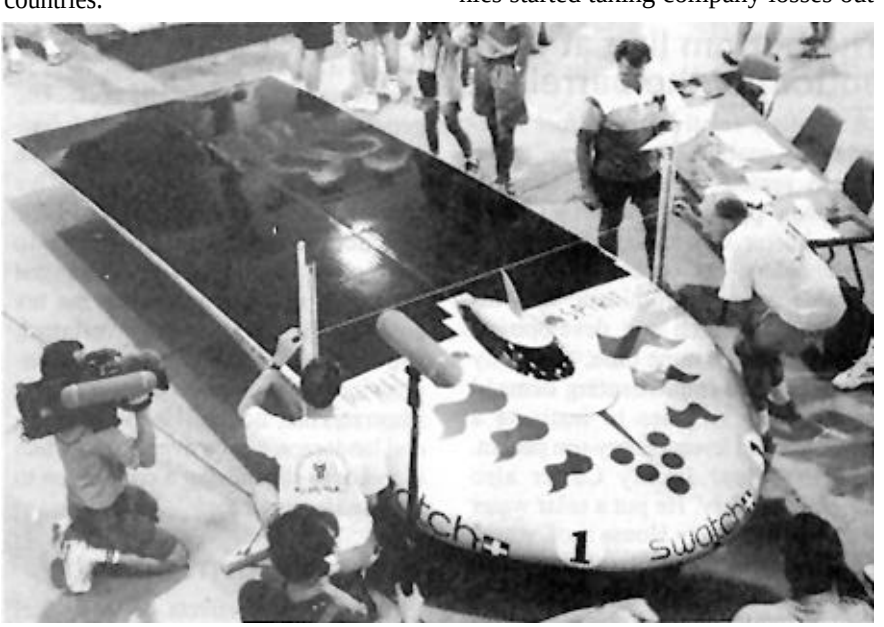
This industrial order meant that Becquerel's observation of light-induced currents, which had occurred sixty years earlier, was not a point of interest for the electricity companies. Nor were they interested in the first solar cell: a pricey gold and selenium embryo created in the 1880s by the American inventor Charles Fritts. At one per cent efficiency, it might be more glamourously described as the dawn of photovoltaics.

Rapid expansion of electrical networks in the 1930s soon saw electricity overtake steam-powered installations. The political and economic significance of this shift eliminated the choice for energy shoppers. Whereas coal corporations had been separate and private entities, electrical grids best operated to common standards and the systems came under government ownership

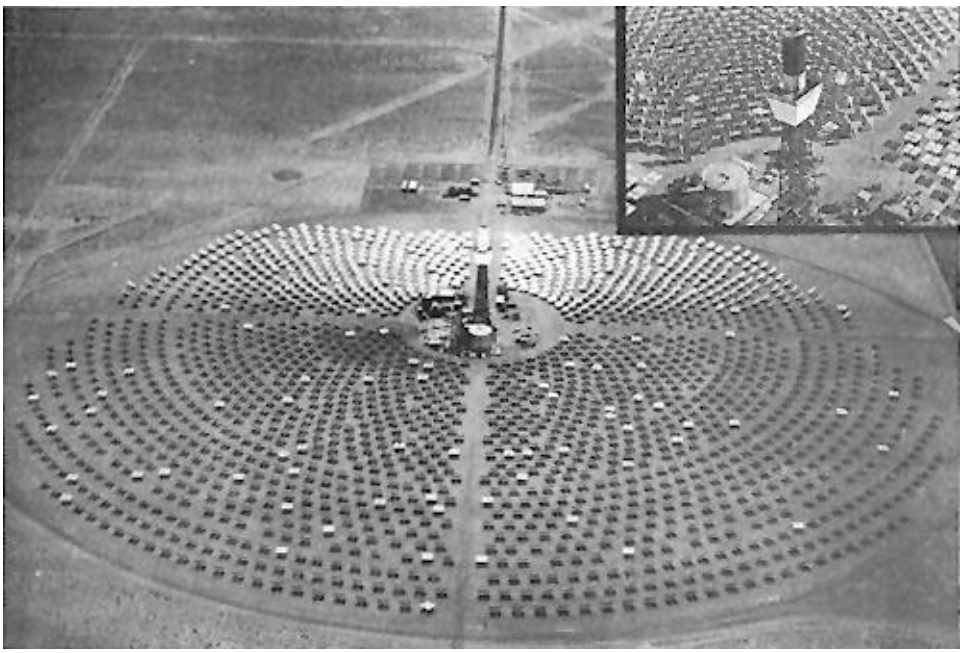
Shocks and surprises

In 1954, researchers at the Bell Corporation Institute happed upon silicon solar cells while they were trying to make electric rectifiers. Although the production cost was A$1000 per watt, the media used the idea to project an image of space-age lifestyles, and the crowd loved it.

Oil producing countries formed the OPEC coalition after Western companies started taking company losses out



Solar racing cars are now more spectacular than ever and attract a great deal of media attention.



A solar energy plant in Barstow, California. Tax concessions introduced by the Carter administration led to the development of a number of such power stations in the US.

of host government royalties. Some countries also nationalised their oil supply. The early seventies saw the October War between Palestinian forces and Israel unleash further political uncertainty in the Middle East. This political atmosphere, and the petroleum price-hikes known as the 'oil shocks', sparked off in the West, a gauche and frantic inquisitiveness about energy sourced from sun, wind and water.

The bottom line at, the bottom of the barrel

Australia's relative fossil fuel independence enabled our government to remain seated when American and European politicians leapt at solar water heater tax rebates for private householders, tax concessions for renewable energy producers, and increases in research and development spending. At the same time, electricity utilities started implementing demand management schemes to instigate a more even and lower energy-use pattern.

US President Jimmy Carter also came to the party. He put a solar water heater on the White House roof, where it stayed until moments after Ronald Reagan came to power in 1980. Carter also introduced the Public Utilities Regulatory Policies Act (PURPA), a watershed in solar integration which allowed private producers of energy to sell power back to the grid. When Carter's tax concessions expired in 1985, they weren't afforded a new lease of life. However, California's tax exemptions, in addition to US federal tax credits, had allowed solar power to attain a competitive selling price.

At its peak in the 1980's, Luz International Ltd ran three power stations in the Mojave desert. The largest commercial electricity generator was its 750 ha 354MW thermal solar farm in the Mojave Desert, California. The generators, like Ericsson's model, contained heat exchangers using oil which were heated by the sun. After five years, the company had reduced their production costs by two thirds to US11c per watt. However, continued expansion was a requisite for the tax credits, which were vital to investment, and building costs finally ran the company into the ground. Its demise clearly illustrates that no detail in the commercial landscape can be overlooked when it comes to subsidising a conversion to renewable resources.

The sunburnt country

Environmental effects of fossil fuel burning has added impetus to international emission-curbing policies, but Australian Ministers Kelly and Kerin's 1990 policy statement rejected '...measures which have net adverse economic impacts nationally or on Australia's trade competitiveness...'. Coal accounts for 12% of our exports.

A 1991 government report reveals that over twelve years, 2% of National Energy Research and Development Council funding was allocated to photovoltaic cells and 50% to coal-fired technology. Total funding for solar research averages at one million dollars annually.

ABARE is the government's research arm which forecasts trends of economic and social indicators. Its publications on the introduction of renewable energy sources invariably lament their apparent lack of financial legitimacy - an issue thoroughly investigated by Gavin Gilchrist in his book *The Big Switch.* The integration of Australia's power suppliers and our mining industry is presented as the major obstruction of a shift away from fossil fuels. Gilchrist's point is that solar power is generally cost-effective. He argues that claims about solar technology's economic impracticability have ignored the real environmental costs inherent in using fossil fuels and erroneously used the outlay for establishing independent systems, rather than their minimal running costs, as a comparison. Superficial analyses have been pedalled out as an excuse to allow the expansion of state utilities. This often involves a waste of public resources, such as the building of unnecessary and expensive grid connections in outback NSW, or short-sighted solutions, such as the installation of diesel generators on islands off Australia's north shore.

In addition, the little money that has been allocated to the area of renewable energy has not always been spent effectively. As part of an election campaign promise, six million dollars was to go towards a project on renewable resources. Until after the publication of Gilchrist's book, consultancy fees for reports of the inviability of various projects were the only target for this expenditure. *The EnergyCard* initiative, to

be discussed further, has since been launched as fulfilment of this pledge.

Whereas European and American householders have long enjoyed rebates for solar hot water systems, there are some localities in Queensland where this innovation has made them ineligible for lower off-peak water rates. The new Australia-wide funding scheme, EnergyCard, operates to facilitate buying into renewable sources. It provides low-interest credit for those wishing to install solar water heaters, and is expected to eventually extend to other units such as pumps and air-conditioners.

While a low-interest loan is no rebate, some states do provide grants for restricted cases of conversion to solar power generation systems. In Victoria's outlying areas, where connection to the grid is quoted as more than $10,000, householders have recently become eligible for assistance under the Remote Energy Assistance Program.

Although our sunburnt country seems more eligible for this kind of development, these measures fall short of assistance which has been available in Germany and Holland for years. They also seem to pale in comparison to the assistance given to fossil fuel projects. Australia's North West Shelf gas project has guaranteed pre-sales. Exploration and prospecting costs are deductible from income from any project and other tax exemptions also apply.

Isolated cases

Despite a slow start on the part of the government, solar power has already established itself in the more remote areas of the country. The Jilkminggan aboriginal settlement near Katherine in the NT is energy self-sufficient. Here 200 people have cooking, TV and refrigeration needs met by solar panels with a diesel generator back-up. The system has a capacity to store 100kWh in its battery bank.

Privatisation of power utilities is set to change the way people access power, and may actually force more people to use solar technology. Andrew, Rod and Ros Menzies have set up a business which installs independent power generation systems. These usually consist of a hybrid of a solar array, a wind turbine and a back-up diesel generator. Andrew Menzies explains that upkeep of the lines is the real cost behind a power bill. He sees people in remote areas, where there are more power poles than inhabitants, being compelled to to install stand-alone systems, rather than abide with frequent black-outs and hefty power bills.

The decentralisation and decrease of government control is the converse of reports produced by ABARE. According to a 1993 report, it is anticipated that interconnection of the state grids will be centrally regulated to allow competition between utilities. As Australia has no equivalent to the PURPA legislation, buy-back arrangements between stand-alone systems and the grid are subject to individual negotiations with the utility in question. At the moment these include, amongst others, the Aurora solar farm in Victoria, a wind farm in Esperance in WA, SolarOne in Queensland and solar ponds near Alice Springs, as well as the less inspiring coal-driven power plants.

Tomorrow's forecast

Solar conversion might be taking root in the fringes of Australian society, but urban residents are still more familiar with images of experimental projects such as solar cars. These, incidentally, are more spectacular than ever. Australia's 'Sunraycer' won the first Darwin to Adelaide solar car race in 1987 and the 1993 winner reached 135 km/h. Less phenomenal are the speeds at which governments incorporate advice from organisations such as the CSIRO and Greenpeace, into policies and regulations.

The environmental effects of carbon emissions have recently been targeted at a conference of international insurance agencies in Europe. Central to discussions was the enormous cost brought about by natural disasters as a result of environmental damage. Implementation of benefits and subsidies by governments and business to promote 'green' choices amongst consumers, would be a step further to previous measures which have not always withstood accusations of being vehicles for ulterior motives or popularity gains. Only when the benefits of solar power are reflected by electricity bills and insurance premiums, that is to say, when the bills consumers pay also reflect environmental costs, will the economic viability of solar energy for conventional household and industry use become apparent.☼

The Power of the Pen

David Coote

GOVERNMENTS around Australia are showing an almost fanatical eagerness to sell off public assets. Economic rationalists assure us that customers of an industry make it conform to the expectations of the customers by exercising those magical market forces. In practice, this is not always the case. Take, for example, the actions of the recently privatised Victorian electricity supply industry.

Retreating when others advance

Windfarm developers in the USA are currently signing contracts with utilities to supply power at around US$0.03/kWh. That equates to about AUS$0.04/kWh - about the price of power from any future brown coal thermal plants in the Latrobe Valley. Data collected by such organisations as the Electric Power Research Institute in the United States indicates that the price of power generated from wind will fall further and that the wind turbine business is poised to make hundreds of millions of dollars for American private industry. While Australian utilities in general have shown little enthusiasm for windpower, Victorian energy planners who 'suspended' the 10MW Toora Windfarm after the 1992 election, have made their attitude all too clear.

The International Panel on Climate Change - not exactly a bunch of rabid greenies - has just released a report which states quite firmly that most OECD nations could drop their energy use by 30.40% using cost beneficial demand management. They go on to say that this action would have a markedly positive effect on the economy of any nation that so acts, as well as considerably reducing greenhouse gas emissions. The Demand Management Unit of the now defunct State Electricity Commission of Victoria found the potential to knock off 20% from Victorian electricity use. This unit is now disbanded, leaving that untapped potential in the hands of revenue-hungry distribution companies.

So what can we do?

I would argue that we can make a difference. Personal experience has taught me that if enough people make a fuss, the 'powers that be' will eventually take notice.

Some time ago I contacted a representative of Citipower - my electricity distribution business under the new regime - about their offer of cheap solar hot water systems. Through a chain of circumstances this has resulted in sixteen of these systems being used in a low-income housing project. At about four tonnes per annum per unit of avoided carbon dioxide emissions, this means that a small amount of effort on my part - and considerably more effort on the part of others - led to roughly 64 tonnes per annum of reduced CO_2 emissions for the life of these systems. It has also introduced the systems into a highly visible urban location, acquainted the architects of their existence and brought them to the attention of other groups involved.

Local government has also proved itself willing to listen to concerned residents who write in. My local council is now considering whether to mandate the use of solar hot water systems for all new or replacement hot water units in facilities under its control.

Still more leverage presents itself at industry level. The electricity supply industry realises it has a case to answer. Related organisations in both Australia and overseas have run market surveys that consistently show customer interest in reducing the environmental damage caused by fossil-fuel electricity generation. When customers are asked, the majority indicate they would even be happy to pay a premium for clean power. So how can we let the industry know it is about time to get on with it? Well, there are a variety of means with varying levels of attendant involvement. but a surprisingly simple and surprisingly powerful method is to raise quill to parchment, nib to paper or finger to keyboard and write them a letter.

They do pay attention

I have been told by senior managers that when an organisation receives a letter on a particular topic, it assumes that up to another 100 people feel this matter is very important. And up to another 1000 people are also sympathetic to the matters. Hence it is seriously considered. That is, unless the letter begins with something along the lines of 'Dear Fascist Arsehole' or 'Dear Environmental Rapist'. While no doubt immensely therapeutic to the writer, this approach doesn't lend itself to establishing a mutually agreeable basis for dialogue.

On the other hand, from both my own experience and reports from people within various organisations, I can state that a letter addressed to a CEO, set up with a modicum of attention to correct format, containing arguments based on facts rather than emotion and making a cogent case for the writer's concerns, will be taken seriously, answered accordingly and, given enough of them, will have an effect on the organisation's policy.

I hope to have convinced you that it is worthwhile to take this apparently minimal action. I have given some points below that you might care to consider for inclusion in any epistles you feel inspired to write. Despite what it may seem, at the end of the day all power derives from the people. Any problem that exists, we have allowed to develop. Perhaps it is about time we took back the reins.

Some questions to ask your energy mandarins

1. In September 1994 Citipower, one of the new Victorian distribution businesses, announced plans to establish a 'premium' tariff for customers who were happy to pay more for power sourced from renewables. You might ask your utility:

a/ When will it offer this service?

b/ What tariffs will be available? Residential? Business? Industrial?

c/ What will the tariffs cost?

d/ How many gigawatts (1000 megawatts) hours per year of renewable sourced power will be available?

e/ What renewable plant will be used?

2. Establishment of a green power tariff offers the opportunity for entrepreneurs to develop small renewable plant. Inquire whether your utility:

a/ Would purchase from private sector renewable sources?

b/ If so, what is the smallest yearly supply it would be prepared to purchase?

c/ The largest?

d/ What will it pay?

3. Citipower has claimed it will continue the Project Aurora intitiatives of the former Brunswick electricity Supply. Does your utility:

a/ Allow customers to pay extra on top of their bill towards renewable plant?

b/ Indicate on its bill greenhouse gas emissions caused by the customer's power use?

c/ Offer rebates on solar hot water systems?

d/ Have any pilot renewable power schemes?

4. The former SECV ran a Demand Management Action Plan that demonstrated the possibility of large reductions in electricity demand and hence emissions through cost effective demand management. The state Government has stated that it is handing responsibility for demand management to the privatised industry.

a/ What is your utility's attitude to demand management?

b/What is your utility's target for demand management spending and increased energy efficiency amongst its customer base this year?

5. One suggestion to encourage the electricity supply industry to initiate demand management and renewable power schemes is revenue capping. This would allow the utilities to only make a certain amount of money from selling power from fossil fuel sources. Revenue on top of the cap would have to come from selling demand management expertise or selling power from renewable sources.

a/ What is your utility's attitude to this suggestion?

6. The European Union has started a scheme to encourage firms to perform environmental audits and generally behave responsibly towards the environment. Participating firms are allowed to display the EMAS symbol. The EMAS symbol is regarded as a powerful marketing tool with consumers who are concerned about the environmental effects of their activities.

a/ Does your utility feel a scheme similar to this would be useful to show that a business has implemented demand management and/or uses power from renewable sources?

7. Does your utility plan any co-generation plants? (Combined heat and power schemes are much more efficient that just generating power and venting the waste heat up the chimney and cooling tower.)

8. Does your utility have any plans for, or involvement in, other renewable or environmentally benign activities?

9. Does your utility plan to set up an advisory board with community representation? (This is a common practice in the USA and many Western European nations.)

10. What energy efficiency plans does it have for its own offices and facilities? (This is a good one to ask government departments as well.)

11. Does it publish an annual environmental report and make it available to the public?

AN AWARD-WINNING HOME

Anna Viola

NESTLED among the green hills of Mt Martha, on Victoria' s Mornington Peninsula, is the glistening new home of Pat and John Boag. The house, which the Boag's designed themselves, has won a number of awards, including the 1994 National Energy and Housing Award for Energy and Efficiency. In doing so, it has helped draw attention to the way energy-efficient design can be incorporated into the mainstream building process.

In 1991 the Boags began hatching the designs for their house in a caravan located on their block. The planning process took over a year, during which time they consulted numerous people for advice on the best way to maximise energy efficiency and comfort. They also found the *Five Star Design Rating Checklist,* supplied to them by *Energy Victoria,,* useful as a basic guide.

Not all the building requirements they specified in their design were met with enthusiasm on the part of the builder, particularly when they required that new suppliers be utilised.

The Boags also had to resist pressure to add what they considered to be unnecessary and energy-inefficient 'ornamentation'. Persistence on their part, however, paid off. They hope that the awards that the builder has received for the house will encourage other builders to look at more energy-efficient alternatives.

Priorities

Energy efficiency was central to Boags' design, but certainly not their only priority. Like many home-owners, comfort and resale value were also high on their list of requirements.

As far as resale value was concerned, they believed it would be best to maintain a conventional look, with no intrusive or unsightly mechanisms. This made them think twice about installing a solar hot water system on their roof. They were also concerned by the cost of its initial outlay and finally decided against acquiring such a system.

Once they started living in the house, they found that comfort came part and parcel with a passive solar design. Even when it is a cold, wet and dreary day, the north-facing windows ensure that

Above: Pat and John Boag on the north side of their new home.

The north-facing windows allow so much light into the house that there is no need for electric lighting in the living areas during the day.

the house is full of welcoming light and warmth.

Windows of opportunity

In keeping with five-star rating requirements, the house has a ratio of 25 to 30% north-facing windows to floor space. This is a hefty ratio, but very effective. A pergola above these windows serves to block the sun's penetrating rays in summer, but allows sunlight to fill the house during the winter. For such a pergola to be effective, it must be at the correct angle, which is worked out according to the location of the house.

With so much window space the Boags had to find a way to stop the cold from penetrating the house, and in the absence of curtains they also wanted a way to keep noise levels down. After investigating options, they found that by far the most affordable and convenient choice was to install double-glazed windows.

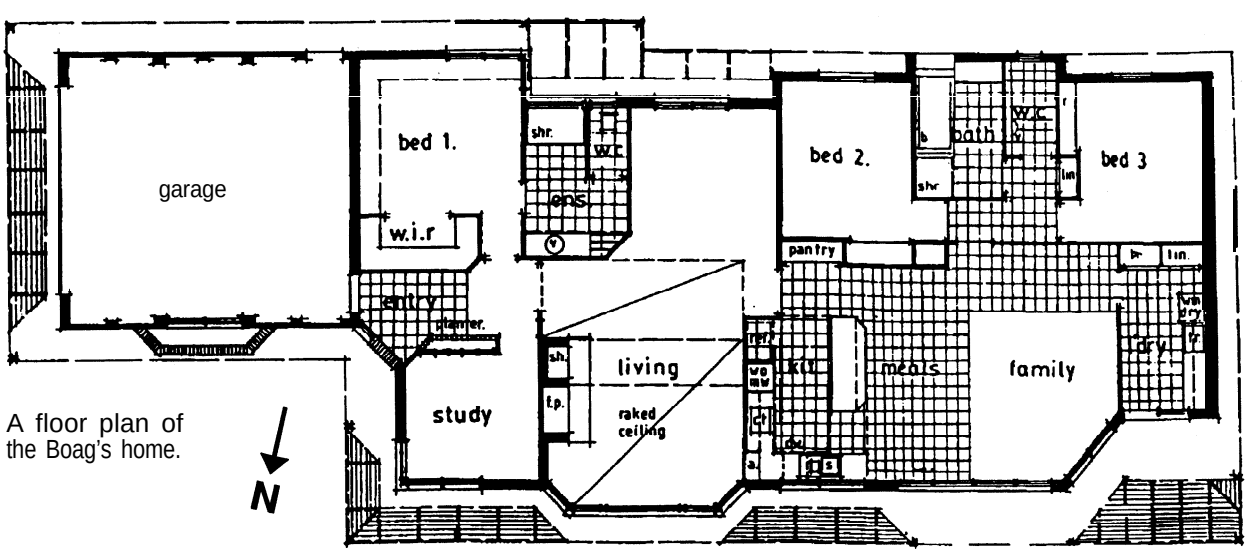
The initial outlay for these windows was quite high, however, when the cost of heavy drapes and of heat loss during the day were taken into account, they compared quite favourably to other windows. There was also the bonus of having an uninterrupted window space!

Pat has also been impressed by the quality of the Rylock window frames. The thermal transfer through the glass areas is controlled by a vacuum seal. You might imagine that cleaning such an enormous window area would be backbreaking. Pat assures me, however, that she just sends John around with a cloth while she follows with a hose and it's soon done. From all appearances they dry streak-free and fast - a bonus with so much beautiful landscape to admire.

Accomodating the view

The house faces north-north-west, thus allowing for exposure to northern sunlight while accomodating a view of the sea to the west. Pat says that some people are scandalised by the fact that the Boags do not have a window on the western side of the house. However, step outside and the gale blowing from the west is guaranteed to sway anyone's mind on the matter.

The lounge, kitchen, dining and laundry rooms run along the length of the house. Installation of cement flooring to create thermal mass meant that it was not practical to install the heating ducts in the floor. Instead, the ducts were placed in the upper walls. A special 54 inch fan attached to the cathedral ceiling circulates the air so that it is not trapped in the ceiling. They reasoned that the benefits gained from installa-



A floor plan of the Boag's home.

tion of thermal mass in the floor far outweighed the losses incurred from having the raised ducts.

The house is heated in three sections. The bedrooms are closed off for most of the day and not heated at all, The lounge area can be closed off with French doors at both ends and additional heating comes from a lovely double-skinned fire place. This only needs to be used in exceptionally cold weather. The kitchen/dining area receives additional heating from the laundry. In the summer, cross ventilation helps keep the house cool.

The house is also winner of the MBAV Gas and Fuel Corporation Award for most Energy Efficient Gas Home. The efficiency of zoning, as well as the heat retention from thermal mass flooring and double-glazed windows, won the house praise for efficiency of the highest calibre.

A multipurpose laundry

The laundry is full of features. It has an *Asko* washing machine and dryer which are among the most energy-efficient on the market. By using a slower cycle, the washing machine uses less energy, and because the clothes are able to soak, the use of suds can be minimised.

The heat from the dryer dries hanging clothes and fans warm air into the rest of the house. The temperature in the laundry remains fairly constant which makes it a comfortable place for Pat to make her bread and do her ironing. As with the rest of the house, every nook and cranny is utilised.

Pat and John designed their home using the Five Star Design Rating Checklist.

The laundry also acts as an effective airlock to the backyard. If the door from the laundry to the living area is kept shut when you open the back-door, the cold sea wind is prevented from entering the rest of the house. The garage and front entrance combine to create a similar airlock. The car drives in from the street and the garage closes behind you. Then there is a door which enters straight into the house. The position of the garage insulates the tint area of the house as well.

The bedrooms get less sunlight as they are along the south side of the house. However, the Boags have included a lovely fernery just outside the ensuite to the master bedroom which adds an extra window as well as charm. They had a bit of trouble with condensation in the bathrooms, and realised they would need double-glazing on those windows too. This immediately remedied the situation.

By taking advantage of the natural slope of the allotment and choosing plants carefully, the garden has been landscaped so that there is good run off. There are citrus trees as well as- Australian natives. Low-lying bushes were planted around the house in preference to trees, which would eventually block the view.

Lifestyle choices

Considering that no lights need to be on during the day, and that passive solar heating is utilised right throughout the house, it is obvious the Boags would have consistent savings on their energy bills. John estimated that they are around a third of what they would have paid in an average new home.

In addition to the design features of the house, the Boags' operate their own energy-saving techniques. How about putting on a jumper when you get cold? It is this sort of common sense which has allowed them to save time, money and, most importantly, energy.

Pat and John have an obvious pride in their home. They have added and adjusted things according to necessity and aesthetics, matching superior products with clever design. Although they are very active people, you can see they enjoy the comfort and convenience of their custom-designed and energy-saving abode.☼

Five Star Design Rating Checklist

The following is a summary of the requirements necessary for a house to receive a five star rating. They are a good starting point when it comes to designing the features of your home.

☆ **Insulation**

- ✓ minimum ceiling insulation R2.5
- ✓ minimm external wall insulation R1.5

☆ **Draught proofing**

- ✓ all external doors
- ✓ doors to bathrooms, toilets, ensuites and laundries
- ✓ windows
- ✓ open fireplaces have dampers or shutters
- ✓ exhaust fans have dampers or shutters

☆ **Orientation**

- ✓ major glass areas have good solar access in mid-winter and are not blocked by plants etc

☆ **Internal mass**

- ✓ concrete floor slab or internal masonary walls in areas with north-facing windows

☆ **Zoning**

- ✓ rooms and doorways situated so that unused areas can be closed off from rooms being heated or cooled

BUILDING WITH GOOD WOOD

Photo by Richard Turner

Sa Gunn

NATIVE forest destruction goes by many different names. Sometimes it is even called 'sustainable harvest of timber'. So how can concerned timber buyers be certain that their building or furniture project is not adding to the hardship suffered by displaced forest people or endangered species somewhere?

As a consumer, you can only be sure of timbers that are sourced close to home. In many cases even these should be checked out carefully. Australian species such as Jarrah, Cypress Pine and Blackwood may well have been logged from fragile ecosystems.

Sales, people are unlikely to know what is sustainable, or even know how to define 'sustainability', because the word has gone through so many shifts in meaning. The term 'ecologically sustainable' suggests long term viability of forest, plant and animal communities. However, forest industry spokespersons now refer to 'sustainable forestry' in terms of a continuous timber supply for human society into the future. But what about the wildlife!

From this outlook, clear felling of native forests (and replacing them with plantations inappropriate to the natural ecology) can be passed off as sustainable.

If you are familiar with radiata pine plantations, you will recognise them as places devoid of birdsong. And yet, due to the industry's marketing emphasis on plantation grown radiata pine, this is one species that consumers can now use without threatening any existing native forest.

'It is unrealistic to expect a builder to seek out ecologically sustainable products unless the building contract demands it.'

Pine is problematic, but less so than most of the other species which are widely marketed. The two main ways

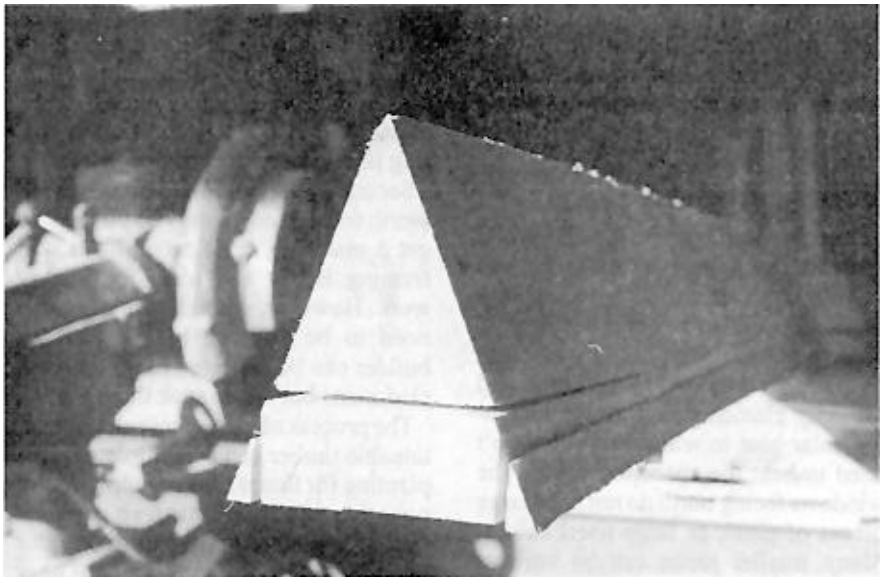


Photo supplied by Andy Knorr of *Radcon*

Sawing timber radially is an efficient way of cutting timber.

we can use timber with a clear conscience are by careful species selection, and by designing construction members to be of the smallest possible size.

Environmental responsiveness is about using locally grown materials, and being part of the process of putting them back. If a site needs to be cleared for building or roadwork, the trees removed should be milled wherever suitable. If we have used old-growth or rainforest timbers, and feel the guilt, we should take the opportunity to re-plant the same or similar species in a favourable location for the future.

The building specification

Builders are tied to realities of cost. They must be competitive when pricing jobs or they don't get the work. It is unrealistic to expect a builder to seek out ecologically sustainable products unless the building contract demands it. If a specification clearly states that rainforest timbers will not be accepted on a job, then builders pricing the job cannot save money by getting a cheap deal on illegally logged tropical timbers. As a client you can make sure your architect's specifications are written concisely, putting all builders on an equal footing.

The best way to specify is positively, based on knowledge of what is available, but sometimes timbers are selected by default, as a result of a negative statement such as:

'Rainforest timber species shall not be used in Building Works. Any such timbers found on the site of the Works or used in construction shall be replaced by acceptable timber at no extra cost to the Proprietor'. (Species List follows).

This is all very well, but how long is the list? It may end up going through a number of pages of fresh wood pulp paper by the time it has covered all the names used by the trade. In the case of particular products being flogged on the local market, using particular old-growth forest or rainforest species, a short list is adequate to make it clear that these are not to be used. Such a list might be compiled from sources such as *The Good Wood Guide**.

Every self-respecting specification should include a protection clause at the start, in the general section, just to make sure there is no mistake. For example:

'Rainforest timber species shall not be used in the Building Works. Preference shall be given to Australian timbers grown in plantations or sustainably managed forests. If not specified, timber species to be used shall be submitted to the architect for approval.'

Although it may be difficult to find forests that have been sustainably managed in an environmentally acceptable way, this clause encourages the possibility that such a source of timber can be found. Some of our forests have been continually logged and re-planted in steady cycles since the 1930's.

Defects

One factor that adds to waste of timber is unnecessary selection of the best quality timber. Old-growth timber tends to have less defects, but old-growth logs are taken from the most sensitive ecosystems, whatever the species. Knots and gum veins are not defects except if they occur where they may affect timber strength. The following clause may be used for a general description of timber:

'Timber shall be well seasoned, cut square and free from excessive sapwood, borer holes or other obvious defects. Gum veins and knots will be acceptable in locations where structural adequacy is not adversely affected Old-growth an d rainforest species shall not be used.'

Ensuring that old-growth timber is not used requires some extra effort on the part of the architect or engineer. Large beams of solid timber should be avoided. Smaller timber sizes in trusses or laminated beams do not need to come from large trees. Younger trees grow faster than old trees, so the practice of sustained yield forestry involves tree harvesting from plantations (or managed forests) at the earliest time that the timber can be useful. Naturally round poles are an environmentally sound option for either posts or beams because they lessen the impact on the old-growth forests that would be cut for rectangular structural members of equivalent strength.

Charts for structural design using naturally round poles can be found in the book *Low Cost Country Homebuilding* Technical Assistance Group, Sydney (Hale & Iremonger, 1983). The sapwood of many species is susceptible to borer infestation, so once the bark is removed, the poles should be treated with a solution such as pyrethrum.

For joists and rafters where exact dimensions are needed across the whole beam length, radially sawn timber is an

innovative alternative. This method has been pioneered by Andy Knorr at 'Lardener Park'. The timber is sawn into wedge-shaped sections, utilising more of the log without compromising any timber quality other than its traditional look. Relatively small logs can be radially sawn to produce stable wedge-shaped beams.

Small is beautiful. Locally-owned and family sawmilling operations have more interest in maintaining local forests for the future than large companies. Beware of corporate exploitation. Some companies spend profusely on promotional material claiming that they are concerned for the environment, but are also involved in export woodchipping of old-growth forests.

Smaller sawmills may not be able to supply the kiln-dried timber preferred for some joinery jobs, but they usually have stocks of building timbers suitable for a variety of uses. Sawmillers often know the local species they have in supply and by referring to traditional building texts such as Watson Sharp's *Australian Methods of Building Construction, you* can find out whether these timber species are suitable for your requirements. Information is also available through wood turning schools, where local offcuts are put to good use.

Solar houses

Over five million tonnes of firewood are used each year in Australia - a volume equivalent to its woodchip exports. If you plan to build, make your home a passive solar house with large living room windows to the north, and masonry elements to store the incoming solar heat in winter, so you won't need to heat the space too often. The windows facing north do not need large pieces of glass, or large lintel beams. Many smaller panes can be built as fixed glazing in framed windows of the same proportion as your stud wall framing. This also gives the opportunity to select timber for your windows from a locally grown durable species, rather than the imported species used by the major window manufacturers.

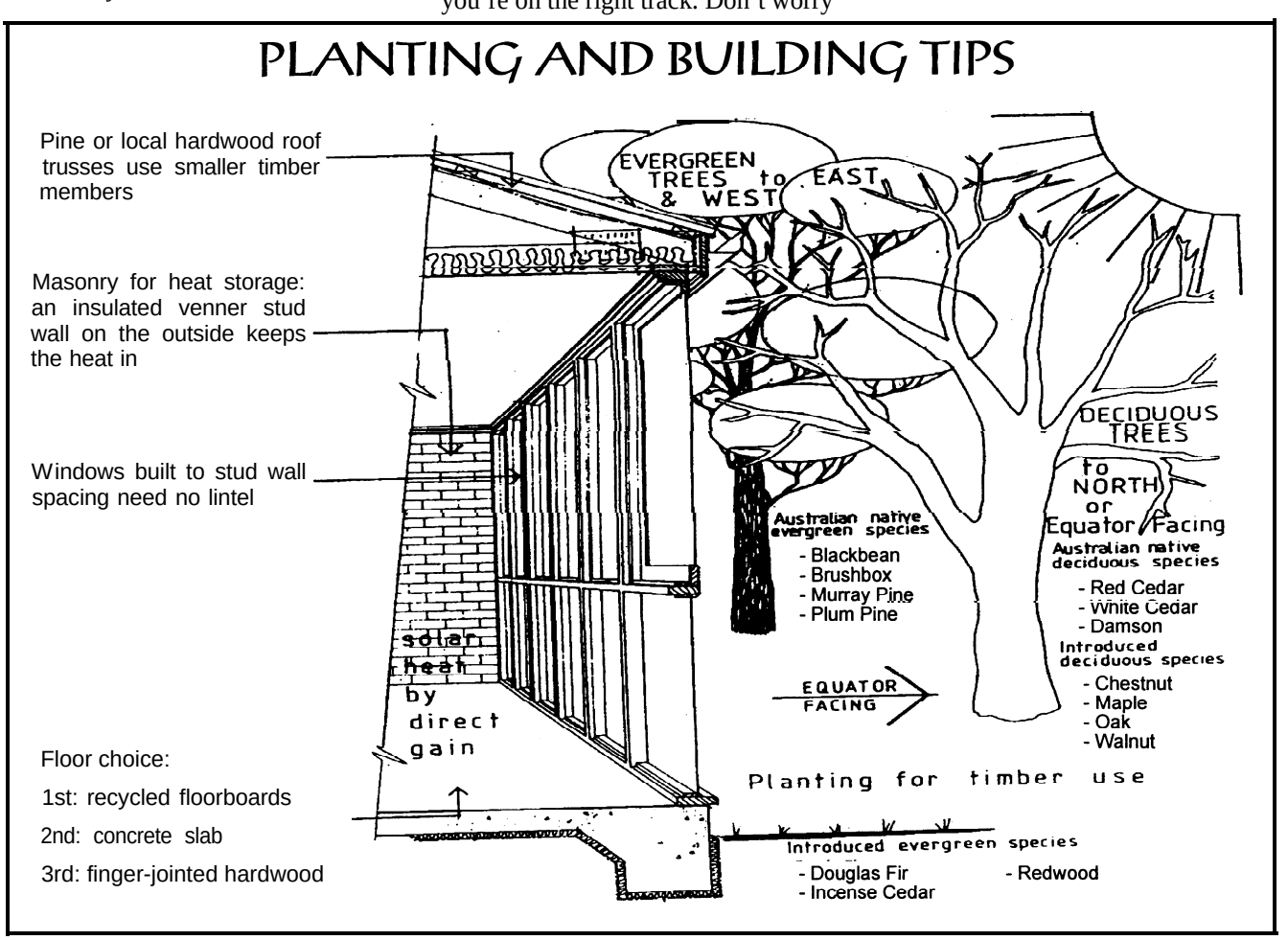
If you feel intimidated by all this and would rather buy recycled timber, then you're on the right track. Don't worry about the aesthetics of old nail holes, notches and so on, they add authenticity. In the city, recycled timber is the closest thing to a local material - until councils start handing out timber cutting licences for street trees, that is.

Second hand windows and doors are worth seeking out, it may be possible to get a matching set. Second hand stud framing is dry and ideal for joinery work. However, second hand materials need to be selected by the user. A builder can be expected to put in recycled items but not to seek them out.

The process of using ecologically sustainable timber can be complete by replanting for future timber supply where possible. Indigenous tree species should be planted to form bush corridor links between forested areas. Other species can be chosen as a conscience appeaser to replenish the type of timber that was used in building.

**The Good Wood Guide (NSW) is published by the Rainforest Information Centre, PO Box 368, Lismore NSW 2480. Ph: (066) 218 505.*

Sa Gunn is an architect based in Castlemaine.



TAMING LI'L OTTO

Hugh Spencer

We recently purchased a *li'l Otto* micro-hydro system from Bob O. Schultze of Electron Connection in northern California to provide us with auxiliary power during the wet season. It is probably the only li'l Otto in captivity in Australia!

Why micro hydro?

We. operate a research station in the coastal tropical rainforest of far-north Queensland. Here, we have a monsoon driven wet season which lasts from January to May, when the sky can be continually grey and the rain comes down in buckets. Our average rainfall is 4000mm (163 inches), 3000mm of which falls during the wet.

Our home doubles as an eating area and office for the Cape Tribulation Tropical Research Station, operated by the Australian Tropical Research Foundation. Behind it is a 30m (100 foot) high narrow gully, which only flows during the wet. At the top is a small permanent spring which provides our drinking water. During the wet, this gully fairly cascades with water.

Getting started

We ran a 160 metre length of 1½ inch black polyethylene irrigation pipe up to a small wooden dam across the gully head. This is held in place by some convenient boulders and a large cluster fig trees, thus obviating the need for cement - an anathema in a World Heritage areas such as this.

The dam is lined with several layers of black polythene to control leaks through the boulder layer that comprises the soil of the area. Several loose layers of galvanised ¼ inch meshing function as an efficient trash filter around the pipe entrance, which is itself protected by a closed tube of the same material.

The pipe snakes its way down the gully to end at the house. We didn't read Bob's recommendation to use white PVC piping - it has far less friction -and paint it, until too late. At least we have an intact run of irrigation pipe to use elsewhere should we move. That is, if the white tailed rats don't eat it fast! (These enormous native rats have a penchant for poly-pipe, especially pipe smaller than 1½ inches, which gets perforated in short order.)

At the house we have a control gate valve, purely to turn off the water when we need to unblock or change jets. From this, a further two metre length of pipe is connected to a modified compression fitting (Fig. 2), into which the short length of PVC pipe supplied with li'l Otto and which carries the jet, is a jam-fit; this makes unblocking the jet a quick process.

The modifications to the compression fitting (as shown in Fig. 1), are tapers cut inside the nipples of the fitting with a lathe to create a smooth conical transition from the 1½ inch to the ¾ inch jet pipe. This eliminates turbulence caused by the square edges of the pipes which can cause considerable energy losses.

Since the present installation will probably be a temporary one, we did

not want to make a permanent cement pad and drain for li'l Otto. We devised a block containing a wash chamber and drain', into which li'l Otto wedged in nicely (Fig. 2), eliminating the need for any clamps. It also keeps the unit stable and secure against the hydro line. We modelled the 'pipe bowl' like cavity out of polystyrene foam in a box and poured cement over it. The foam was removed by digging it out and finally burning it out with a gas torch.

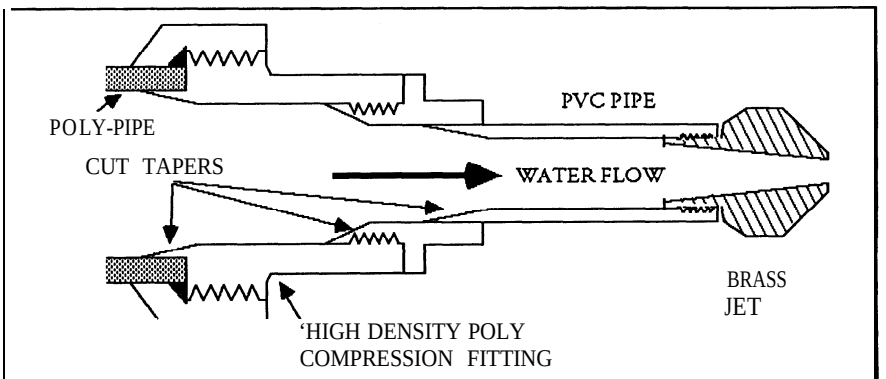


Figure 1. A cross-section of the polypipe adapter showing where tapers have been cut with a lathe to eliminate turbulence-forming steps in the interior of the

How it works

With our 30 metre head, we get 30 watts from li'l Otto using the biggest jet provided (¼" diameter, 36 litres per minute) and we haven't really tried to calculate the system efficiency, as there is more energy available than we can actually use. I do not use any special voltage regulator, the 12 volt hydro line is wired in parallel with the solar panels, and the home-made shunt regulator deals with both.

You certainly would not want to use a series regulator or a pulse modulated with a DC hydro system such as this, unless you like replacing generator bearings.

Li'l Otto is a vertical shaft micro-hydro using a permanent magnet DC motor as the generator. It uses an injection moulded plastic impeller and the entire device is fitted in a housing made out of high density PVC plumbing fittings twelve inches high and seven inch diameter at the base.

It has an integral amp meter with a very useful six amp full scale Its two power connection screws coming out of the top like stubby antennas. I put a yoghurt bucket over it to keep the top end dry.

It comes with a collection of brass jets of different sizes and a short length of ¾" PVC pipe that fits into a collar glued (rather weakly, in ours) to the body of the hydro to align the jet with the Pelton wheel.

With our cement base, I found that it was more convenient to use the plastic sleeve (now detached) as a locater in the hole on the side of the unit, and rely on the heavy hydro-line and the concrete block to hold the two parts in alignment. In fact you can 'tune' the power output by slightly rotating the body in relation to the jet.

This arrangement allows one to readily change the jet (as the water flow changes) or to clean it. Using higher quality magnets in the DC generator could greatly boost generation efficiency at little extra cost. Brush wear is minimal, and the brushes take half an hour to change.

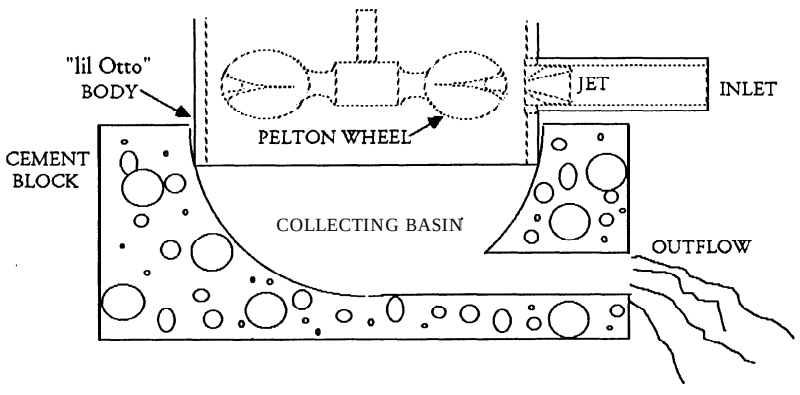


Figure 2. A cross-section of the cement block with the collecting basin and drain outflow. Li'l Otto wedges into the sides of the basin, and is held firmly in place.

We love li'l Otto!

Unlike the equivalent Australian micro-hydro systems that I have looked at, li'l Otto is cheap (A$600), small, relatively efficient and uncomplicated. What li'l Otto clearly demonstrates is that using seasonal micro-hydro resources, even in Australia, should not be sneered at.

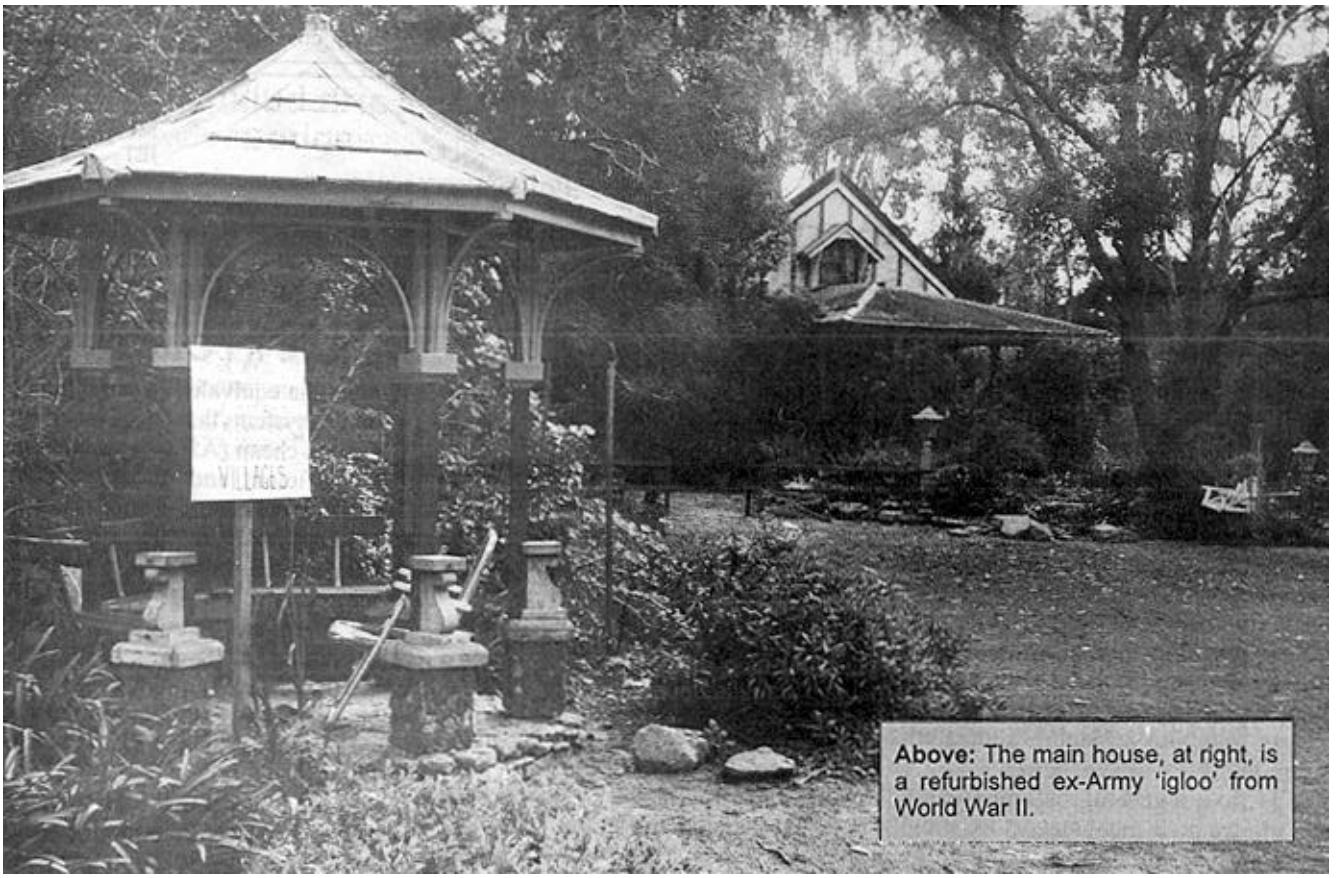
This is especially true true in high conservation areas such as the Daintree World Heritage Area where where a viable alternative to grid power must be found quickly if the area is to be properly protected.

Last year (pre-li'l Otto) our batteries were quite flat by the middle of May because there was little sun (we have 400 amp-hour nominal capacity at 12 volts) Over the last three months, 'lil Otto' has produced about 65 kilowatt-hours.

As I write this (on my hydro-powered Power-Book 100) the batteries are equalising - that is, sitting on +14V - and gassing happily for the first time in months. It is bucketing with rain, and we have oodles of electric light during this very grey and overcast time - the glory of it!

During the dry season our 100 watts of PV panels suffice. Our total outlay, including li'l Otto, pipes, valves and fitting, was about $A1,200, about the same as two 50 watt panels, but as Bob O(tto) Schultze says, 'the sun ain't gotta shine'! ☼

PIGFACE POINT



Above: The main house, at right, is a refurbished ex-Army 'igloo' from World War II.

This experiment in sustainable living in an urban setting demonstrates that this lifestyle is not simply about conserving energy and growing vegies, but enjoying life as well.

Ted Trainer

PIGFACE Point is the name of my farm, located in the last piece of bushland in the Liverpool area, near Sydney. It is being developed as an educational site to introduce people to sustainable living.

The aim is to set up a variety of displays, devices, models and experiences that visiting teachers can use to explain to their classes why consumer society is unsustainable. It also shows what sorts of settlement patterns, economic systems, technologies, and lifestyles would be characteristic of a sustainable society.

Although still far from complete, the site has been taking visitors on tours for about ten years, and approximately 1200 people come through each year.

Using renewable energy

The site is not only highly self-sufficient, but derives its energy from a number of renewable sources.

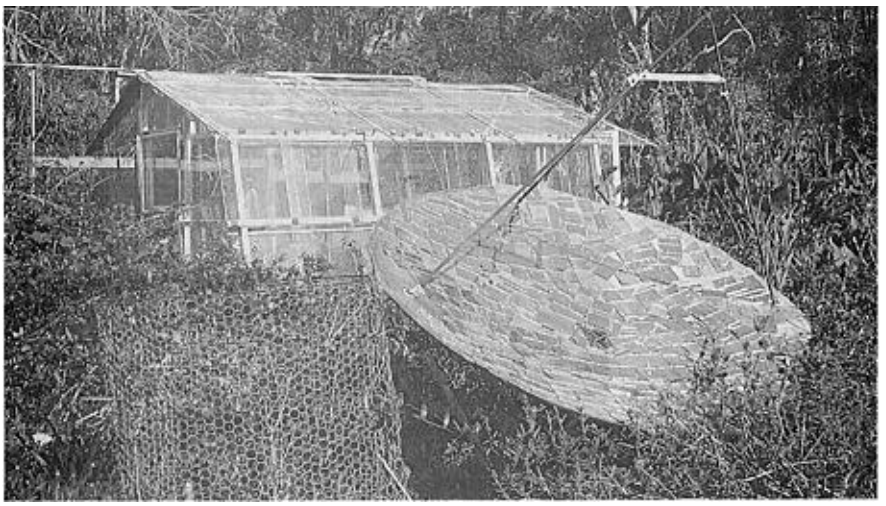
A mill driven by river tidal flow pumps water from the wetland to the garden. Excess water from this tidemill and the farm's three windmills drives the overshot water-wheel that pumps moving greywater to the vegetable garden. A 1.5 metre Pelton wheel and a turbine made from teaspoons are also on display.

Three 54 watt solar panels provide all our electricity needs, which are minimal because we live simply, without such items as phones or faxes. In this way we consume about a quarter of the energy used by an average Sydney household. Gas is the only energy source we obtain externally.

Low-cost housing

The main house is an old Army igloo - a recycled relic from World War II. Its designers obviously weren't too interested in energy efficiency, but we have been able to create a comfortable and efficient living place.

In winter the house is heated by an open fire which is fed with wood from the property. A copper coil situated over the fireplace is used to heat water.



The solar greenhouse at rear contains a water tank which stores heat supplied by the solar panel at left. The parabolic reflector in the front of the picture is made of pieces of broken mirror on a fibreglass dish.

Heat loss is minimised with the help of insulation batts, heavy curtains on the windows and carpet on the attic floor. Kitchen and bathroom waste from the house provides fuel for our simple methane digester, which generates a flame for demonstrating to visitors the potential for biogas.

The caretaker's cottage is a medium-sized two bedroom structure built to council standard for $A7,500 (in 1989 dollar value).

This is no more than one-eighth the cost usually paid to build a house, but closer to one-fortieth the cost most people end up paying when they have to borrow the money to buy their house and pay back three dollars in interest for every dollar borrowed.

Smokey the Shetland pony is an essential part of the community. In addition to carrying firewood in saddlebags, he maintains a firebreak by grazing in the paddock next to the house.

The cottage was built in our spare time over a period of six months, and is quite conventional. Had it been built from mud brick it would have cost far less. We are therefore able to drive home the fact that when it comes to housing costs there are alternatives.

Earth building and greenhouse wonders

While the main house is made of fibro, several of the animal houses and garden sheds demonstrate different earth-building techniques. The garden shed is made from stones and mud, and its roof is laid with home-made tiles. 'Ye Chooks Inn' is an example of the wattle and daub method. Thatching on the roof was constructed using reeds from the property's wetland.

One small shed contains examples of the neighbourhood pottery. The kiln outside is made from 300 housebricks. This is also used for metal-casting and glasswork. The blacksmith's forge and anvil are also nearby.

In addition to the sheds we have a greenhouse which is not only used for growing plants, but has a chimney for drying fruit. There is also a large water tank for storing heat and growing fish.

A little help from the animals

A Shetland pony called Smokey carries firewood, stone, and mulch, using saddlebags. He and the rest of the herd (one sheep, one goat, and poultry) graze in paddocks on the fire-threat side of the houses and in doing so help to maintain the firebreaks.

The poultry clear up and fertilise plots for vegetable gardening. They are rotated around various pens, occupying sunny ones in winter and shady ones in summer.

Paddy the sheep is capable of providing all the knitted and woven goods needed for up to three families. We have our own home spinning, weaving, and knitting hobby industries. Paddy's annual shearing is one of our community comedy festivals.

Encouraging vegetation

Fruit trees in the pens provide some food for the animals. An experimental planting site is being developed for finding out which trees will grow well in our difficult soil and water conditions.

The entire site remained a dry sandy slope devoid of trees or shrubs for some 20 years after it was purchased in the early 1940s. The only plant we could get to survive was the pigface daisy, hence the name of the place.

After years of carrying greywater, trees and gardens were slowly established. The area is now heavily forested with trees around fifteen metres high, providing an effective demonstration that it is possible to do wonders in severely deprived circumstances.

'Foreverland'

Part of the swampy ground is being landscaped to show how a neighbourhood can be made leisure-rich. Small ponds and creeks have been dug by hand. There are twelve bridges, a castle and pergolas. A cave and a pirate ship are soon to be added.

The point that we try to make is that instead of watching television for 20 hours a week - the Australian average we could spend time building our neighbourhoods into leisure-rich landscapes, where we could spend our spare time without consuming energy or resources.

In this landscaped area there is a small statue of Peter Pan with the following verse:

'Peter Pan is laughing at you and me
He wants to know how can it be
We work so hard to produce and get
All the things we think we want, and yet,
We could spend most of each day
As he does in adventure and play.'

One of the most important points that we try to make at the site is that a conserver society will liberate us from unnecessary production and consumption and give us far more time for leisure, art, craft, creating community and play.

The community factor

It is important to understand that although the sorts of alternatives noted so far are essential for a sustainable society, they are not the main requirements.

The crucial factor for sustainability is the development of small and highly self-sufficient local economies, wherein most of the things people need can come from local land, labour, talent and capital. Another essential factor is the transition to a zero growth or steady state economy.

Showing how society can change

Such a society *can* exist, and not simply in the bush. The main display on the site takes the form of a model showing how a normal car-dominated suburban neighbourhood could be made into a self-sufficient community.

Many roads and other spaces are lifted away and replaced by a dense edible landscape of woodlots, orchards, greenhouses, windmills, ponds, etc. This enables concrete illustration of many associated themes to do with building a community with a localised economy.

Visitors can see how rammed-earth bricks are made.

Confronting the future

From our experience of living at Pigface Point we know very well that it is possible to live very well on low levels of income and resource consumption.

We find it extremely frustrating that mainstream society plunges towards ecological and social disaster because of its blind and manic obsession with economic growth, when we know that there is a simple and attractive alternative path that would defuse the big problems.

The conventional development strategy, which assumes that nothing is more important than constantly increasing the amount of business turnover, is not only failing to solve the big problems, it is now their basic cause.

More than 30 million people are unemployed in the OECD countries. Hundreds of millions in the Third World suffer appalling deprivation.

Conventional growth and trickle down development will never solve these problems, yet it would probably only take five years to transform the most desperately poor regions into highly sustainable and satisfying settlements based on the alternative principles being demonstrated at Pigface Point.☼

Ted Trainer is a lecturer in the School of Social Work at the University of New South Wales, Kensington, NSW 2052. People interested in visiting the farm can write to him there. Visits will be conducted when numbers allow.

Pedal-powered pumping!

Monty Russell

SOME time ago I put together a pedal powered water pumping machine using an exercise bike, an old gear pump and some recycled hardware.

It makes a great demonstration piece, and I sometimes take it on tour with the Energymobile. It can be used to demonstrate a number of aspects of hydraulics, energy transfer, fluid behaviour and human behaviour, as well as being an interactive display whose challenge people enjoy.

It shows that almost any amount of physical labour, no matter how small, can be converted into useful work. What is also demonstrated is that it can take quite a lot of effort to do something as simple as moving water from one place to another.

ATA president Herb Wildes taking a bit of exercise.

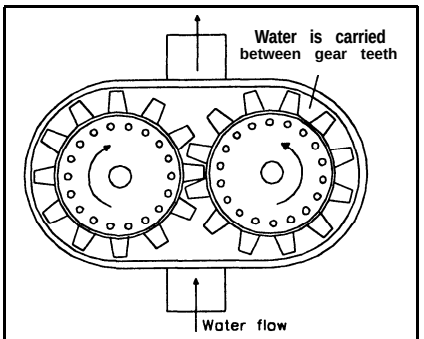
How it works

A person pedals the bike, which is connected to the gear pump by a chain. Gear pumps have been around for many years, and are a simple yet effective way to move liquids from one place to another. They also have the advantage of being able to pump water regardless of the speed at which they run at.

The water is pumped into the vertical column, where it escapes through nozzles spaced ten centimetres apart. As the water level rises and the pressure increases, the water flows at an increasing rate and the number of nozzles in use increases.

Under steady pedalling with a speed of about 70rpm, the setup will pump about 20 litres of water per minute. This means that with about half an hour of moderate exercise while watching TV, you could pump the entire daily water requirement for your household into a header tank. No cost for fuel, no extra time required, and no guilt.

However, most people cannot resist the challenge and pedal as hard as they can to try to get the water to the top of the column. One bloke pedalled so hard that he made himself dizzy and had to sit down for a while.0



A simple gear pump.

Water-powered pumping

Kathryn Peck

ON a mountain in southern New South Wales, a man clambers up among the rocks. Oblivious to the icy water, he deftly makes a final adjustment to the curious machine he has just chained into position.

He is Ralph Glockemann - Inventor. The machine is *the Glockemann Pump,* an exciting new idea which looks set to make big waves in the world of water-powered water pumping.

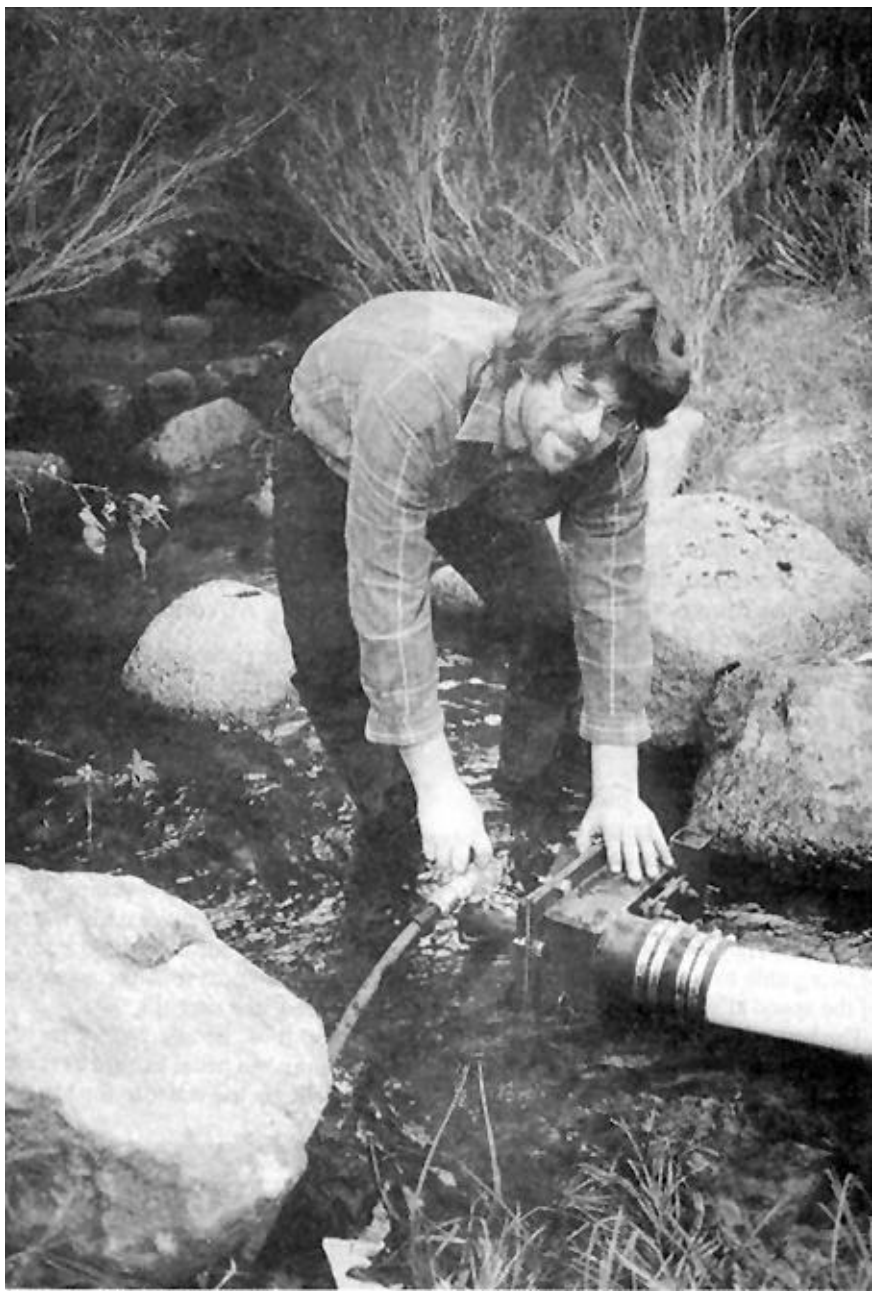
Ralph has always been fascinated by all things mechanical. When he first landed in the bush some five years ago, he quickly gained a reputation locally as a techno wiz and an all round Mr Fixit.

So much so, he was approached by a local couple who had found conventional hydraulic rams inadequate for their situation and other alternative type pumping options too expensive or impractical. 'Can't you come up with something to suit us?' they asked Ralph innocently.

Intrigued and challenged, Ralph got down to some heavy pondering and not a little experimentation. He quickly abandoned any thought of variations on hydro rams or water wheels, concentrating instead on some concepts he had been considering earlier.

Finally, in his own words, 'After the third fiddle of the fifth prototype, success!'. Ralph had invented a pump which uses the force of water acting on a diaphragm to literally push water uphill.

Amazed that something so simple had not been thought of before, he quickly lodged a patent application to protect his great discovery. Since then he has been experimenting with many design variations, testing, testing, testing, so that every bug is ironed out.



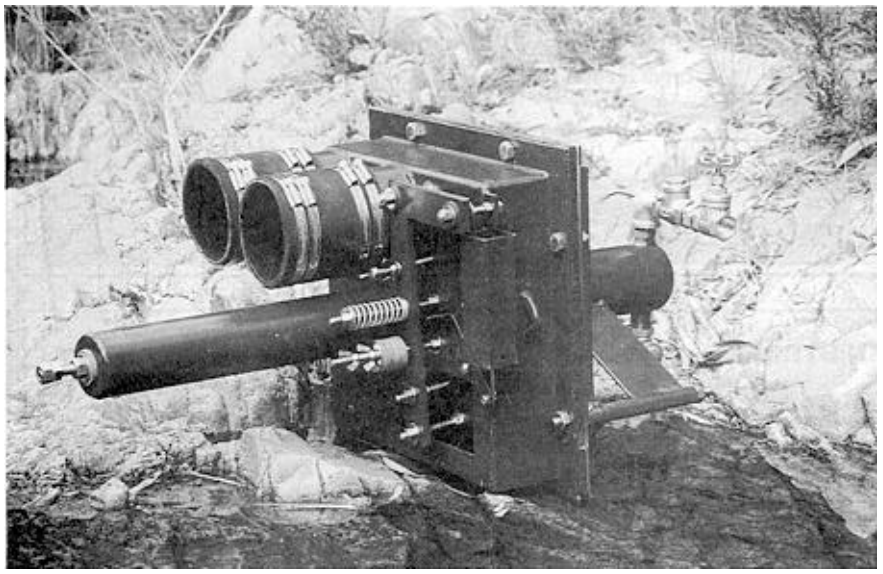
Ralph Glockemann and his amazing ram pump.

Simplicity itself

What this invention is all about, and what makes it so unique, is that it is able to convert a lot of water falling a short distance (as little as 0.5 metre) into a little bit of water raised to a high altitude (200 metres plus). To do this the pump has three phases in its operation.

Firstly, water begins to flow down the drive tube(s), through the diaphragm chamber and out the exhaust valve. The water speed increases and after about two seconds the flow triggers the exhaust valve and the valve slams shut.

Secondly, with the exhaust valve shut all the water in the drive tube must come to a sudden stop. This causes an



Here you can see a close-up shot of the Glockemann pump. A fairly simple and robust device.

expansion of the diaphragm providing a mechanical movement which activates a piston pump that forces the water in the cylinder up the delivery pipe.

Finally, at the end of the piston stroke, the water in the drive tube has used up its momentum and so the pressure in the diaphragm chamber drops, which allows the exhaust valve to spring open. With the exhaust valve open, the return spring can pull back the diaphragm, which provides a return stroke of the piston allowing the piston to draw water into the cylinder and bring the machine around to the beginning of the cycle.

To set the pump so that it is working at the optimum rate for the prevailing conditions, it has a throttle adiustment which is set when the pump is operating. On full throttle there is two to two and a half seconds. In times of drought, when there is a reduced water supply, the throttle can be set at a quicker rate of less than one second per stroke.

This adaptability is certainly one of the Glockemanns most impressive features! The pump is almost silent in operation and its remarkable simplicity makes it easy to understand and easy to install and operate, thus making it a really user-friendly product

After seeing a Glockemann in action, it will be obvious that you do not have to be a mechanic, or even have a special interest in alternative technology, to appreciate the uses for this machine. Once set up and adjusted, the pump just quietly keeps on going all day and every day with a minimum of fuss, with perhaps just a quick clean of the strainers now and then.

One Glockemann owner has boasted that just about the only time he goes. down to the creek to look at his pump is when he is showing it off to his friends!

Minimal maintenance

Ralph knew, when he was perfecting his pump, that it was not enough to be environmentally friendly and able to pump to high heads. It had to be cost effective, with low maintenance, and be reliable as well. The only part on this machine which has to be changed or renewed occasionally is a small leather piston cup, which requires replacement around every twelve months.

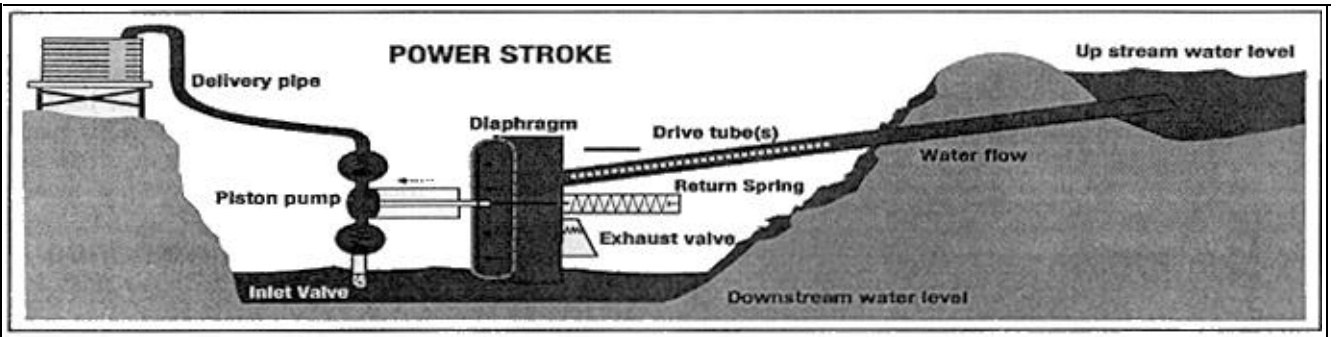
The diaphragm rubber is also replacable, and these can be cut from old tractor or truck inner tubes that are usually found lying around any farm. If not, you can certainly get them from any tyre sales place - and do a bit of recycling while you're at it! The diaphragms last for several years and changing them is a simple and quick procedure.

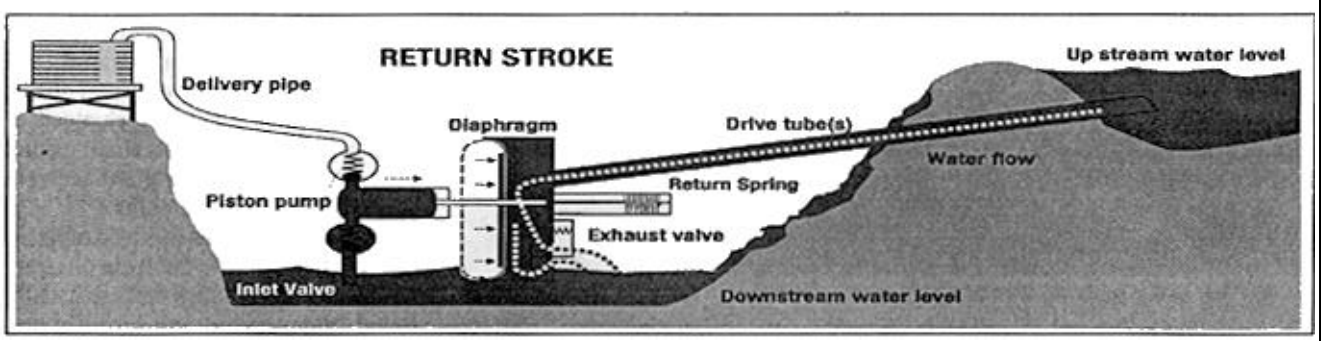
Site selection

This is what it is really all about, as the this pump can be powered by falls as low as 0.5 metre - an achievement unthinkable for a hydraulic ram pump. It is also capable of running from very small water flow rates, sometimes as

Glockemann pump - performance statistics

Model	Supply rate (litres/sec)	River fall (metres)	Delivery height (metres) – Output (litres per day)									
			20m	35m	50m	75m	100m	125m	150m	175m	200m	250m
Homesteader 360	9	1.4	17500	11800	8600	5730	4300	3440	2900	2460	2150	1720
		1.2	15000	10100	7400	4940	3760	2950	2500	2100	1850	1480
		1.0	12500	8440	6170	4100	3080	2460	2080	1760	1540	1230
	7	0.8	8000	5250	3870	2570	1930	1540	1280	1100	960	770
		0.6	6000	3940	2900	1930	1450	1160	960	830	720	570
Oasis 220	4.5	1.4	8750	5900	4300	2820	2150	1720	1450	1230	1080	860
		1.2	7500	5060	3700	2460	1850	1470	1250	1050	920	740
		1.0	6250	4220	3080	2050	1540	1230	1040	880	770	610
	3.5	0.8	4130	2620	1930	1280	930	740	640	550		
		0.6	3100	1970	1450	960	700	560	480			
Bambino 110	1.2	1.4	2200	1520	1100	730	540					
		1.2	1900	1310	950	630						
		1.0	1580	1090	790	520						
	1	0.8	1200	730	530							
		0.6	900	550	400							





The pumping cycle of the Glockemann pump.

little as one litre per second. Ralph conservatively estimates that as many as fifty per cent of rural properties with access to running water could make use of one of his pumps. Once one is installed, they start popping up everwhere as neighbours cotton on to a good thing. The creek where Ralph's own pump is installed already has nine other Glockemanns.

The most straightforward location for a Glockemann is one where there is a naturally occuring fall of at least 0.5 metres over not more than an eight metre distance (the higher the drop, the more water you will be able to pump).

When looking for a good site, remember that the drive tubes do not have to be dead straight. In fact, many pumps have been installed with ninety degree bends in the drive tubes and they work well. This, of course, is a major bonus, as the pump can often be tucked behind a boulder or under a ledge for added flood protection.

If you do not have a convenient natural drop in your creek, there is still no problem. By moving a few rocks around, it is possible to make a small weir to make a drop.

In some situations the drive tubes can be placed so as to siphon from an existing pool by using a simple bleeder-tube arrangement. Once in place, the pump is chained into position.

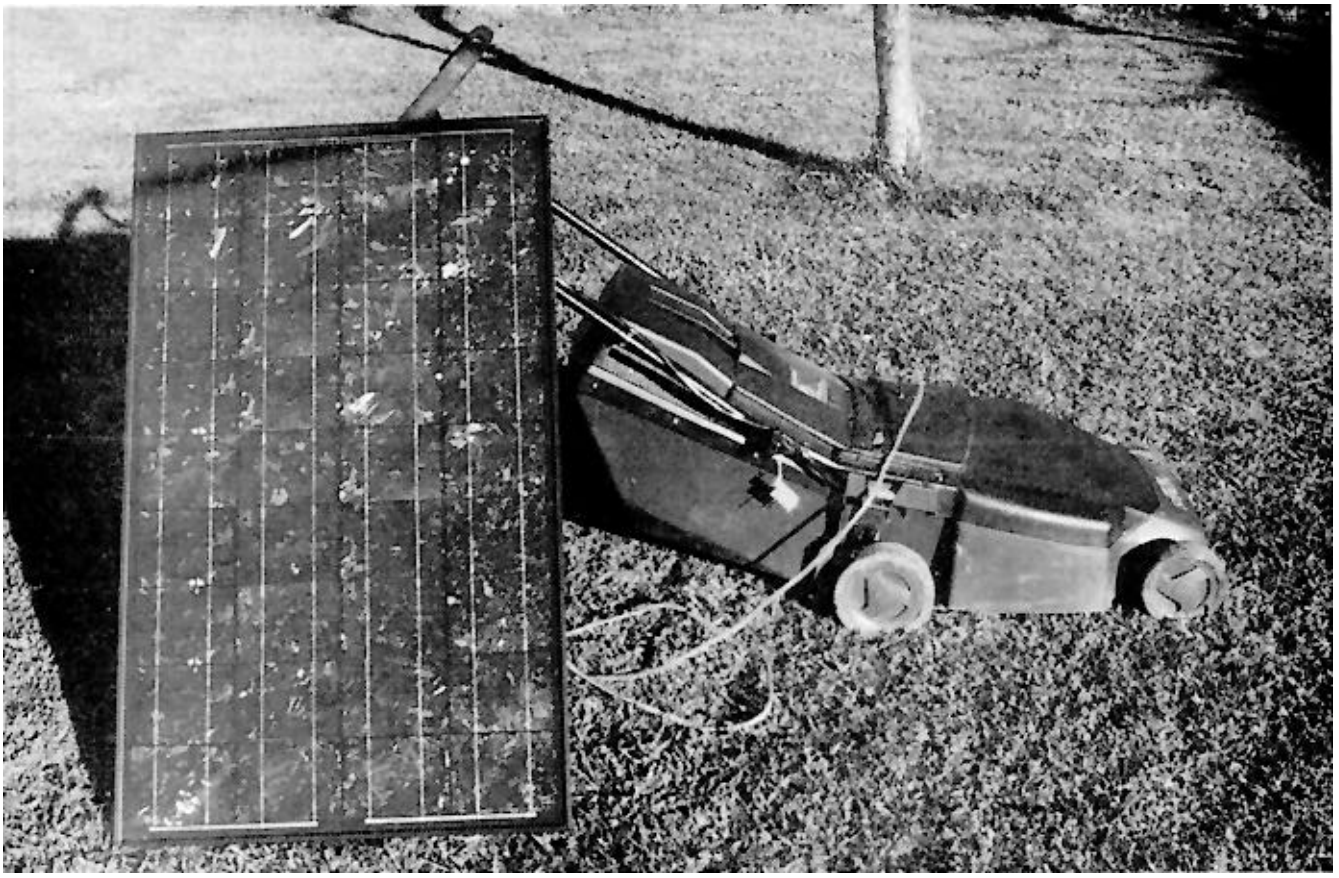
Flood protection

The Glockemann is a very tough and durable device, and once in position is almost wholly floodproof if properly installed.

The pump has an automatic flood cut-off mechanism which prevents the pumping of silted or flood-polluted water by simply stopping the pumping operation when the cut-off is activated. After the flood recedes, you just pop down to the creek, check the strainers, disengage the flood shut-off and bingo, the pump starts again.

So there you have it. An environmentally friendly, cost effective, low-maintenance,' reliable, flood-protected water-powered water pump. If you decide to take the plunge and get a Glockemann, the next time it is pouring rain in the middle of the night, instead of sloshing down to the creek in your pyjamas to drag that petrol guzzling beast to safety, you can snooze on smugly and leave all that puddling in freezing water to enthusiasts like Ralph ☼

Keeping your lawns GREEN



Lance Turner

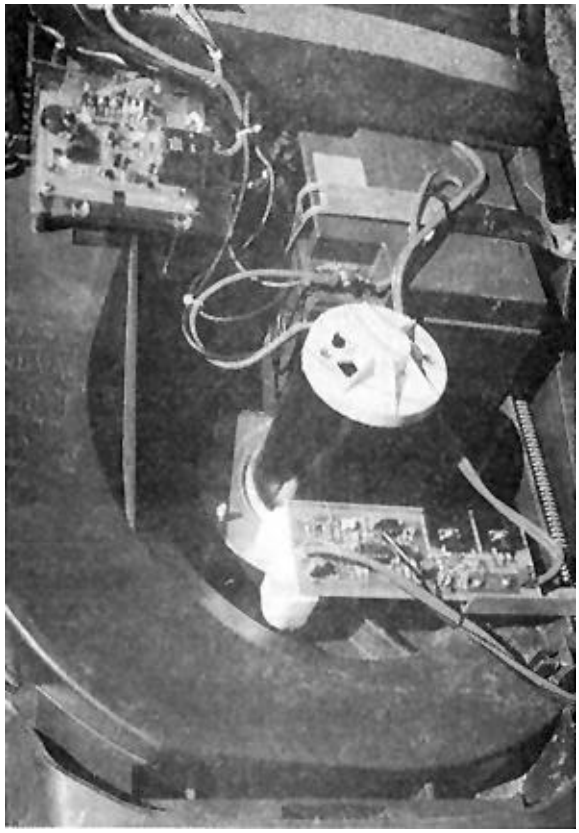
LAWNS; love them or hate them, the country is full of them. And every week or so they need to be cut. Think about it. Each week over a million lawn-mowers Australia-wide are started and run for half an hour or more, all in the name of a beautiful lawn.

That's one hell of a lot of petrol. And what's worse, with the revelation that both unleaded and leaded petrol contain up to 30% by volume of the carcinogenic compounds known as aromatics, it means a large amount of potentially cancer-causing chemicals are being spewed into the atmosphere.

Remember, lawn-mowers don't have catalytic converters to remove these substances (not that these devices are very effective anyway!), and the operator is in very close proximity to the exhaust of the machine. The same can be said for all other petrol-powered gardening machines, such as lawn-trimmers, lawn-edgers, chain saws etc.

A better solution

There are, of course, electric mowers on the market. The only problem with them is that you need to drag an enormously long extension cord behind you all the time. If you should accidentally



Inside of the *Stealth,* showing the added regulator from *Oatley Electronics*

run over the cord, you really will see fireworks.

Some time back, *Black and Decker* came up with a solution to all of these problems when they released a lawn-mower that was rechargeable. This machine, known as the *Stealth,* was very quiet and efficient, and could cut the average front and back lawns on one charge.

Of course, there were no emissions from the mower itself-they came from the power station that produced the power used to charge the thing. But still, the total energy cycle was less polluting and more efficient than the average petrol mower, which is why it was featured in our *Products* column some time back.

When I moved into a house that had lawns front and back, the time had come for me to buy a lawn-mower, and the Stealth was it. The cost was $499, and while a bit on the high side, it was a lot less than the $699 being asked for them when first released.

Now, the first thing you are supposed to do when you get this thing home is put it on charge to top up the battery. And this is what I did. After 24 hours it was still charging with no end in sight. Hang on, this thing supposedly only needed a top-up charge, and a full charge is not supposed to take longer than a day, so what's going on?

Being a tinkerer, I opened the unit up to get a better look at what was happening. The inside of the mower is fairly sparse. There is a surprisingly small *Preslite* electric motor which is connected to the battery via the safety key contacts and a circuit board that contains, amongst other things, a microprocessor and a 70 amp relay. The battery itself is a 12 volt, 38 amphour sealed lead-acid unit. You can see from the photo above what is actually under the mower's cover, which is a lot less than you might expect.

What regulator?

After removing the top cover of the mower, I connected a voltmeter across the battery terminals. At 15.4 volts, the reading was a bit on the high side for a 12 volt battery and it had started to gas internally (this was obvious from the sizzling/bubbling sound of gas bubbles under pressure that was coming from the battery). Now, sealed lead-acid batteries are not supposed to gas, as there is no way to top up the electrolyte. Something was definitely wrong here.

So, off came the charger, and out went a call to Black & Deckers' Stealth hotline (yes, that is what it's called). After a bit of discussion, arrangements were made for them to pick up the unit and fix the problem. After about three weeks (two weeks longer than promised), I got the mower back with the result that no fault had been found!

The Black & Decker service staff had even included a charging graph so that I could see what voltages the battery should reach. According to this graph, the charger was supposed to take the battery voltage up to 14.8 volts and then allow it to drop back to 14.2 volts. From there it then cycles between 14.2 and 14.5 volts. The maximum voltage that the charger was ever supposed to produce was 15.2 volts.

So, on went the charger. Monitoring the voltage all the way, I was dismayed to see the voltage reach 15.8 volts before the charging system went into float mode. Even then, it cycled between 15.2 and 15.5 volts - a full one volt higher than stated on the graph. I'm not too impressed with the servicing of this obviously faulty machine (by the way, I did measure the voltage with more than one meter, and both digital and analog meters agreed that the voltage was too high).

But having dealt with service departments before, and having a lawn that was by this time about six inches longer than it should have been, I decided to do the lawns and then convert the thing to solar power.

After the lawns were done (the battery lasted for the whole back lawn, despite its size and length), I started on the conversion.

Before I go on, I should mention that doing this sort of modification to your mower will void the warranty, so don't touch it unless you are willing to give up this form of security.

A new regulator

The regulator in the mower was obviously out of whack. When I say 'regulator', I mean the on-board microprocessor that controls the mowers motor, keeps an eye on battery voltage while the mower is running and supposedly controls the battery charging.

I could find no way to adjust the charging voltage (the only trimpot on the circuit board did nothing for the charging voltage, so it was reset to its original position and then left alone) and the built-in charging system seemed to use a method incompatible with pure **DC** such as that from a solar panel.

I decided to fit a separate regulator built from a kit from *Oatley Electronics.* This is a very good kit that will

handle up to sixteen amps at either twelve or 24 volts and costs just $27 plus postage - an absolute bargain.

This regulator design also has the advantage of not drawing any current from the battery. Current to run the circuit comes from the charging source only.

Installation

The conversion was dead simple. I built and tested the regulator, setting the trimpot so that the battery would only charge to 14.2 volts.

The circuit board has terminal blocks for the external connections to the power source and the battery, but the indicator LED has to be connected to the circuit board via a length of figure-eight wire. This LED is a simple multi-purpose indicator which provides a charging status by either flashing when the battery is being charged, or staying on continuously when the battery is full

I then mounted the circuit board, at one end, to a bracket that was fixed to a couple of spare mounting posts inside the mower, while the other end was supported by a block of Styrofoam glued into place.

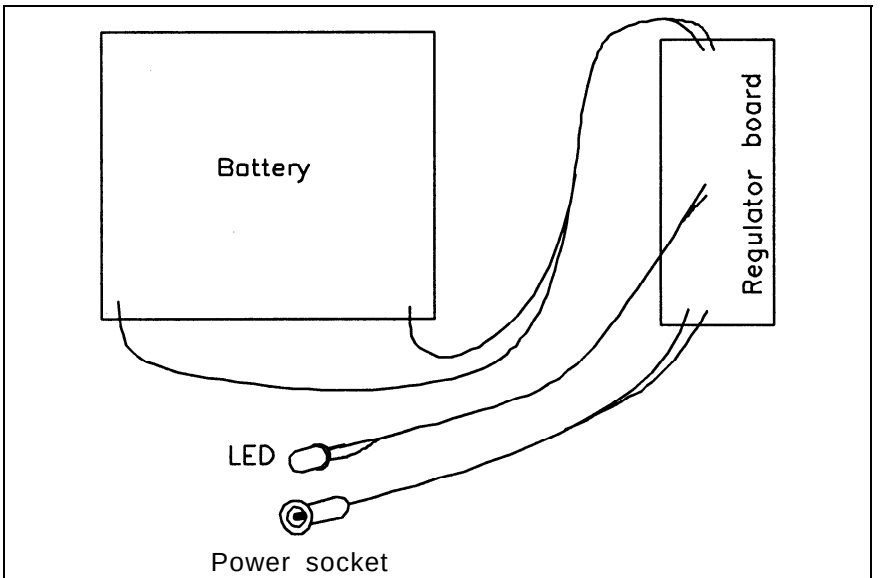
The circuit board was connected to the mowers battery, directly to the battery connecting posts, and to the power input socket. Two lengths of 20 amp figure-eight flex were used for these connections.

Solar power is supplied to the mower via a standard DC coaxial power socket which is mounted in the mowers cover, along with the charging indicator LED.

To finish the job, it was just a matter of replacing the cover and retaining screws -nothing to it!

Panel size

Power for charging the mower is provided by a *Solarex 83* watt, 12 volt panel. In sunny conditions, this panel, with its continuous output of over five amps, will charge the mower in under two days. So far, I have never had to top up the mowers battery with mains supplied power, despite living in Melbourne and mowing the lawn every week or so. I suspect that a 60 watt panel would suffice for most areas with the possible exception of Tasmania.



This simple diagram shows how it is all wired together.

While you should be able to get by using solar power, the mower can be charged from other power sources should the need arise. You could use any filtered power supply, such as the battery charger described in the last issue of *Soft Technology*. Remember though, that you must make sure the regulator you use (if not using the Oatley unit) is suitable for this type of power source. If in doubt, ask the supplier or only use solar power.

Other options

If you are not sure about building the Oatley regulator, then an off-the-shelf unit might be the way to go. You should be able to get one for about $60 that can handle the five or so amps required.

Of course, you don't have to install a separate regulator inside the mower. If you have your own 12 volt power system you could connect the mower to it directly, but you will need a power diode in series with the battery so that your power system will only charge the mower, not discharge it.

After all of this is finished, you will have a mower that not only produces no pollution or emissions at all, but will no doubt outlast any petrol-powered unit because of the simplicity of its power system. The only moving parts in the mower are the motor armature, the on/off switch, the wheels and height adjuster.

Final thoughts

The Stealth itself is an excellent idea, and seems to be well thought out and designed. Why mine had this particular fault when everything else works so well, I just don't know. Maybe this case was a one-off. Let's hope so for the sake of all those people who have bought this mower and don't know anything about batteries!

Incidentally, lawn-mowers are not the only garden power tools that come in rechargeable versions. I also have a twelve volt lawn trimmer (whipper snipper style), made by Ryobi, that I plan to solar power in the near future.

Its source of power is also sealed lead-acid batteries, but this time they are in the form of *Gates* cells. These are the size and shape of standard 'D' cells, but contain the positive and negative plates, separated by an absorbent fibre material that holds the liquid acid, all rolled up into the shape of a cylinder.

Gates cells are a particularly rugged cell that has a low internal resistance, allowing a cell the size of those used in the lawn trimmer to provide short bursts of current of up to 200 amps.☼

A simple tip

When mowing your lawn, don't set the cutting height too low. Leave the lawn at least two inches (50mm) long so that it requires less water in the summer months.

RAPS Battery-charger buying guide

Needing information to select a battery charger for your Remote Area Power Supply? If so, this article can help you choose the right one.

Glen Mack

MOST RAPS systems in Australia incorporate the use of a generator, either as the primary power source only, or in the case of hybrid systems, connected in parallel with a renewable source such as solar, wind or hydro power.

In either of these systems you will need a battery charger to convert the 240 volt alternating current from your generator to a direct current supply at a suitable voltage and amperage to meet the charging needs of your batteries.

Some inverters have battery chargers built into them. While these units are very capable of charging batteries in their own right, we will not discuss them here as they have been looked at in our *Inverter buying guide* in issue #49.

How does it work?

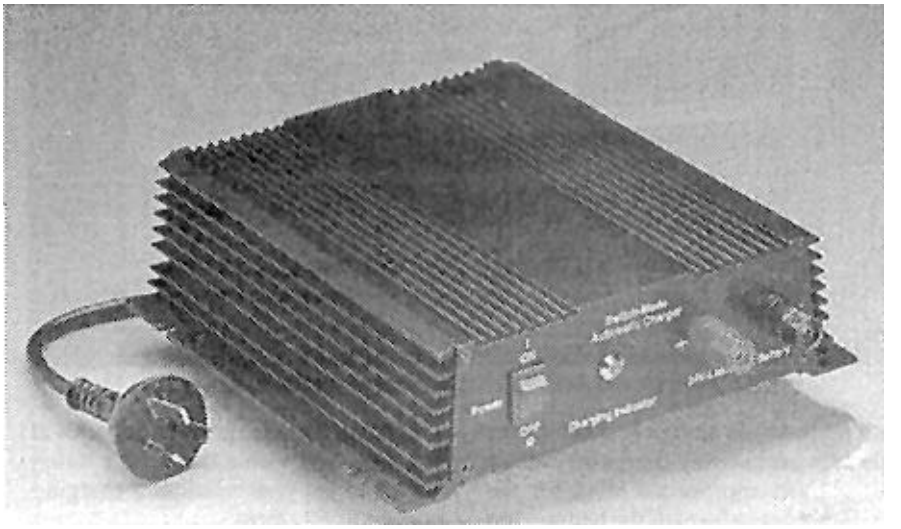
The basic battery charger comes in two different forms, those being the older, 50Hz, iron-cored transformer units, and the later switchmode types.

Old iron-core

An example of the iron-core type was discussed in the article *Build your own battery charger* which appeared in Soft Technology #52.

Essentially, this type of charger will consist of a power transformer connected to a rectifier and some form of filtering circuit.

The input primary coil of the transformer is connected to the 240 volt supply and is usually fuse or circuit-breaker protected. The output secondary coil will produce an alternating current at an **RMS** voltage to match your battery charging needs. This **AC** voltage is then rectified (converted to **DC)** through a series of four diodes arranged in a bridge rectifier configuration.



Switchmode chargers are generally the most efficient and lightest in weight, but with the far greater number of internal components, there is more to go wrong.

The output of this circuit is unfiltered direct current, which is then usually filtered through a combination of inductors and/or capacitors to give either a smooth or only slightly rippled direct current, depending upon the filters complexity. The secondary **DC** circuit is also fuse protected and usually electrically isolated from the primary circuit for safety reasons. The current is then supplied to a set of output leads or terminals, ready to supply your battery's needs.

This, however, is only the basic idea involved with this type of charger. Many of the units on the market have some form of voltage regulation, varying from simple to complex. The less well regulated of them will usually have to be supervised, or connected to a voltage regulator, to prevent overcharging.

Some chargers, with more sophisticated regulation, may be more suitable for your **RAPS** system if you want everything to be automatic,

Switchmodes

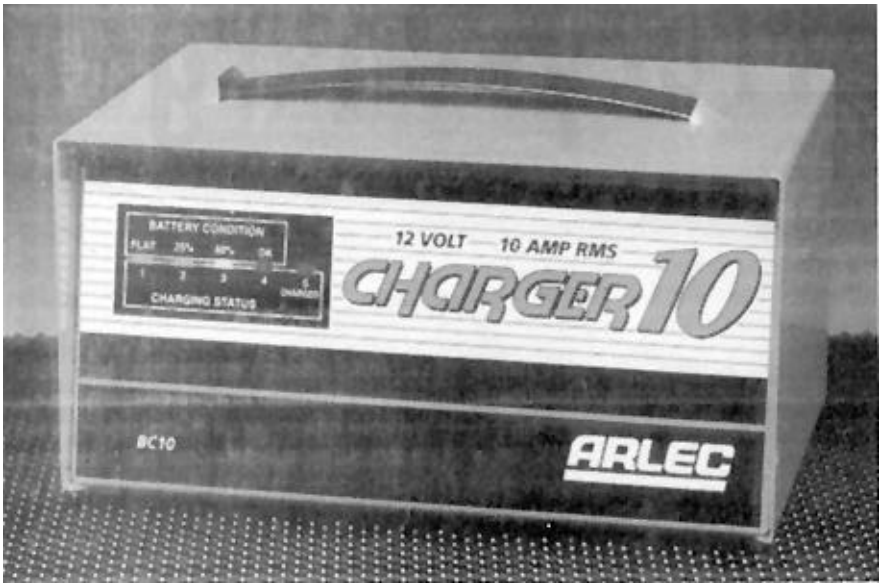
The second type of charger topology is the switchmode type. These also use a transformer to convert the high-voltage **AC** to lower voltage, but the circuitry and method are more complex.

In a switchmode unit, the incoming **AC** is rectified and filtered to form high voltage **DC.** It is then fed to an inverter circuit that converts it into **AC** of a much higher frequency than the normal 50Hz of the mains or generator output.

The high-frequency **AC** is then fed to a transformer to be stepped down to a lower voltage, after which it is rectified, filtered and delivered to the output leads or terminals.

So why use high frequency switching, with all of its added complexity? Firstly, the high frequency used means that a much smaller (and lighter) transformer can be used for the same level of power conversion.

Secondly, because the **AC** in the primary of the transformer is being created by the chargers own circuit, voltage regulation is easily attained in this type of charger. Virtually all switchmode chargers will be voltage regulated, and because they have such good control over the output voltage, many incorpo-



This is a simple *Arlec 10* amp charger of the 50Hz variety.

rate multi-mode charging. This means that they can not only charge the battery at the most appropriate level for the type and charge level of the battery, but also include modes such as float and equalisation charging.

Switchmode chargers also have other advantages, one of which is weight. For the same power output, a switchmode unit will generally be much smaller and lighter than an equivalent 50Hz unit.

Another area where a switchmode is generally superior is in efficiency. Some switchmode chargers have efficiencies of over 90% for most load levels, and hence generate very little heat while running.

What size charger?

Battery chargers are rated at a maximum current rating for a voltage output. This rating may be continuous or for a given maximum duration only and is usually stated in the manufacturers specifications.

There are two critical factors to consider when selecting your battery charger and they are the system voltage and the maximum rate of charge of the batteries. This maximum charge rate is usually taken as one tenth or 10% of the amp-hour capacity of your batteries at the ten hour charge rate (Cl 0).

As an example, if the capacity of your batteries were 800 amphour at a charge rate of 100 hours (C100), at the C10 rate the capacity may be only 600Ah. If you wanted to charge your batteries at this rate, you would divide this rating by ten to get your maximum charging current of 60 amps.

If the system voltage is 24 volts, your charger in this example would be a 24 volt, 60 amp charger. If there are no chargers rated at exactly this maximum charge rate, then one should be selected with an amperage rating below this level. Although the charger in this example may be rated at 24 volts the actual voltage to the batteries could be as high as 30 volts, depending on the type of charger, the state of charge of your batteries and/or the type of battery. In 12 volt and 48 volt chargers this voltage will be as proportionally high also, so if your inverter has high-voltage cut-off protection your should make sure that the maximum charging voltage is below this so as to avoid system shutdown.

Battery charger efficiency

Every charger has power loss in the voltage conversion process and the lower this loss is, the greater the efficiency rating of your battery charger. Most of the power is lost through the heat given off by the transformer and other high-power components. If the efficiency rating of the charger is not know it can be calculated by dividing the average DC output power by the average AC input power of the battery charger.

As stated earlier, switchmode chargers are generally the more efficient of the two types. Efficiency can be greater than 90% with this type, whereas a 50Hz charger will rarely exceed 80%.

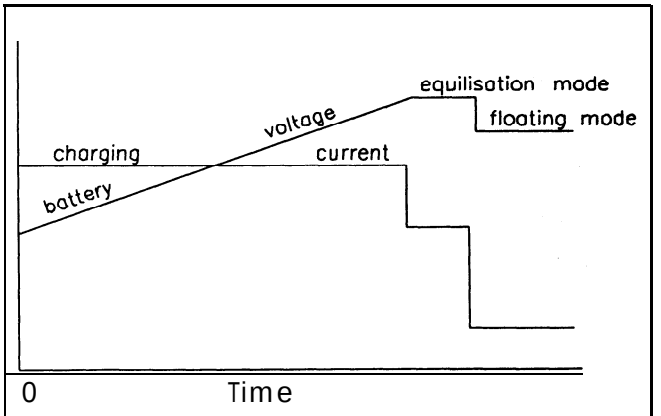
Battery safety

Lead-acid batteries give off explosive hydrogen and oxygen gasses as a by-product of their use. Together with the possibility of sparking from the terminals, this can create an extreme safety hazard. Care should therefore be taken in their installation and maintenance so as to reduce this hazard. It is suggested that the Australian Standard *AS3011* ***Part I and/or Part 2 -Electrical Installations: Secondary batteries in buildings,*** be followed as guidance in the above.

Types of batteries

The batteries are the weakest component in any RAPS systems, however technology is constantly improving their performance, especially that of the lead-acid, which has excellent prospects for improvement.

As the charger within your system should be matched to the battery type being used, a good understanding of their performance and characteristics is necessary. RAPS system batteries can



A typical charging graph for a fully regulated, multi-mode charger.

basically be divided into three distinct types in regard to their charging requirements and performance.

These are the nickel-cadmium battery, the flooded-cell lead-acid battery and the sealed lead-acid battery. Ni-Cads are rugged, tolerant and have a high performance. They make excellent RAPS batteries, but their cost makes them, in most cases, economically unviable and are very rarely used as such.

The sealed lead-acid battery is also rugged and requires little maintenance. However, they have the disadvantage of being expensive, and because of their sealed nature, must not be overcharged. Like NiCads, these batteries are not commonly used in RAPS systems.

The large majority of batteries used in RAPS systems are of the deep-cycle, flooded wet, cell type. Because of this, most battery chargers for RAPS systems have characteristics that suit this type of battery. These batteries are designed to withstand high rates of discharge and charge without effecting their service life. They can also be discharged quite deeply, usually down to 50 per cent of capacity.

Charging tolerances

Aside from the regular maintenance of your batteries, the supply of an ideal charge to your batteries can do a lot to maintain their service life.

Assuming that your batteries are of the deep-cycle flooded-cell lead-acid type, ideally the battery should not be discharged below 50 per cent of its capacity or below its specific cut off voltage. Nor should it be charged for prolonged periods above its gassing voltage. Any prolonged discharge or charging below or above these battery levels could damage them or reduce their capacity.

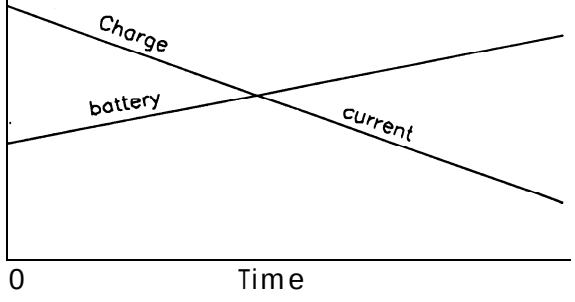
During discharge some batteries may develop a different voltage with respect to the other cells. This can usually be remedied by applying an *equalising* charge to the batteries, at least once a month. Unequal charging in batteries is more common in banks with parallel strings, and this configuration should be avoided if possible.

Because they are sometimes charged above their gassing voltage, flooded-cell lead-acid batteries are usually charged with their charging current being regulated. On the other hand, sealed cells usually have their voltage regulated to a level close to their maximum voltage.

Charger characteristics

The basic unregulated 50Hz charger as described previously, has a variable voltage and current rate characteristic when charging lead-acid batteries. In the initial charging phase of a discharged battery the current would be at its highest level at the start and this would slowly reduce as the battery voltage increases.

This type of charger may be OK for NiCad batteries or your car battery but for systems using the flooded-cell lead-acid battery you may find it more suitable to have some form of regulation. Regulation is usually electronic and can incorporate microprocessor control with multi-stage cycles, ideal for charging flooded cell batteries.



Charging graph of a typical unregulated charger, of the type that appeared in an article in the last edition of Soft Technology.

The tapering of current in an unregulated charger is usually not a benefit in the charging of the flooded cell lead-acid battery. The charging duration will be longer and the battery capacity is usually less than in a regulated charge where the current is held level up to the battery's gassing voltage.

Besides being less efficient, constant under charging of a battery can permanently reduce its top end capacity. As mentioned, some chargers have multi-stage processors included as part of the regulator. Depending upon the charger, this processor automatically senses the state of the battery charge and puts the charger into one or more charging modes.

Besides the constant current regulation up to battery gassing voltage, flooded-cell batteries can absorb current for a short time at this voltage limit without damage. This mode of charge is called *absorbtion* mode and charges the battery to the top end of its capacity. Absorbtion mode, also known as an equalising charge, is usually followed by what is called *floating* charge, in which the charging voltage is reduced to just below battery gassing voltage, with charge current reduced to a minimum. This allows the charger to be permanently on line while constantly supplying a top-up charge.

As well as this regulation, battery chargers can include other features that may be of benefit to you or your system.

Other features

Chargers can incorporate other features, such as automatic current limiting, which limits current on initial switch-on, surge protection circuitry, or selection switches which adjust charging parameters to account for changes in temperature or battery type.

They may also include built-in ampere or voltage meters or indicator lights to give an idea of the state of the battery charge. Some chargers also have multiple system voltage capabilities, that is, the same charger could be used in, for instance, both 12 or 24 volt systems.

Battery chargers can include all of the above or a combination of the these features. Whatever type of charger you finally decide to buy I am sure that the information in this article will help you choose the right one, happy charging. ☼

Soft Technology

Battery charger buying guide

Model	Manufacturer /Supplier	Type	Output Current (amps continuous)	Automatic Regulation	Output Voltage Volts			Input Voltage Range Volts AC	Weight	Dimensions	Comments	Recommended for	Price
					Nominal	Float	Equalise		kg	L x W x H cm			$ (+ tax)
BC924	Arlec	I	5	no	6,12 and 24	na	na	240	5	22.5 x 20 x 20	hi/lo charge switch	lead-acid	210
BC10		I	6	no	12	na	na		2.8	19.6 x 13.2 x 11		lead-acid	80
BC1024		I	8 & 3.5	yes	12 & 24	14.2 & 28.4	na		5.5	22.5 x 20 x 20		lead-acid	235
BC15		I	8	no	6 & 12	na	na		5.4	22.5 x 20 x 20	hi/lo sw.	lead-acid	195
BC20		I	12	no	6 and 12	na	na		8	29.5 x 23.2 x 23.2	hi/lo sw.	lead-acid	260
BC2424		I	18 & 9	no	12 & 24	na	na		10	29.5 x 23.2 x 23.2	hi/lo sw.	lead-acid	350
PS491		I	24 & 12	no	12 & 24	na	na		16.5	38.5 x 29 x 16.5	Hi/Med/Lo	lead-acid	525
PS439		I	20 for 6 & 12V	no	6,12,18 & 24	na	na		17.1	44 x 35 x 30	variable charge	lead-acid	710
PS470		I	25 continuous 200 for engine start	no	6 and 12	na	na		16.5	38.5 x 29 x 16.5	hi/med/lo	lead-acid	665
Smart Charger BC 4000		I	4	yes	12	13.8	14.6 @ 4A max		3.53	20 x 17.5 x 11.5	temp. regulated	lead-acid	165
BC 6000		I	4	yes	24	27.6	29.2 @ 4A		3.53	20 x 17.5 x 11.5	temp. regulated	lead-acid	185
Truecharge 10	Bainbridge Marine	S	10	yes	12	13.7–14.2	na	90-135, 48-62Hz or 200-260 48-62Hz	1.6	19.1 x 16.5 x 7	battery type selector switch	lead-acid batteries 25AH-200AH	360 (inc tax)
Truecharge 20		S	20	yes	12	13.7–14.2	15.5VDC@4 A max		2.5	39.4 x 16.5 x 7		lead-acid batteries 100-400AH	510 (inc tax)
Truecharge 40		S	40	yes	12	13.7–14.2	15.5VDC@4 A max		3.2	39.4 x 16.5 x 7		lead-acid batteries 400AH and above	705 (inc tax)
Swichtec E332-10	Hawker Batteries	S	12	yes	24	na	na	207-264V	1.2 - 1.5	25 x 6 x 12.9	temp. compensated	lead-acid	price on application
Swichtec E622-11		S	15	yes						25 x 8 x 12.9			

Model Name	Manufacturer /Supplier	Type	Output Current (amps continuous)	Automatic Regulation	Output Voltage Volts			Input Voltage Range Volts AC	Weight	Dimensions	Comments	Recommended for	Price
					Nominal	Float	Equalise		kg	L x W x H cm			$ (+ tax)
Swichtec E333-11	Hawker Batteries	S	6	yes	48	na	na		1.2 - 1.5	25 x 8 x 12.9	temp. compensated	lead-acid	price on application
Swichtec E343-10		S	6	yes	48	na	na		1.2 - 1.5	25 x 6 x 12.9			
Swichtec E623-11		S	10	yes	48	na	na		1.2 - 1.5	25 x 8 x 12.9			
Swichtec E731		S	50	yes	12	10-12V	12-18V		6.2	27.5 x 26 x 14.3			
Swichtec E732		S	25	yes	24	20-28V	24-34V						
Swichtec E1332		S	50	yes	24	20-28V	24-34V						
Swichtec E733		S	15	yes	48	45-58V	54-69v						
Swichtec E1333		S	25	yes	48	45-58V	54-69v						
Swichtec E2732		S	50	yes	24	20-28V	24-34V		8.5	34.7 x 27.5 x 14.3			
Swichtec E2733		S	50	yes	48	45-58V	54-69V						
1208	M&H Power Systems	S	8	yes	12	13.8	na	180 - 260	1.2	15.2 x 18 x 6	Reverse Polarity Protected	sealed lead-acid	123
1212		S	12	yes	12	13.8	na		2.1	20.2 x 18 x 6			214
1225		S	25	yes	12	13.8	na		2.6	25.2 x 18 x 6			344
2404		S	4	yes	24	27.6	na		1.2	15.2 x 18 x 6			139
2408		S	8	yes	24	27.6	na		2.1	20.2 x 18 x 6			192
2415		S	15	yes	24	27.6	na		2.6	25.2 x 18 x 6			344
SM600		S	24 & 12	yes	12/24	28/56	30/60	99 - 264	4	40 x 48.2 x 8.8	Reverse current, temp. protected	lead-acid	price on application
SM1500		S											
SM1800		S	62.4 & 34	yes	24 & 50	26 - 29 52-58 adjustable	up to 32/60 adjustable	180 - 264	10.2	44.3 x 26.5 x 10.7			
SMF3000		S	102 & 56	yes	24 & 50	26-29/52-58 adjustable	up to 32/60 adjustable	180 - 264	13	39.4 x 13.3 x 30.9			

Soft Technology — Battery charger buying guide

Model Name	Manufacturer /Supplier	Type	Output Current (amps continuous)	Automatic Regulation	Output Voltage Volts			Input Voltage Range Volts AC	Weight kg	Dimensions L x W x H cm	Comments	Recommended for	Price $ (+ tax)
					Nominal	Float	Equalise						
MPS 1200/30	Power Electronics	S	40	yes	24	27	30	200-260	3.2	35 x 10 x 11.5	temp.& over voltage protection	lead-acid	1200
MPS 1200/60		S	20	yes	48	54	60						
MPS 1200/90		S	13.5	yes	72	81	90						
MPS 1200/120		S	10	yes	96	108	120						
MPS 1200/150		S	8	yes	120	135	150						
W1220	Woods	–	12	–	12	na	na	240	–	–		lead-acid	288
W1240		–	30	–	12				–	33 x 28.5 x 27			539
W1280		–	60	–	12				–				861
W 2420		–	15	–	24				–				487
W2440		–	30	–	24				–				804
W2480		–	60	–	24				–	–			1495
W 4820		–	15	–	48				–	33 x 28.5 x 27			857
W4840		–	30	–	48				–	–			1495
1215N	Woods	–	15	–	12	na		240	–	–		lead-acid	413
1230N		–	30	–	12				–				760
2415N		–	15	–	24				–				760
2430		–	30	–	24				–				1135
PSE 1212	Solar Charge	S	15		12	na	na	115 or 240V	–	22.2 x 20 x 6	reverse polarity protection	lead-acid	220
PSE 1225		S	25						–	27 x 20.2 x 7			350
PSE 1245		S	45						–	–			585
PSE 2408		S	8		24	na	na		–	22.2 x 20 x 6			220
PSE 2415		S	15						–	27 x 20.2 x 7			350
PSE 2422		S	22						–	–			585

Key: S = switch mode, I = iron core.

All prices are ex tax except where indicated

Fuel Cells: Past, Present and Future

This photo kindly supplied by *Ballard Power Systems.*

Above: Ballard Power Systems (Canada) have implemented a project involving the conversion of a bus to run on a solid polymer electrolyte fuel dell. A 120kW system using three parallel strings of eight 5kW stacks was used to provide a nominal voltage of 200VDC. On-board fuel storage is gaseous hydrogen with a fuel reformer located at the bus terminal.

Adrian Oakey

IMAGINE driving a lightweight car where the only noise to be heard is the tyres on the road and the whine of an electric motor, or having a power plant right next door that you cannot even hear. Well, you can do more than imagine, because these cars and power plants already exist, and they exist because of fuel cells.

Fuel cells are devices that convert hydrogen and oxygen gas into direct current (DC) electricity and water. The hydrogen can be supplied as a pure gas or from hydrocarbon fuels such as natural gas, LPG, petrol, coal gas, alcohol and methane. The oxygen can be supplied as a pure gas or by using air.

The beauty of this process is that it makes hardly any sound and has conversion efficiencies between 60 and 80 per cent as compared to steam plants which have only efficiencies of approximately 35 per cent.

The fuel cell effect was first discovered by Sir William Grove in 1839 when experimenting with dissociation of water using sulphuric acid and platinum electrodes. He developed a 50 cell stack by 1842 but discontinued his work as batteries offered greater promise at that time. However, further work was carried out by other inventors. The first fuel cell stack of any significant power was developed by Francis Bacon between 1932 and 1950 in which a 5kW stack was constructed.

Further developments were not made until massive funds were injected into fuel cell research by NASA during the 1960s to develop a power plant for the Gemini and Apollo space programs. As of 1995, commercial power plants are being produced in the MW range. However, the technology is still relatively

Operation of a Fuel Cell.

Porous electrodes are sandwiched between a liquid or solid electrolyte. Hydrogen gas is flowed over the anode and ionised by the catalyst causing electrons to be stripped from the hydrogen molecules. The electrons then flow through the load circuit creating the electrical current. Meanwhile the hydrogen ion is transported through the electrolyte and recombined with the electrons at the cathode in the presence of oxygen. This causes the formation of water. Heat is also evolved due to inefficiencies of the process. For some types of fuel cells, ions other than the hydrogen ion are transported through the electrolyte, ie the oxygen ion.

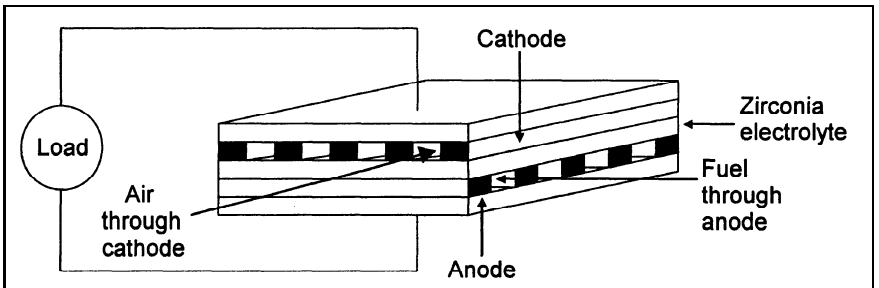
expensive. Extensive research is currently being carried out to improve the reliability and reduce the cost of fuel cell systems.

Different types

There are five main types of fuel cells; Alkaline (AFC), Solid Polymer Electrolyte (SPE), Phosphoric Acid (PAFC), Molten Carbon (MCFC) and Solid Oxide (SOFC). The AFC and SPE types are low temperature fuel cells (70°C to 120°C) and require pure hydrogen to operate.

Efficiencies can be over 50 per cent if using pure hydrogen but if the energy to reform hydrocarbons is taken into account then the efficiency is approximately 35 per cent. The PAFC type is a medium-temperature (200°C) fuel cell which, after hydro-carbon fuel reforming, has an efficiency of around 40 per cent.

The MCFC and SOFC are high-temperature (650°C and 1000°C respectively) types and are capable of having hydrocarbons reformed internally to the fuel cell because of the high temperatures involved. This increases the operating efficiencies to 60 to 70 per cent.. SOFC's have the additional advantage of the electrolyte remaining solid so that it can be used as a structural component on the cell stack. Potentially this will allow fuel cell stacks to be constructed up to 1MW/m^3 compared to 200-300kW/m^3 for other types.



Schematic of Solid Oxide Fuel Cell Construction.

The low- to medium-temperature fuel cells are being promoted for small and mobile applications where the difficulties of working with high-temperature systems make SOFC or MCFCs inappropriate.

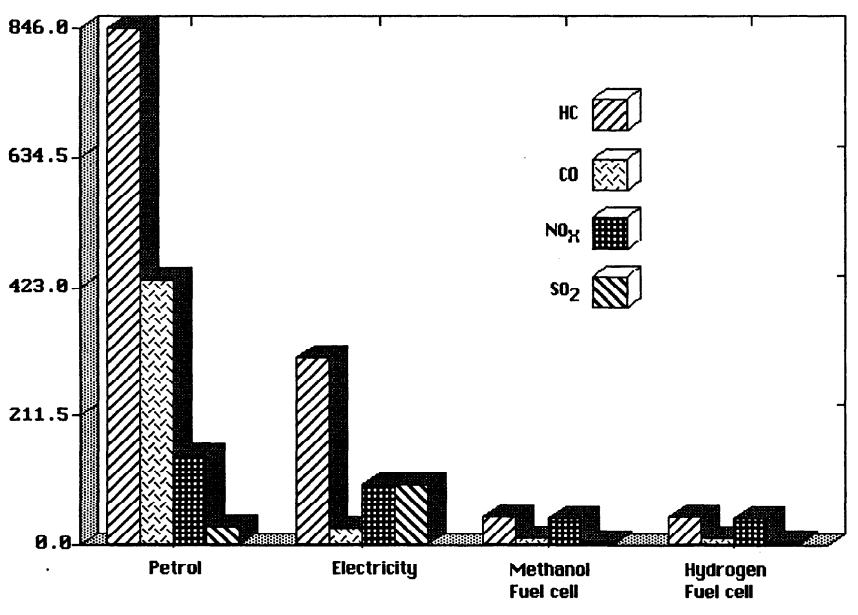
The SPE fuel cell in particular has great potential, as the solid electrolyte removes the need for electrolyte management systems, resulting in higher power densities. Because costs need to be reduced, extensive research is being carried out to decrease the amount of platinum catalyst and to look at alternative forms of catalyst such as organics.

Medium- and high-temperature fuel cells are being promoted for use in large scale power plants. The PAFC is currently the most proven technology and cell stacks ranging between 40kW and SMW are being produced commercially. Stacks of up to 11MW have been constructed.

MCFC and SOFC technology is still undergoing development with the construction and evaluation of experimental stacks. With the higher efficiencies and abilities to internally reform fuels, MCFC and SOFC systems have the potential to dominate PAFC technology.

The use of fuel cells in mobile applications is limited by the storage density of hydrogen achievable in gaseous form. It is thought that SOFCs may be applicable to mobile applications as solid fuels can be easily used without an additional reforming infrastructure. However there are potential storage systems for hydrogen gas that may provide practical storage densities, so it is difficult at this stage to determine which fuel cell technology will dominate the mobile application market.

The use of fuel cells is not limited to the steam reformation of hydrocarbons (fossil fuels). Fuel cells can be used in conjunction with photovoltaic (PV) and windgenerator turbine (WGT) farms. Excess energy from the farms can



These are the comparative emissions from each type of energy production.

Fuel cell development in Australia

A company called *Ceramic Fuel Cells* (CFC) has been formed as a result of research into SOFC's conducted by the materials division of CSIRO. CFC is a consortium including *BHP, CSIRO, ERDC, ETSA, Pacific Power, SECV* and *SRF*. The objective of CFC is to produce multi kilowatt SOFC stacks for a range of applications including central and dispersed power generation, industrial co-generation, commercial buildings, remote settlement power, remote residential and remote communications systems.

be converted into pure hydrogen and oxygen through electrolysis and stored. The hydrogen and oxygen can then be reconverted to electricity when there is a need for additional power that cannot be provided by the PV or WTG farms.

As pure hydrogen is used, the overall efficiency of the low-temperature fuel-cells is improved and, unless the waste heat is utilised, the efficiency of the high temperature systems reduced. (Though high-temperature systems would most likely still be more electrically efficient than low-temperature systems).

While current fuel cell technology is not fully competitive with traditional power plants, with continued support and investment it should become mainstream within twenty years for both stationary and mobile applications0

Solar Hydrogen

A joint German-Saudi Arabia project called *HY-SOLAR* is currently underway whereby hydrogen is produced in Saudi Arabia by PV-electrolysis (high solar insolation) and transported to Germany (low solar insolation) and converted into power using fuel cells. A 350kW solar hydrogen facility has been constructed at Riyadh and a 10kW facility in Stuttgart. In addition, the Germans are funding a program called *Solar-Wasserstoff-Bayern* which has facilities including a 278kWp of PV array, 110kW alkaline electrolyser, an 80kW PAFC, hydrogen and oxygen storage units (at 30 atmospheres pressure) as well as other smaller electrolyser and fuel cell systems.

References:

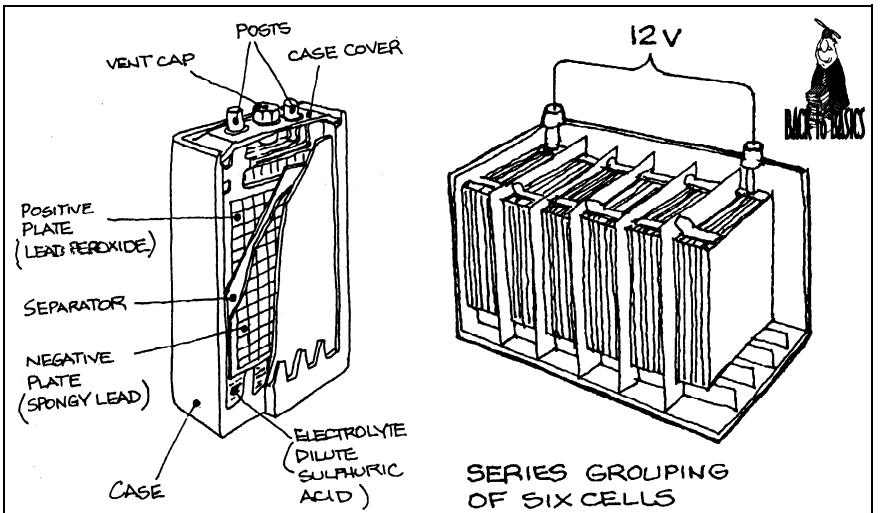
* *'Hysolar and Solar- Wasserstoff-Bayern', C.J. Winters and MFuchs,* International Journal of Hydrogen Energy, *Vol 16, No 2 I, pp 723-733, 1991.*
* Fuel Cells: Clean Alternative Energy Technology of *21st* Century, *S. P.S. Badwal, K. Foger and M.J. Murray, Energy, Economics and Environment Gippsland Basin Symposium, Melbourne, 22-23 June 1992.*
* *'World Development of Fuel Cells', D.S. Cameron,* International Journal of Hydrogen Energy, *Vol 15, No.91, pp 669-675, 1990.*

BATTERIES

Batteries come in almost every conceivable shape and size, ranging from the tiny button cells used in watches to the large batteries used to start cars, and the even larger versions which form part of most remote area power supply (RAPS) systems.

Claire Beaumont and Lance Turner

ALTHOUGH they look different, all types of batteries store electricity and produce it when required. But what's inside a battery, and how does it work?



Here we can see the construction of large-format cells and batteries.

Batteries vs cells

Before we go any further, we should consider the terms *battery* and *cell* which are often used as though they were interchangeable.

A cell is a single, self-contained unit that contains the appropriate materials to produce electricity. The AA, C or D 'batteries' used to power most portable appliances are actually cells. They produce 1.5 volts, which is the lowest. possible nominal voltage for their type of chemical reaction.

A battery is a group of cells that are wired together to produce higher currents or voltages. A car battery, which usually has six 2 volt cells wired in series to produce 12 volts, is an example of a true battery. Another example is the small 9 volt transistor battery, which contains six small 1.5 volt cells in the one case to produce 9 volts.

How does a cell work?

Most cells consist of plates or layers of two different types of metals, in between which is a substance known as the *electrolyte. The* electrolyte can be in the form of a liquid, such as sulphuric acid, or a paste or gel, as is the case with common 'dry cells'.

The combination of metals and the electrolyte causes a chemical reaction (known as electrolysis) that causes electrons to try to move from one plate to the other. This is the same type of chemical reaction that occurs when you bite a piece of aluminium foil. The foil reacts with saliva and your amalgam fillings to produce a small electric current. You feel this as a horrible sensation through the nerves in your teeth.

In some batteries the electrolyte takes part in the chemical reaction that produces the electricity, but in others it just provides a means for the electricity to flow between the plates.

This movement of electrons causes a flow of current through any electrical device connected to the battery.

Connections

Both cells and batteries have to have some way of being connected to the outside world. This is done through *terminals,* which connect directly to the plates inside the cell or battery. The positive terminal is connected to the positive plate(s) and the negative terminal connects to the negative plate(s).

In the case of the small common dry cells, the terminals can be found at each end of the cell, and consist of a flat metal plate with either an indent (negative) or bump (positive) in the centre. Larger batteries and cells usually have terminals that can have either special push-on connectors attached to them, or 'posts' that are connected by a clamp that goes over the post, or else a bolt that goes through it. Terminal posts of larger batteries are usually made of lead, but may be of other materials including stainless-steel.

Voltages*

Most common cells have a voltage of somewhere between one and three volts, depending on the chemicals present in the cell. Batteries can vary in voltage from as little as one volt right up to hundreds or even thousands of volts.

A battery's voltage can be increased by connecting the cells in series, while the current capability is increased by connecting them in parallel. By using both series and parallel connections in the same battery, storage capacities and output voltages are almost limitless.

Formats

Cells (and batteries) come in a number of different *formats,* a term used to describe the construction of a cell. The commonly available batteries used in torches, radios, and other small appliances are known as small format dry cells.

Batteries such as those used to provide power on remote properties are known as large format batteries. Most of these batteries are of the flooded wet cell variety, that is, they contain a liquid electrolyte which completely covers the plates and fills the case. This is different to a dry cell or battery, where the electrolyte is usually in the form of a paste.

Capacity

The total amount of power a battery or cell can put out before it is 'flat' is known *as the capacity* of the battery.

The measurement for capacity is *amp* hours, ie the number of amps drawn from the cell multiplied by the hours run. This figure is usually obtained by testing the battery over a set period of time, quite often a 20 hour period.

This means that if a cell is rated at 100 amp hours at the C/20 rate, it will provide five amps continuously for 20 hours. This does not mean that it can produce 100 amps for one hour, or even 10 amps for 10 hours, because capacity decreases as discharge rate increases.

Most small format cells do not have a capacity rating printed on them, but all large format cells and batteries should have this information.

Which chemicals are used?

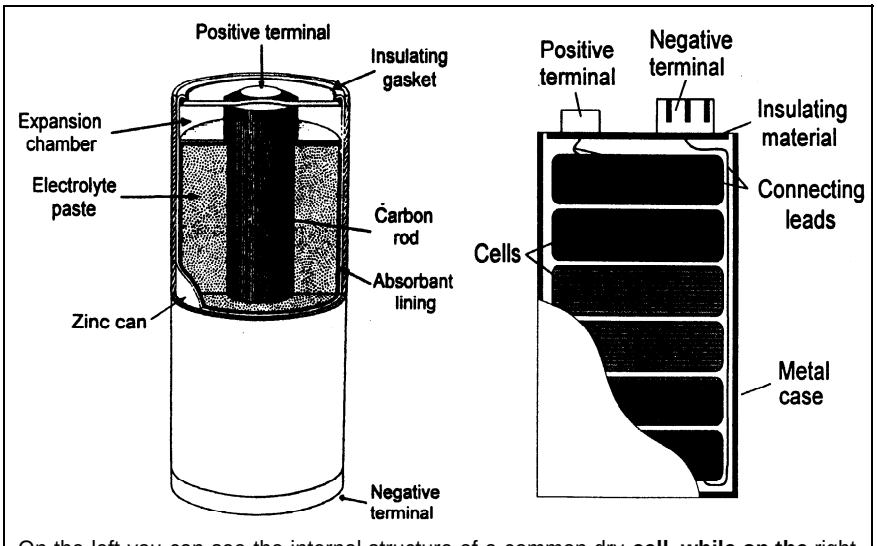
Toxic chemicals and heavy metals are often used in the construction of many types of cells. This creates huge problems when it comes to recycling or disposing of the cells. Many batteries are able to be recycled, especially the large format types, where quite often the manufacturers of the batteries have recycling schemes in place to reduce the amount of toxic waste that is dumped.

Zinc-chloride cells are the most common small format dry cells on the market today. The chemicals used in these cells are toxic and caustic, and can be dangerous if they leak from the cell. Alkaline dry cells, which have a much higher energy density (more total power for their size) than standard zinc-chloride, also contain caustic chemicals that can be very corrosive. However, as they provide more power per battery, they require replacement (and hence disposal) less often.

Rechargable batteries, such as Nickel-Cadmium (NiCad) or the newer and far less toxic Nickel-Metal-Hydride (NMH), are much more environmentally friendly alternatives. They can be recharged 1000 times or more if treated correctly, which results in much less toxic material going into landfill. Zinc-chloride (and alkaline) cells can in fact be recharged with a special charger, although success varies from cell to cell. They should never be put in a conventional NiCad charger as they will get hot and explode!

NiCads do have drawbacks, the main one being the lower cell voltage (1.2 volts compared to 1.5 for zinc-chloride or alkaline). This can be a problem when they are used to replace a zinc-chloride or alkaline cell, as some appliances will not work well on the lower voltage. Also, NiCads, both small and large format, contain not only caustic potassium hydroxide, but also the highly toxic metal cadmium.

Batteries such as those used in most RAPS systems, or to start your car, are known as lead-acid batteries. As you would expect, they contain the toxic heavy metal lead as well as highly corrosive and dangerous sulphuric acid.



On the left you can see the internal structure of a common dry **cell, while on the** right is a 9 volt transistor battery which contains 6 cells.

Safety precautions

Because of the generally low voltages involved with the use of batteries, most people believe that they are quite safe to handle and use. While this may be the case with small torch cells, the same can definitely not be said for the large-format units.

Lead-acid and NiCad batteries have a very low internal resistance. This means that they can deliver high currents with a minimal drop in voltage. What this equates to, are batteries that can provide huge amounts of power for short periods - even the average car battery can provide 5kW or more of power for up to 30 seconds at a time.

When dealing with much larger batteries, enormous amounts of power are capable of being generated, making a short circuit across the battery terminal a very serious situation indeed. Large battery banks have been known to completely vaporise a metal tool that has been shorted across the terminals. If you were unlucky enough to be holding the spanner at the time, then it would probably mean the loss of a hand.

Lead-acid batteries can also produce the highly explosive gas hydrogen, and must never be used or charged anywhere near naked flame, sparks or any form of heat that may ignite the gas. When maintaining or otherwise working around these cells, it is a good idea to wear a face shield or other protection0

** If you've forgotten what voltage is, or if you never understood it, see Back to Basics ST#52. It also has information about series and parallel wiring.*

To learn more about the various types of batteries used in RAPS systems, see the Battery Buying Guide in ST#46.

Look Ma -- no batteries!

Lance Turner

THERE is no doubt that bicycles are one of the most efficient and environmentally friendly forms of transport in existence today. But as with most vehicles, certain levels of safety must be adhered to in order to prevent needless deaths and injuries caused by collisions with other vehicles.

After common sense and a bike helmet, one of the most important pieces of safety equipment is the bike light. Riding at night without either a main headlamp or red tail lamp is inviting disaster head-on. But there is one major drawback with many of the lights on the market today, and that is that they run from batteries.

Of course, there are head lights that run from a dynamo that is driven by one of the bikes wheels, and there are LED tail lights that can be run for up to 300 hours on a single pair of alkaline batteries. But these designs and many others available have their drawbacks.

Batteries cost money and are an environmental nightmare when it comes to their disposal. Using rechargables is better, but the lower voltage compared to a non-rechargable dry cell can make lights appear dim, and their flat discharge curve gives no warning of impending failure.

An alternative

Wouldn't it be great if there was a device that could store electricity for long periods, be charged in only a matter of minutes, and had an almost unlimited lifetime? Well, there is. It is called a super capacitor, and until recently the main use for these devices was for providing back-up power to the CMOS memory chip in computers so that the computer knows its configuration when switched back on.

While unable to hold anywhere near the amount of energy as a battery, a super cap can be used to replace batteries when the circuit being driven is of low power consumption and high efficiency.

Capacitors are used in every piece of electronic equipment made today, and there are many different types. Capacity is measured in farads, or more commonly in millionths (micro-farads) or even smaller units. But super caps are measured in milli-farads for the smaller units and farads for the larger types.

A bike light

By careful design, a light can be built that will run for over two hours on one full charge, and the capacitor can then be re-charged in a matter of only minutes for the next run.

Here we will describe two designs for high-efficiency bike lights that are powered by super caps. One will be a low-power unit with only one cap, and can be considered an economy model. The other will be a more powerful device with four or five capacitors.

The circuit for the smaller light (see figure 1) is fairly simple in its operation. The super cap drives a circuit that consists of a LM3909 LED flasher IC, a 470pF capacitor and a resistor. These three devices are all that is required to flash the high-brightness LED.

The 3909 chip has been specially designed to flash an LED using minimal power in the process. There is no better device for the job (as far as I am aware) and at a price as low as two dollars, why bother looking?

How it works

The 470uF capacitor is charged via both the 3909 and the 10k resistor. When its voltage reaches a certain level, the 3909 dumps the charge stored in this capacitor into the LED. It does this using a bit of clever internal switching that connects the charged capacitor in series with power supply and the LED, thereby doubling the power supply voltage across the LED. This provides a short, sharp flash in the LED, with relatively long spaces between flashes.

What this also means, is that the circuit will continue to function even when the power supply voltage (the voltage left stored in the super cap) is below the voltage that would normally be required to turn the LED on. Pretty clever really.

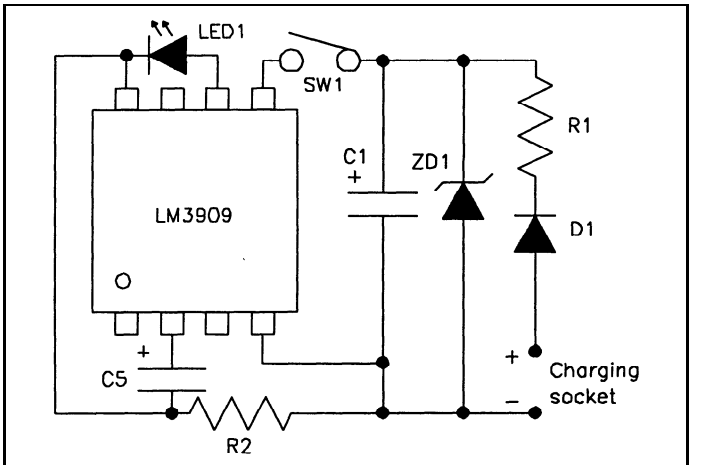


Figure 1. The circuit diagram for the smaller of the two lights.

Bigger is better?

The larger of the two designs can be seen in figure 2. This design is even simpler than the first, as it uses a proprietry circuit to do the flashing. What is a proprietry circuit you ask? Well, here is the story.

In order for the LED to be seen from the side, as well as the rear, a lens of some sort is required. After some searching, I found the perfect answer in a small, round (approx 40mm diameter) safety flasher from *The Reject Shop*. This unit costs just $2, is fairly well built, and contains a 1 candela LED, two button cells and an integrated circuit all mounted on a small circuit board inside the unit. Even with all these components the unit was cheap when compared to a large standard light bezel.

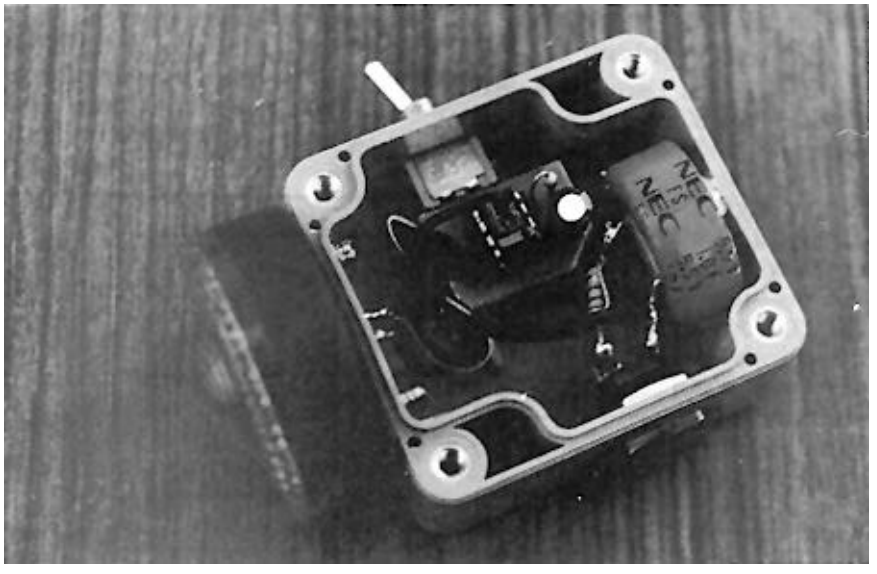
In the larger design the super caps are connected directly to the circuit via the on/off switch, as in the other design. But as the flashing circuit is already on the circuit board, that's all there is to it!

Protecting your super cap

Now it is time to explain the charging circuit, which is the same for both versions of the bike light. The lights are charged by connecting them to power supply of up to 15 volts. The current from the power supply will first travel through the diode, Dl. This is to prevent damage should the light be connected in reverse.

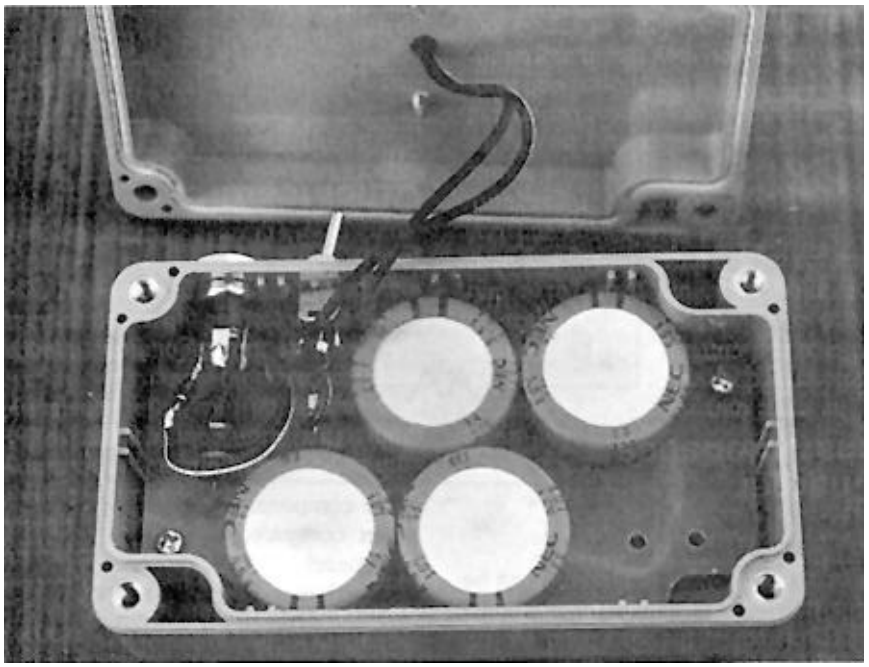
A 5.1 volt, 1 watt Zener diode is used to limit the voltage across the super cap to a safe level. Most super caps are limited to 5.5 volts (the internal power supply of the computers they are designed for are 5 volts). The 150 ohm, 1 watt resistor is there to limit the current flow so that the Zener diodes power rating is not exceeded.

These three components form a crude but effective voltage regulator for the super cap, and must be included in the circuit if the cap is not being charged from a regulated five-volt supply (which most people do not have).


Here you can see inside the smaller of the two units. Note the tiny circuit board mounted on the switch. The super cap can be seen on the right.

Construction

Both designs are housed in sealed, waterproof project boxes, available from *Jaycar Electronics* (other companies have them, but they usually cost more!). For the smaller version of the



Here you can see the circuit board inside the larger of the two units. Note the four super caps mounted on the board, along with all of the other components.

light, I used the smallest box available in the range, and for the larger bike light I used the second in the range.

Economy model

In the smaller version, the IC, small capacitor and resistor were mounted on a tiny circuit board which was then soldered directly onto the switch. The super cap was connected to the circuit via a short length of figure-eight wire, as was the LED.

The regulating components were soldered directly between the super cap terminals and the lugs on the back of the power-input socket. For a lens, I used another of the Reject Shop lights with. the original circuit board removed.

The lens base was screwed to one end of the box and sealed with silicone sealant. Two holes 0.8mm in diameter were drilled 3mm apart in the centre of the base, through to the inside of the box. This allowed the LED leads to be inserted through these holes, the leads to be bent and cut short, and the connecting wires to be soldered directly onto them.

The LED used for the smaller light was not the original from the $2 lens, but instead a 3-candela, 5mm unit from Jaycar. This costs only $1.25 or so and represents excellent value for money when comparing candela/dollar figures. Better brightness levels could be achieved by using a 5-candela device, although these are fairly expensive.

The switch and circuit board were the last things to be fitted, and were placed through a hole just large enough for the switch. If you want to waterproof the switch, buy the switch and a matching waterproofing hood from *Dick Smith Electronics.* Once you have done all of this, the unit is then finished.

Bigger but brighter

In the larger unit, I etched up a circuit board to hold all of the components except the switch and LED - the latter being mounted on the original circuit board that comes with the cheapie lens. The LED originally supplied on this board was not really bright enough, so I replaced it with a 5-candela, 10mm unit from *Tandy Electronics.* While this cost nearly $8, it puts out a lot of light and is visible for several hundred metres.

The components, including the four super caps, were then soldered into place. The resistor and Zener were left standing a few millimeters from the board to allow better cooling when charging. The lens base was screwed to the box lid, sealed with silicone, and a hole drilled to allow the wires to pass through to the circuit board.

The wires were passed through. the hole from inside the box, soldered to the LED board in place of the button cell holders, and the circuit board and lens fitted to the lens base. The main circuit board was then screwed into, position using the moulded mounting posts in the bottom of the box, and the seal and lid put in place.

Once this is all complete you can connect the unit to a twelve volt supply. In five minutes or so, the super cap(s) will be fully charged. Flick the switch and the LED should start to flash. With the smaller of the two units, the flash rate will decrease with time, but the flash intensity less so.

With the larger unit, using the proprietry circuit, the flash rate will stay fairly even, but intensity will drop off a fair bit after two to three hours. If the unit is used on and off for only short periods, then the total running time will be longer than if run continuously.

How you mount the light is up to you, but we used a velcro strap that was lying around. There are many ways you could do it, including a pair of strong 'tool clips' to attach it to the seat tube, adhesive velcro, or a releasable cable tie. Or you could use the old mounting

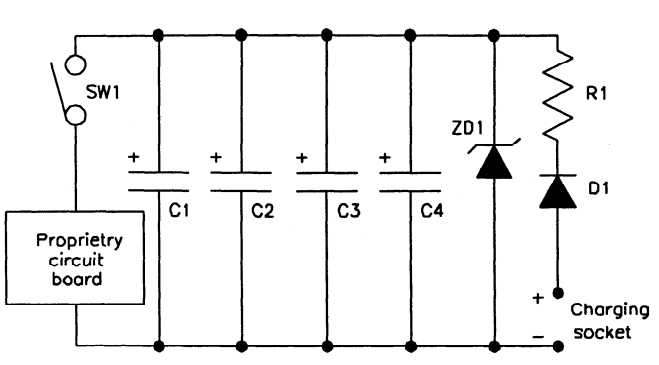


Figure 2. Despite the extra capacitors used to extend the running time, the circuit is simpler than figure 1.

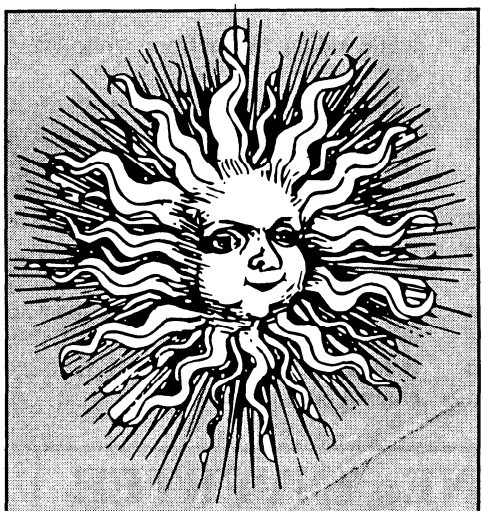
Parts List – Super capacitor bike light.

R1	150 ohm 1 watt resistor
R2	10k 1/4 watt resistor
C1-C4	1 farad super capacitors
C5	470µF 16V electrolytic capacitor
U1	LM3909 LED flasher IC
D1	1N4001 diode or similar
ZD1	5.1 volt 1 watt Zener diode
LED1	High-brightness LED (at least 1 candela)
SW1	on/off switch (small toggle or similar)

bracket from the battery-powered bike light that you no longer need!

As mentioned before, charging the units is simply a matter of connecting them to a twelve-volt supply. Of course, a lower voltage can be used, but the charging will take longer. One of our office staff has been testing the larger unit while riding home from work every day

The light has performed very well, and has only required charging once or twice a week. We have also tried charging it during the day from a small 9 volt, 50ma solar panel placed in the office window. This works very well, even on cloudy days. In full sun this panel should charge the unit in less than 30 minutes (these panels are available from the **ATA** for a cost of $26.90 including postage)☼



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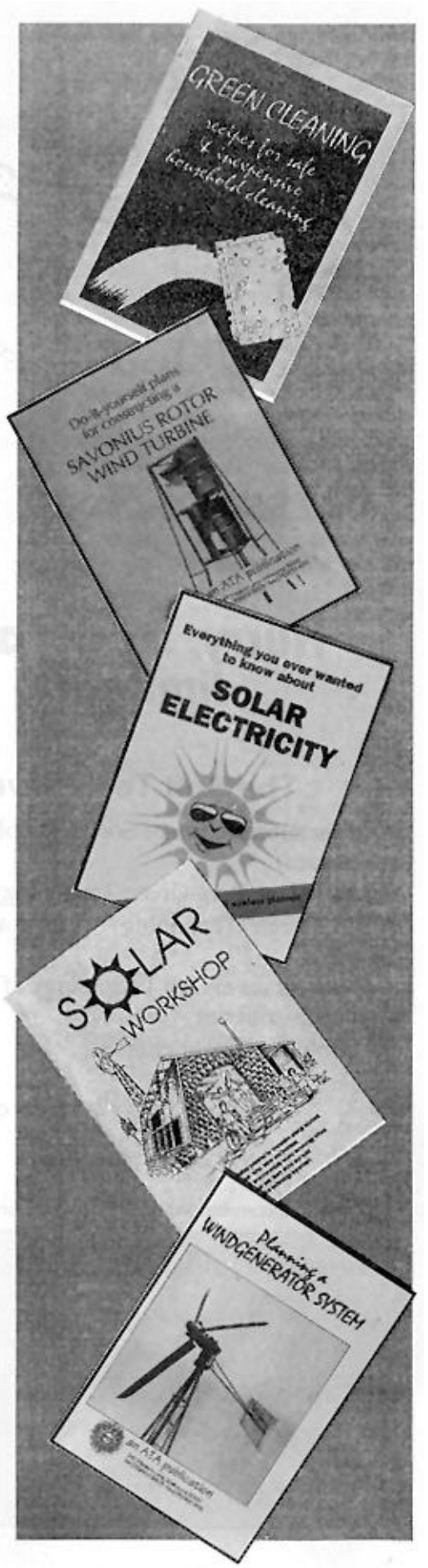

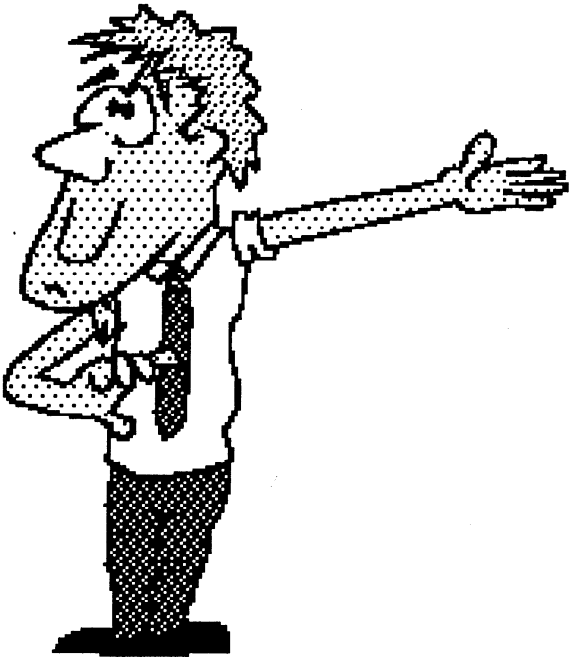

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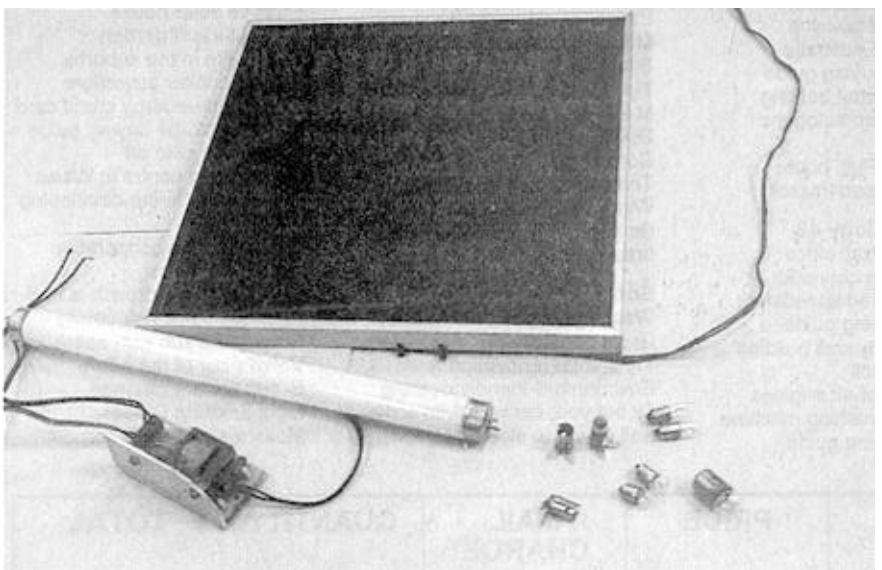
Build your own
False Skylight



Cyril White

DOES your house have a room that seems to be dark and dingy all of the time? Many houses do, and they can require the lights to be left on all day as well as at night.

Rooms like that can be a real pain in the neck when it comes time to pay the power bill, not to mention the added environmental burden they create. One option, of course, is to install a skylight, but this mightn't necessarily be the best option.

Skylights can make a house very hot in summer time. If you are renting or if the room is in the lower storey of a two-storey house, then a skylight is simply not viable. And then, of course, there is the cost to consider. Whatever the problem, there is an alternative that has advantages over a conventional skylight. This alternative is what is known as a false skylight.

A false skylight?

The false skylight, in its most basic form, consists of a solar panel that is placed on the sunny side of the roof of the house which is connected to some form of lighting in the room that needs to be lit.

What the solar panel will be used to power will depend on the required light output and efficiency of the system. You may like to keep it simple, and just use an incandescant bulb or two, but the system will be very inefficient. Of course, if you have a large solar panel doing nothing, then that may not matter.

A more efficient alternative may be a quartz-halogen bulb, or even better, a fluorescent light fitting.

The flexibility of this system allows it to be utilised for many other lighting tasks, such as for a backup lighting system or even as garden lighting with the addition of a battery.

So, is it difficult to design and build such a system? Actually, it is so simple that a kid could do it, and not only have fun doing it but learn from the experience at the same time.

A few decisions

To start with you have to make a few decisions about what you want, what you need and what you can afford.

The fast and probably the most important decision is what sort of performance you want from the system. You must decide what the system has to deliver, what rooms or halls are to be lit and how brightly they are to be lit. By doing this fast you help yourself work out what you need.

An example

Lets use my house as an example. It has a hallway that doesn't get any outside light at all. There is also a dining room, joined to the kitchen, that has outside light coming through from the kitchen windows, but which is not strong enough to light the room adequately at the far end.

There are also two bedrooms that face south and have blinds that must stay closed for the purposes of privacy. Finally, I also wanted to have some garden lighting.

While the hall (or for that matter the dining room) didn't have to be lit very brightly, the bedrooms did. The garden lighting, however, only needed to have low-level lighting.

What do you need?

You must now determine what components you want to use in your initial

setup. This will determine what you can add to the system if your needs change. In my example, the majority of the system needs are for low-level lighting.

I decided to use a 2.2 volt solar-grade battery and lots of 2.2 volt globes, as well as a 2.2 volt solar panel. If you know a little about solar cells, you probably know you can't get 2.2 volt solar panels. But don't worry, I'll tell you how you can make them yourself.

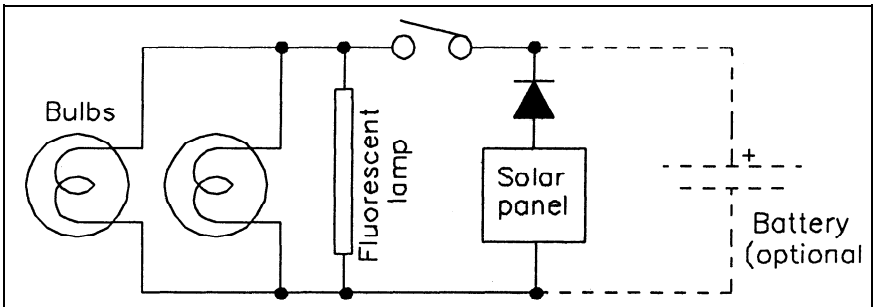
Now to the heart of the matter - the battery. You don't really need a battery, but you will face the problem that on cloudy days the system will barely work at all. If you do have a battery then the system has a backup for those cloudy days and your lights should be as bright as normal. You will also be able to use the system at night, or for a backup lighting system for that inevitable power failure.

If you're building a garden light set you'll need to store the power that is collected by the solar panels during the day. To help save money and the environment by recycling, use a reconditioned or second-hand solar grade battery. You can sometimes get them through your local solar equipment installer/supplier. The cost should be around $50 to $60.

If you do decide to use a battery, remember that there are a number of safety rules to follow when using large batteries. You can read more about this in the *Back to Basics* article that appears elsewhere in this issue, and in Soft Technology #46. You may also like to use a regulator of some kind, unless the battery is very large compared to the solar panels.

Construction

Now to the working end: the lights. The globes that need to be used are very low voltage so torch globes will do nicely. I used 2.2 volt screw-in torch globes that I purchased at *Kmart* in a twin pack for one dollar. For this I also used *Miniature Edison Screw (MES)* screw-in globe holders that I got at *Jaycar Electronics*. These cost me about sixty cents each and hold the globes well. By powering these from your battery or another two volt source, you will be able to determine, with a little trial and error, how many of these you need to light the area.



This is the basic circuit diagram for the false skylight. The battery may or may not be used, while your choice of light type (bulbs or fluorescent) will depend on what you want from your system.

Which panels?

This brings us to the topic of solar panels. As mentioned before, you will have to construct the solar panel from individual solar cells.

The globes mentioned above are rated at 2.2 volts at 0.2 amps. To work out how many solar cells you need, multiply the number of globes you've got by 0.2 amps. If you have decided to use, say, ten globes, then you will need to be able to supply 2 amps at 2.2 volts or so.

Now we will discuss putting the solar panel together. I bet you think this is the hard bit, but it isn't! Most electronic shops like *Dick Smith* or Jaycar have little solar panels available for $4 to $8. These are rated at 0.45 volts at 0.4 or 1 amps. However, while these are supplied in their own small cases, these cases aren't waterproof (You may wish to buy larger single sealed cells, such as the 3 amp units sold by *SolaCorp* and available through the ATA).

The idea is to get as many of these cells as you need, and connect them to get the voltage and current that you require. Lets say you need 2.2 volts at 2 amps or so. This could be rounded up to 3 amps (give your system some room to grow).

To find the number of cells required in series, simply divide the system voltage by the volts per cell. In our example of a 2.2 volt system, you would require 2.2/.45, or 4.88 cells. Rounded up, you would need five cells, plus one more to overcome the voltage lost across the protection diode. The cells are to be connected in series, (positive to negative) to get the required voltage at one amp (if using one amp cells). As you need three amps, you will need three strings of six cells, or eighteen little cells linked to make a bigger panel.

Now it's just a matter of putting all the panels into a waterproof box that has a sheet of clear plastic over it. This plastic allows the solar cells to get sunlight, but prevents them getting wet, which causes them to die after a few weeks. You then connect the panel to the battery with the diode on one of the wires to stop the power flowing back into the panels, which could flatten the battery and damage the solar panel.

Another system

If you need very bright lights, you can use a six volt solar-grade battery and multiple eight watt fluorescent lights.

These lights are rated at about 1.5 amps each, but they are very bright. The best and cheapest way to get these is to go to Kmart or somewhere similar and buy a two-in-one torch. This is a normal torch with a fluorescent on one side.

Once you have your torch(es), set the switch on the torch to the fluorescent setting. You can then hook up the wires from the solar panels (or the system battery if you are using one) to the battery terminals inside the torch case. An easy way to do this is to cut some of the plastic case away just near these terminals so you can hook your power wires up to the torch firmly.

You can buy six volt solar panels that are already made up and waterproof from your solar equipment shop. Many of the twelve volt panels can be rewired to provide six volts by changing the jumpers in the junction box on the back of the panel.

What will it cost?

The cost of the fluoro is under ten dollars, with the solar panel cost dependent on the number of lights to be powered. You can shop around and buy the odd piece here and there and over time make the system bigger and better. Start off by lighting the darkest areas of the house and build it up from there.

Garden or security lighting system

You've got to make everything as waterproof as possible, then work out how many solar panels you will need. Multiply the number of amps your lights need by the number of hours that they are going to be left on. Divide this by six (for the time the solar panels will be working), add 10 to 20 per cent for charging losses, and you get the amp rating for the solar panel necessary to supply the battery. Just buy the nearest panel(s) you can afford and you're in business.

As an example, if your lights require 3.4 amps, and you want to run them for ten hours per night, then you will use a total of 34 amphours. Divide this by six and you get 5.67 amps. A 55 watt panel would suffice here for a six volt system.

Finally

If you have followed me up to this point you will have the solar panel wired up to the battery (if used) and the globes mounted in their holders. Now it's just a matter of hooking the battery to the globe holders by running wires to the globes. You must make sure that the wires are thick enough so that there is minimal power loss in the wires, otherwise your lights may not be very bright, and the wires may even get hot. You might also want to put a switch in the wires to turn the lights on and off0

Handy tips

- Make sure you connect the solar panel to the battery (if used) using the right polarity.
- It's a good idea for you to let the battery charge up from the solar cells for up to a week before you start to use the globes, just in case you have very cloudy conditions during the first few days of using your system.
- If some lights work and not others, try turning off the ones that are. If the other lights then come on, you are just a bit low on power. This will improve with more sun, so don't worry. If the others don't come on when you do this then there may be a problem with the wire connections or the globes may be blown. Check the simple things first.
- It's also a good idea to put a light sensor on the system if you're using it as a garden light set. This turns the lights off when the sun rises in the morning, saving you getting up early to switch them off.

QUESTIONS & ANSWERS

A few solar questions

At the moment I am buying a house which already has solar installations on the roof for domestic hot water. Fine. But what I dream about is a hot water central heating system with radiators in every room, hot water and pumping all supplied by solar power. Do I have to cover the roof with solar panels to do it? Or is it just not feasible?

I'd also like a solar-powered lighting system in the garden. I know individual free-standing lights are available but I gather they vary greatly in quality. Can you recommend some good ones?

Finally, a pumping system for some miniature fountains and water-play in the garden?

Jane Donnelly, Lyons ACT

Heating

Allowing warm air from a glasshouse attached to the house, by opening a door or window, can be a very effective way of heating part of a house at reasonable cost.

The method you suggest would be expensive and not very effective for the following reasons.

Firstly, radiators generally require a water temperature of 70° to 80°C. A solar hot water system is unlikely to reach this temperature, especially in winter. Lower water temperatures require larger panels, and in winter, they would need to be huge.

Secondly, at best you can collect only one kilowatt-hour per square metre of solar collector each hour. In winter in Canberra you would be doing well to get four kilowatt-hours per square metre per day. You would probably get much less, so your suggestion of covering the northern half of your roof with panels would still not provide you with enough heat unless your house was exceptionally well insulated.

Thirdly, if you have enough area of panels, you would need to store the heat. Coils of polypipe (a special grade is required) in a concrete floor would be a possibility.

Finally, the days that you would need the heat most would be when the sun isn't shining, so on cold, overcast days the sun would contribute nothing to your solar heating system.

Garden lights

I would suggest running low-voltage underground wires to the lights you want in the garden. The power would be provided by a battery which would be charged by a large solar module or modules. A reputable solar dealer would be happy to design and supply you with a system. You could run the lights from mains power via a transformer if the battery gets flat.

The other option is garden lights with a built-in solar module, but most have modules that are very small. Some of the lights on the market are very flimsy and soon fall apart. Lights that have too small a module will either have a weak light output or run for a very short time each night. Also, being close to the ground, shading may reduce the power the module can generate.

Fountain pumps

Like the garden lights, I would run the power underground to the pump for your fountain. Your pump could also be a low-voltage one and powered by the same battery and solar module arrangement.

This could be costly, so again go to an experienced person you feel you can trust. Find out how long you can expect the pump and the lights to run on a sunny day, how long the battery should last and what you can expect if there are several overcast days in a row.

Decide what you want fast and then ask what it will cost.

Andrew Blair

I was wrong!

As a person not experienced in publishing I made several elementory mistakes in my first venture into answering a question. Firstly, I hand-wrote my answer (I have terrible writing), then I did not proofread it personally. I made a terrible gaff in the second part of the answer which was the only part that made it into print.

I read it in the published magazine and cringed. I cringed even more when Andrew Blair wrote me a detailed letter outlining what I had left out and got wrong. I also had a phone call from the charming and puzzled Michael Siddons from *Quantum Energy Systems,* who could not understand how I did get it so wrong. (Frankly neither could I).

So Mea Culpa, Mea Maxima Culpa.

There are two issues involved in the design of the Solar assisted heat pump, radiation and conduction/convection. If only radiation was involved then there would be nothing wrong with your school boy logic. But that is not the case and anyway the increases in COP would be small for the cost (diminishing returns).

In fact glazing the panel of a solar assisted heat pump would be a disaster from the thermal point of view as it would reduce the heat gain from conduction/convention. When the sun is not shining, glazing or insulation would actually decrease performance.

Glazing a panel when the sun shines and covering it so that there is no radiation to the sky on a frosty night would improve efficiency but at great inconvenience and cost.

Lyndsay Last

BP SOLAR, manufacturer of solar cells, modules and systems for nine years in Australia, have added their skills and experience to ours to help answer your questions about solar power systems.

Andrew Blair and Lance Turner are here to answer your general technical questions.

We do our best to answer all questions sent in, but space is limited, so try to keep your questions short.

Please keep in mind that every situation is different, so the answers given here may not necessarily be perfect for you. If you are in any doubt, we advise that you seek the services of a qualified person who can come to you.

Send your questions to:

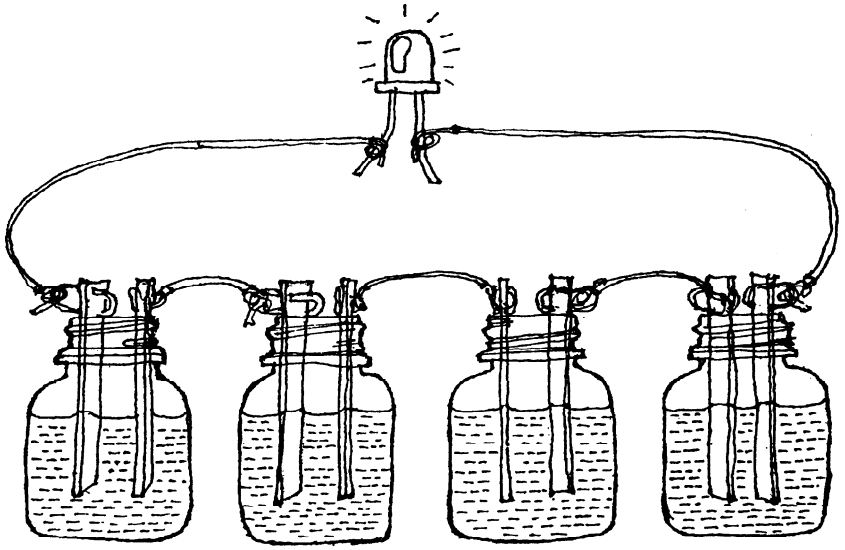
Soft Technology

247 Flinders Lane, Melbourne VIC 3000

NOEL'S TREASURES FROM TRASH

Low Cost Home Science Project #13

Electrical cells, or batteries as they are more commonly known (see Back to Basics article in this issue), are used to produce electricity by chemical means. Primary cells are those whose parts are eaten away during the process and can't usually be recharged, eg torch batteries. Secondary cells can be recharged, as the chemical reaction is more easily and completely reversible.



You can see here how all of the pieces go together to form the battery

Before we start

To fully benefit from this experiment you should really have a small multimeter, which is very useful for measuring volts, amps and ohms. These can readily be obtained from *Tandy Electronics, Dick Smiths* or *Jaycar* for under $20 and, if you look after it, it will last many years (I still have my first one after 35 years).

In this experiment we will use various different types of metals and liquids to produce primary batteries that can be used to do work. In our case, they will light a *Light Emitting Diode,* or LED.

Primary batteries produce a voltage when two different metals are placed in an acid or alkaline solution. For our experiment, this solution will be a fluid such as those listed in the box below.

Finding the best materials

Set the voltmeter to a scale of three to ten volts, connect a piece of copper to the red (positive +) lead and the zinc to the black (negative -) lead.

Then place the copper and zinc into a bottle filled with vinegar, but don't let them touch. Now, measure the voltage generated by the cell with your multimeter and enter the voltage recorded in your table (next page). You can then repeat this process for each of the different types of metals that you have collected.

Now, make another table that lists all of the electrolytes. Try just one pair of metals, say copper and zinc, and try each electrolyte (for the lemon, push the metal pieces into it). This will allow you to find the most useful electrolyte.

You will need:

- *Flat pieces of metal, about 1cm x 5cm, ie.*
- *copper (flattened copper pipe)*
- *aluminium (aluminium cans)*
- *stainless steel*
- *lead (flattened car tyre weights)*
- *zinc sheet or well galvanised nails*
- *carbon (from torch battery (not alkaline) or burnt stick)*
- *any other metals you can find.*
- *Five crocodile-clip leads or ten paper clips joined with copper wire*
- *small plastic or glass bottles (vitamin bottles)*
- *blotting paper*
- *some pieces of plastic mesh (orange bags)*
- *1 LED - these cost about 30 cents.*
- *vinegar (acetic acid)*
- *a lemon (citric acid)*
- *baking soda (bicarbonate of soda)*
- *salt (sodium chloride)*
- *detergent*
- *water*

Tools needed:

- *Hammer*
- *Hacksaw*

Making the battery.

Now you can assemble a battery, which is a group of cells. In our battery, the cells will be connected in series, to increase the available voltage.

Start by filling five bottles with the best working electrolyte. Wrap five pieces of copper in plastic mesh so they won't be able to touch the other electrode when placed in the bottle.

Connect one piece of copper to the anode (positive) longer leg of the LED using a crocodile clip lead or paper clips and wire, and place this piece of copper in the first of the five bottles.

Connect the other four pieces of copper to four pieces of zinc and place them in the bottles so that you have one piece of copper and zinc in each bottle (except for the last one). Now connect the last (fifth) piece of zinc to the cathode (negative) shorter leg of the LED and place it in the last bottle

After you have made the final connection to the LED, it should light. If it does not, try connecting the LED the opposite way round. Usually the LED will get dimmer as bubbles of hydrogen form on the electrode, as these block the flow of current in the cell.

If you want to, you can use a flashing LED in place of the normal one, but this will require about twice the voltage and costs about two dollars.

We will now make a Voltaic Pile, named after the Italian, Voltaire, who first made it in the year 1800. It is best made with discs of copper and zinc with blotting paper soaked in vinegar. These are just stacked together, in the order of copper, blotting paper, zinc, copper etc.

Using this method you can make a battery that produces as much voltage as you like, but make sure that you don't go over *20* volts for safety.

In a following issue we will look at constructing some rechargeable batteries ☼

Voltages for various metals in an electrolytic cell

	Copper	Zinc	Aluminium	Iron	Lead	Stainless Steel	Carbon
Copper	0						
Zinc		0					
Aluminium			0				
Iron				0			
Lead					0		
Stainless Steel						0	
Carbon							0

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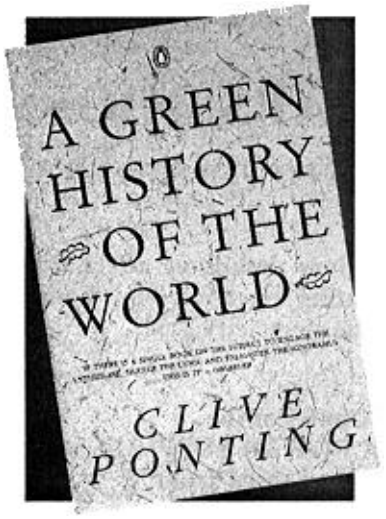


A Green History of the World

Clive Ponting
Penguin, 1992, $16.95

This book makes it clear that history is not about kings and queens or other powerful individuals. It presents a bigger picture of culture, illness, warfare, colonisation, philosophy, climate changes, population growth...and how people treat other people.

The only 'revolutions' you will read about here are what Ponting calls the two 'great transitions'. The first great transition was the development of agriculture which provided much larger quantities of food than ever before, stimulating population growth and allowing complex societies to develop. The second great transition was the change from wood (and to a lesser extent wind and water power) to non-renewable fossil fuels as the primary fuel source.

Societies dissolving under the weight of self-created environmental problems are a recurring theme throughout the book. The first example is that of Easter Island; a society which, at its peak in about 1500AD, was one of the world's most advanced for the technology then available. Centuries of deforestation meant that eventually the island's limited resource base was completely depleted and the culture, which had been built. up over a thousand years, collapsed within a century with the degradation of the environment. The society was in such poor shape that explorers who arrived there in later years could not believe that the ancestors of these 'primitive' people had had anything to do with the wonderful stone statues found on the island. (Hence the fantastic 'visitors from outer space' theories you may have heard.) Although the deterioration of the environment must have been obvious even in one lifetime, the people were apparently unaware that their society was facing destruction.

Every day over the fairly long period that I read this book, I would find something to amaze, shock or horrify me. It is such a fascinating book that I was tempted to simply reproduce a selection of quotes instead of a review. In fact, I have to admit that I (who consider marking a book absolute sacrilege) marked paragraphs and whole pages throughout. Ponting's research is exhaustive. He provides examples from all over the world, and throughout history, to clearly demonstrate his points.

So, are we doomed to extinction? I still don't know. Ponting himself says that it's too early to tell whether our lifestyle is sustainable. As I read, I found myself constantly wavering between admiration for human beings' resourcefulness and resilience, and horror at our selfishness and profligacy.

I think a comment Ponting makes on the final page puts it all into perspective. 'If this book were to give a chronologically accurately weighted account of human history then of its 407 pages, 405 would have to be devoted to hunting and gathering communities, 2 pages to agricultural societies and just a couple of lines to modern industrialised societies.' Considering the huge amount of damage we have done in that short time, I think we should be heeding the lessons of the past.

Read this book. It is guaranteed to make you think, and you'll find some great ammunition here to back up your arguments. But, be warned, some of your own ideas may well be blown out of the water along the way.

- Claire Beaumont

Earthworms in Australia

David Murphy
Hyland House, 1993, $14.95

Endorsed by many experts in the field, this compact yet comprehensive publication has become a bible to gardeners, fanners, conservationists and worm farmers (and probably a good many waste disposal managers as well).

Written by a former tanner who first turned to worms as a means of waste disposal in his business, the book is for laypeople by a layperson with a style that is very down to earth and readable. It draws on the author's own practical knowledge and experience, as well as sourcing scientific research and advice.

The text is laid out under chapter headings with the topics ranging from earthworm basics and benefits to setting up a vermiculture business. Subheadings break down the information into bite-size pieces and the text is punctuated throughout with photographs, tables and illustrations.

The author certainly manages to convey his admiration for the earthworm and its silent work; illustrating to the reader the enormous benefits they bring to the community and the environment, as well as underlining business potentials.

The positive message is that there is plenty of opportunity to reap the benefits of worms - so get to it!

- Miranda Brash

God's Earth: Religion as if matter really mattered

Paul Collins
Dove, 1995, $19.95

God's Earth is an impressive discussion about the historical causes of the current environmental crisis. In a systematic and structured way Paul Collins identifies and describes various aspects of humanity's relationship with the natural world. Issues such as the myth of progress; the belief that the world offers limitless resources; Cartesian dualism (the separation of the mind and body); and the historical roles of religion and philosophy are all examined in depth.

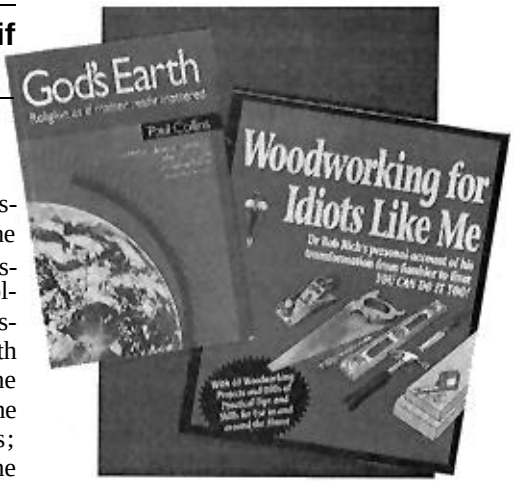
Although it covers many aspects of this most complex issue, the principal emphasis of Collins' work is expounded within a religious context. He examines the role of traditional Christianity, both its virtues and its failings, and focusses on the philosophical developments that have permeated it as well as those that preceded and influenced it. Collins comprehensively explores and compares the ideas and writings of those philosophers who, throughout the ages, have contributed to the current state of humanity's conception of ecology.

The central theme of his his book is the acknowledgement that mainstream Christianity, especially fundamental Christianity, has denied the importance of the body as a material entity by focussing on the soul, resulting in an uncaring and exploitative attitude to all things of this earth.

No easy answers or simple solutions are offered following the indentification of the causes of the environmental crisis. Issues relatingto population and contraception; laws of nature; and notions ofjustice, are discussed as examples where Christianity has allowed the destruction of the natural environment to be rationalised. The final conclusions advocate that wholesale changes in attitiudes are desperately needed, especially a new and justifiable respect for nature.

Collins' writing style can be quite dense. However, ultimately it is worth persevering since the content is most rewarding in terms of clarifying both the underlying causes that have led to anthropocentric attitudes becoming the greatest threat to the environment, and the opportunities that religions could take to play a key role in redressing the continuing decline in the quality of our natural environment.

- Kris Lakusa



Woodworking for Idiots Like Me

Bob Rich,
Aird Books, 1994, $19.95

As well as being an admirable reference for idiots and seasoned chippies alike, this book contains entertaining anecdotes about Bob Rich's life and friends. It is through these stories that Bob educates the idiots of the world about the intricacies of woodworking and a host of other technical information. Some stories are fictional and some are fact, but all make the learning experience very enjoyable indeed.

Bob covers many aspects of woodworking in the more technical section of the book from skewnailing to sharpening chainsaws. The proper use of handtools is explained clearly with the aid of good diagrams. There is good cross-referencing between the technical information and the more colourful part of the book. The illustrations are simple and get the message across very well, but sometimes lack geometric integrity.

I was delighted to see sections on how to fell a tree, how to use a hammer, and how to make a billy cart. No matter what your level of expertise is, you will find this book both enlightening and entertaining. Bob Rich has created a reference which instills confidence in the reader and makes you want to get down to work immediately, or sit up late and chuckle at his humour.

- Thomas Herbst

Remote Area Power Supplies -An Introduction

SEIAA
1995, $15.00

Anyone who has intended to install a RAPS system on their own will know that there is a very limited amount of readily available information on the subject. As a result, they either end up getting their local installer to do it (the best option if one is in the local area and you can afford it), or if they live in a remote area not serviced by an installer, install a system themselves that may be undersized or possibly even dangerous.

For a long time there has been a need for a publication that would allow people who are thinking about setting up a RAPS system by themselves to gain enough technical knowledge to do the job safely and effectively.

Remote Area Power Supplies - An Introduction is a new publication from the *Solar Energy Industries Association of Australia.* In what amounts to a stripped-down version of their *Renewable Energy Certificate* course, this 100 page book gives enough detail for the average person to gain a good grasp of what RAPS systems are all about.

The book is divided into separate chapters that deal with the individual components of a RAPS system, as well as considerable information on the correct sizing and safe installation and maintenance of such systems.

All topics are well covered, with emphasis being placed on the safety issues involved with working on these types of power systems.

This book is a must-have if you are looking at installing, or wish to know more about, your own RAPS system.

-Lance Turner

WHAT'S ON

Science and Sustainability Conference

- 26 - 30 September, 1995

Flinders University - SA

The fifth annual National Students' Science and Sustainability Conference is an event designed to develop practical strategies for the ecologically sustainable reconstruction of our communities, economy, industry and education systems.

The conference brings together students from all over Australia to discuss not only their role, but those of science and the higher education system in moving toward an ecologically sustainable future.

For more information contact Mark Wilkins, C/- Flinders University, GPO Box 2100 Adelaide SA 5001 or ph:(08)202 2675 fax:(O8)201 3504 or Email: admaw@cc.flinders.edu.au

Towards sustainable furniture by design competition

- 6 October, 1995

Rozelle - NSW

The *Ecodesign Foundation,* with support from the Federal Goverment's Vi*sions of Australia Touring Program,* is running a competition open to student and professional designers.

The competition is divided into four different design areas. They are:

- sustainable plantation materials
- a single recycled material
- a combination of recycled and plantation materials
- a single new, synthetic, environmentally benign material

Winning entries will be displayed in

- national touring exhibition which will begin at the *EcoDesign Foundation's* Display and Research Centre at Rozelle.

The general aim of the competition is to give industrially manufactured, recycled furniture a higher profile in the industry as well as to encourage designers to incorporate environmentally friendly design methods and materials into their products.

Closing date for entries is 6 October, 1995.

For further information and entry forms, please contact Claudia Nemeth at the EcoDesign Foundation on ph: (02)555 9412 fax: (02)555 9564.

Australian and New Zealand Society for Ecological Economics Inaugural Conference

- 19 - 23 November, 1995

Coffs Harbour NSW

This conference has three aims, which are:

- to launch the Australian and New Zealand chapter of the International Society for Ecological Economics.
- to promote an ecological economics approach to environmental policy-making.
- to establish a network of individuals and organisations to service resource policy, issues.

Key speakers will be Dr David Suzuki and Professor Robert Costanza.

Registration fees for the conference vary, with discounts for early registration, students and concessions.

For more information, contact the Centre for Agricultural & Resource Economics, ph: (067) 73 3546 fax: (067) 73 3944.

A change of name

Due to ongoing growth and expansion, *Selectronic Components* will now be known as *Selectronic Australia Pty. Ltd.*

Company ownership, personnel, phone and fax numbers have not changed, and the trademark *Selectronic* will be maintained.

World Renewable Energy Congress

- 15 -21 June, 1996

Denver, Colorado - USA

The World Renewable Energy Network (WREN) is to hold its biannual conference in America next year.

WREN is a charity group that is a network of worldwide organisations promoting environmentally safe and economically sustainable renewable energy.

For more information, write to: 147 Hilmanton, Lower Earley, Reading RG6 4HN, UK or ph:(01734)611 364 fax:(01734)611 365 (omit the 0 if dialing from outside UK).

Owner-built homes tour

- 9.45am, 15 October, 1995

Clifton Creek - VIC

The Clifton Creek Primary School Fundraising Committee will be holding its annual fundraising tour of owner-built homes in the Bairnsdale area. The homes will be open for inspection from 10am until 5pm.

For added interest, there will be a display of local crafts at the school, where refreshments, BBQ lunches and cakes will also be available for the entire day.

All money raised from the day will go directly to benefit the children attending this small rural primary school.

For further information, contact Robyn Hermans on ph: (051)57 9388.

RAPS Training Courses

The SEIAA can now offer their RAPS training courses to suit your budget and needs. You may take either the design theory course, the practical course, or the combined theory and practical course.

For more information, contact the SEIAA on ph:(03)98668977 fax:(03)98668922.

FESTIVAL FOR MIND · BODY · SPIRIT MELBOURNE

Mind Body and Spirit Festival

• 21 - 24 March, 1996
Exhibition Centre - Melbourne, VIC

This popular exhibition has undergone a change of venue for 1996. It is to be held at the new Melbourne Exhibition Centre at Southbank.

The festival will feature more than 200 exhibitors, demonstrations of products and services, and a lecture/workshop program.

For more information, contact Australian Trade Exhibitions on ph:(03)9819 0211 fax:(03)9818 8553.

Eco-housing Co-operative: introductory nights

• 2 - 3 October, 1995
Sydney - NSW

The recently formed *Inner Pod Ecohousing Co-operative* has been set up to create a place-specific, small-scale permaculture co-housing development for inner suburban Sydney.

The development will aim at providing a sustainable, community-oriented option for city living. It is being deliberately designed to reduce impact on the environment, to provide its residents with affordable housing and to improve their quality of life.

Commercial facilities will be incorporated so as to create opportunities for self-employment and educational and demonstrative activities.

The guiding ethos for the development is based on permaculture principles: earthcare, people care, limits to growth and the distribution of surplus.

If you are interested in joining the group, or just require some more information on this development, go along to one of the information nights.

For more information contact Cate (w) ph:(02)857 1388, (h) (02)665 3365 or Nigel ph: (02)850 9672 (w), (02)858 1275 (h).

Wind energy workshop

• Monday 18 September, 1995
Centre for Electrical Power Engineering - Monash University, VIC

This workshop will be held to provide a forum for:

- ☼ participants to become familiar with the people involved in the wind energy field in Australia and New Zealand
- ☼ participants to become aware of the range of specific problems related to this area
- ☼ some possible solutions to be considered to help resolve the problems of the wind energy industry and wind energy usage

The workshop will be arranged around a series of talks and discussions which will provide an opportunity to discuss and develop ideas relating to issues concerning the industry.

All participants will have the opportunity to discuss their ideas.

Speakers will include representatives from the wind turbine manufacturers, related industries and other specialists. The workshop will predominantly relate to wind turbines under 30kW, although issues relating to larger turbines will not be precluded.

Cost $110 per person for booking until 28/09/95. After this, a late fee will apply. This cost includes meals, as well as copies of the workshop proceedings.

For more information contact Peter Freere on ph: (03)9905 5219, fax: (03)9905 3454 or Email: peter.freere@eng.monash.edu.au

Annual Postgraduate Awards

• Commencing early 1996
Energy Research and Development Corporation

The Energy Research and Development Corporation invites people eligible as a candidate for a PhD or Masters (research) at an Australian university to apply for its annual Postgraduate Awards.

These awards enable high-calibre students to undertake research in areas relevant to ERDC's charter - to facilitate and stimulate investment in effective energy innovation to benefit Australia.

At least five awards will be offered in 1996, covering a period of up to three years, commencing early in the year. Applicants are free to choose their own research project, but it must be related to energy and ERDC's investment objectives.

Applications close Friday 20 October, 1995. For Postgraduate Award kits contact Leah Richardson, ERDC, GPO Box 629, Canberra, ACT2601 or ph: (06)274 4807, fax: (06)274 4801.

Energy, Environment And Economics Symposium

• 20 - 24 November, 1995
University of Melbourne -VIC

This international symposium will provide a forum for the exchange of information and ideas concerning the efficient and economic production, utilisation and conversion of energy, as well as the environmental effects of such processes.

Keynote addresses in the following areas will be delivered:

- ☼ financing environmentally friendly energy alternatives
- ☼ implementing energy technologies in rapidly developing countries
- ☼ environmental protection through government regulation and market incentives
- ☼ regional opportunities for participating in greenhouse gas mitigation
- ☼ fuels and transport for the future

The symposium will be jointly chaired by Professor Nejat Veziroglu of the University of Miami, **USA** and Professor Bill Charters, Dean of Engineering at the University of Melbourne.

Over 120 papers, covering most of the issues, will be presented. Delegates will be offered the opportunity to participate in a wide range of technical tours, as well as attend social functions where they can mix with fellow delegates.

Registration costs $550 dollars, or $150 for full-time students.

For more information ph: (03)9344 6748 fax:(03)9347 8784, or write to EEE Symposium Secretariat, Dept of Mechanical and Manufacturing Engineering, The University of Melbourne, Parkville VIC 3052.

LETTERS

Another faulty compact fluoro?

Last week I purchased a *Mirabella* globe after reading your product review on page 11 of ST#51.

Far from outlasting eight normal globes (as advertised on the packet), it only lasted five days. I did not mistreat it in any way.

I think you should do better testing on products before endorsing them in your magazine.

Maria Grist, Sth Hobart TAS

The products column you refer to is in fact not a products review column, but merely a listing of new products on the market. We generally only do one product review per edition, that being on the last page of the products section.

We chose to include the *Mirabella* lamps because we had been trialing a number of them over the few months prior to that edition of the magazine. I have five of these bulbs myself, and have only had one failure, which was caused by running the lamp in a fully sealed enclosure.

This is one of the big no-nos of compact fluoros and can lead to premature failure due to heating of the electronic ballast. The Mirabella bulb that failed had simply developed a 'dry joint' on one of the solder joints and was easily fixed with a quick dab of the soldering iron.

Another problem can result from running them on square-wave or modified square-wave inverters, as the standard diodes in the inverter ballast cannot cope with the harmonics generated by such inverters. If you have been running your compact fluoro on this type of inverter, then there is a good chance that one of the rectifier diodes has gone pop. These are easily replaced (if you know what you're doing) with 400 volt, 1 amp fast diodes, available from places such as *Dick Smith Electronics.*

If you have not done either of the above things to your fluoro, but have been unlucky to have one fail anyway, I suggest you contact the manufacturer, who should replace the unit.

Unfortunately, very few manufacturers have tested their compact fluoros on anything other than sine-wave power, or if they have they haven't released the data. This makes it difficult to tell whether a new bulb is suitable to run on a square-wave inverter, and is not helping the cause of energy-saving lamps.

I'm sorry to hear of the problem you have had with the Mirabella lamp. It would be great if we could test every new item we list in the products column, but it's just not possible.

Lance Turner

A few more questions

I have run *two* of the *Philips* PL9/C lamps to failure - both were run continuously (one following the other) in the same socket in the house, and both gave almost exactly the predicted 8000 hours of life, so I have no axe to grind with the manufacturer on the predicted life of their product.

Whilst I acknowledge that there may be a basic difference in the inverters that are used to power filament-type CF tubes -as used in the single piece lamps - as distinct from the obvious non-filament CF tubes which are used with the replaceable-tube two piece lamps, I think the question of actual tube lifetime of the two basic types needs to be addressed and answered by a manufacturer who, one would think, has gone into this matter before committing the company to a long-term involvement with a product.

Regarding my experiences with the reclaimed 9 watt inverters, they seem to run one of the standard 8 watt straight fluorescent tubes at a rather high temperature, suggesting that the next size of 13 watts may be a better marriage - I have bought two 13 watt tubes and am about to try them. I selected the 8 watt tube for initial trials after measuring the effective length of the ionised column of gas in a 9 watt CFL tube, and it came out surprisingly close to what the 8 watt linear unit is. The cross-sectional area of the tubes is remarkably similar, so the comparison of tubes in this application would appear to be reasonably valid.

Donald Seedsman,
East Burwood VIC

And a solution

I read your CFL repair article with interest. I've had a couple of 11 watt 2D units croak. When the first one died I felt the manufacturer should be told so that a solution could be found for what might be a quality control problem. So I rang them and was very pleased with the response.

Electronic Ballasts in Bayswater supplies them (has them made) and I spoke to Geoff Foster on 9762 6322. I posted the ballasts back and was promptly sent new ones in the mail.

The most recent one was posted to Freepost AAA-Smart, PO box 999, Bayswater 3153 at Electronic Ballasts' request. I didn't quiz them at length on the matter but was offered the info that early batches had problems and that they have changed their manufacturer.

Got any good oil on repair of *Dulux* lamps? I've got a couple with dead electronics and good tubes. Do they have fusible resistors as well?

Ian Boehm

Ian actually wrote to us in March, but his letter got lost in the internet download until recently. For those of you who have not seen the original article Ian is referring to, it was in Soft Tech #51.

Ed

More renewables for WA

Jock Bennet's letter about what is wrong in WA seems to me to reflect in some ways the rather shaky history of the application of renewable energy in this state. He refers to the solar thermal power plant that was constructed many years ago at Meekatharra. As he says, it was dismantled, but why?

As far as I can ascertain, the plant was reliant upon technology which was not up to the rigours of the WA outback in terms of distance and communications.

When any new technology is installed, even if it is 'old hat' to the people who developed it, (in this case Germans), it is very much up to the man on the ground in the bush to make things work. The operator in Meekatharra must know how to deal with things on-site. Perhaps the then

State Energy Commission was sold an effectively unproven system, and it should also be remembered that this was in the days of the *Solar Energy Research Institute,* which may well have been less sophisticated in its approach to renewables than we are nowadays.

I am no supporter for the need for coal-fired power stations, nor am I an apologist for our various State Governments, but I think it is quite reasonable for decision-making engineers to be very cautious after making expensive mistakes like Meekatharra, and this must surely affect their advice to politicians.

We are doing better. The first small-scale wind farm at Esperance continues to operate without problems, and we have a much larger wind farm now on stream. For the first time we have a small photovoltaic plant at Kalbarri which is connected to the grid. The Kalbarri plant is expected to demonstrate that there are benefits to be gained from PV plants, such as the stabilisation of voltages at the extremes of long transmission lines and the supply of additional power to match summer afternoon peak loads. Other projects that are smaller, but none-the-less significant, include the desalination of water at Shark Bay (a wind turbine project that has proven to be far more efficient than predicted), wind turbines servicing a sewage treatment plan south of Fremantle, and the hydro scheme at the Ord River Dam.

Of course, it is true that there are windy sites in WA, but there's more to it than casual observation. We are undergoing a paradigm shift in power generation, and it is not easy for utilities with large numbers of staff weaned on large machine culture and the culture of power supply at any cost to everywhere to make the transition to small machines, and this is not helped by expensive mistakes.

I have no doubt that renewables will play an ever-increasing role in the supply of electricity in WA, but I am also convinced that it will be very much a role of integration. There is no technical reason why we cannot contemplate whole suburbs of grid-connected houses with PV panels on their roofs (owned by the householders) selling electricity to the grid when they have surplus.

Peter Fries has shown this at Coolum in Queensland. However, we will be better served if we take into consideration the fact that this is a new approach, and new technology, as I said before, requires a new engineering and technical approach.

In short, we have to learn how to do it and manage it. To get there we do need more money, and to persuade governments to part with it requires a lobbying force that concentrates on the economic benefits of a renewable energy industry as well as the environmental ones.

Bill Parker, Editor - Solar Progress

Give the 'roos a go

The article in Soft Technology #52 about the Nautilus shell-shaped bluestone house was fascinating and we read it with pleasure until we reached the sentence: 'Al and Kathy can have an uninterrupted view of the local kangaroo herd bounding towards the sunset, with their dogs, Chausette and Cocoa, in hot pursuit.'

We were apalled! To the newcomer to the bush, it is lovely to see their dogs having such freedom, but to the kangaroos this is an experience of terror. A mother 'roo, subjected to this nightmare by a neighbours cocker spaniel, abandoned her joey - apparently deciding that while her joey would not survive if the pursuer killed her, she would, if she survived herself, go on to produce further offspring.

As this is a drought year, the 'roos have been forced to become more and more daring in coming out of the bush to feed even in the broad daylight. We are delighted to see them too, and treat them as honoured guests, going to great lengths not to disturb them. Our dog is trained not to bark or go anywhere in their direction. A watchful eye is kept on her during the day and she is shut in a run (with a lovely double-insulated cosy kennel) at night.

Please tell Al and Kathy they will not enjoy such a sight for very long, I'm afraid, as the 'roos will simply give their place a wide berth. It is a great privilege to live on the edge of the forest and we see wombats, echidnas, koalas, so many lovely birds, but we have to go to great lengths not to disturb them all - driving very slowly at night etc, or we will lose our privilege.

Margaret Boyd, Bellengarook VIC

Polution and politics

I am not sure whether sarcasm does any good but I have a few comments if you're interested. Our Prime Minister says the bucks stops with him, well it doesn't, it stops with pollution. He also says he gives the top directors of industry problems instead of them hassling him, but he doesn't because he was so soft in his efforts to implement a carbon tax.

I feel the real solution to our environment is when politicians answer the question as to whether it is God or Man [sic] who is responsible for our future and the destruction of the planet. Our industrial leaders are like little boys who poo their pants and tell their mum they didn't do it.

Why are our leaders always on the back foot and wimping when it comes to the clean-up? Where is the power of positive thinking now? All we see is ethnic cleansing but no actual cleansing. Talk about the opposition not hav-

In response to a letter we printed in ST#52 from John Icely in PNG, Brian Bartlett from Queensland suggested that American company *Real Goods* stocks a *James* washer that may be just what John is looking for.
We dug out our copy of this truly amazing catalogue. On page 354 we found the washer mentioned by Brian. It is made of welded stainless steel, is hand operated, and also has an option wringer attachment. The cost of the machine is US$195 (cat# 63-411), and the wringer is an extra US$119 (cat# 63-412). Apparently, Real Goods are happy to send items to anywhere in the world. Their contact details are ph: +1 (707)468 9292, fax:+1 (707)468 0301.
Another possibility is the *Wonder Wash*, as featured in the product review in issue #51. This is a simple and very efficient machine, and costs A$99 from *The Cleanhouse Effect* ph:(02)698 2033.

ing any policies. As for the *Berlin conference on Global Heating*, why did the Prime Minister send a boy to do a man's job? [sic] Because that is what it amounted to as far as Australia's contribution was concerned, how humiliating.

It seems we are hit-and-run victims, The environment and those who love it are being insulted with either cheap thrills or long-term thoughtless wisdom. I am glad your magazine is changing this.

I am sorry, but some things have to be said.

C P Skeates, Garran ACT

Solar bikes in New Zealand

When will prices drop on PV panels? We have just had two *Solarex 50s* stolen!

Is there interest in the Solar Bike Race either in Australia or Japan? We are very interested and plan to develop a trike. Can you supply any articles on small motors, regulators and the latest on batteries?

Here in New Zealand, Stewart Lister (Solar Car Race) is also interested in the solar bikes. Can pedal power in a HPV be used also for some generation for the battery? Lastly, are there any good videos on solar that work in New Zealand video machines?

Robert Stowell, Kerikeri NZ

The importance of experience

Upon reading the *Solar Energy Industries Association of Australia* advert on page 80 of Soft Tech #52, I felt obliged to put pen to paper. The advert states, and I quote, 'Ensure your system is safe. Have it supplied and installed by a member of the SEIAA. Call or write for a member list.'

This would seem to me to imply a guarantee that if anyone were to use such a member to supply and install a system it would be absolutely safe, and using any other person to perform the task who is not a member of that organisation would indeed be a risky venture.

Well let me warn you, the prospective purchasers, many is the time I have witnessed extremely shoddy and sometimes potentially lethal works performed by all types of qualified tradespersons: electricians, plumbers, carpenters, bricklayers to name only a few.

As an electrical mechanic with over 33 years experience I have learned to take academic qualifications with a pinch of salt, for even they are no guarantee that a job will be well planned and executed. The qualification certificate that the aformentioned organisation proclaims will save people this headache (or heartache) indeed worries me as it takes a lot of experience to learn this trade backwards.

I have installed literally hundreds of remote area power systems over the last ten years and I am still learning (and any person who states they are not, are proverbial know it all smart alec's). I defy any person, with or without an electrical background, to 'pick up' all the knowledge required to become a sound tradesperson in the space of even twelve months training. It is not possible.

The best advice I can give to the public out there wishing to ensure the purchase and/or installation of a good system is to check out your local bloke, find out from him (or her) names of some of their local clients and ask around to get a feeling of their work quality and their after-sales service. Then, when satisfied with their credentials, get a written quotation from them before handing over your deposit.

I have sold a few inverter's to 'do it yourselfers' who insist that they have their own electrician hook it up, and it has come back to me fried very shortly after. Boy, they sure as hell are disappointed that such abuse is not covered by warranty.

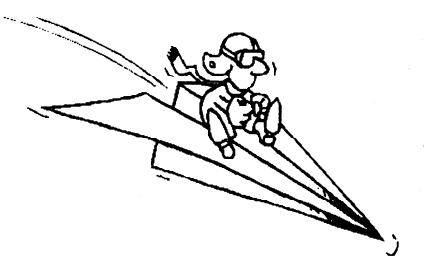
If a customer comes to me and buys equipment to self install, I have always been prepared to help with good advice, but a number go away and do not follow that advice either thoroughly enough, or in some cases, whatsoever, with the result that rather unsafe systems are sitting there just waiting to bum. One such customer's house did indeed bum to the ground. Only then did he have me install the whole system to the new house.

I would not like to see those willing to help themselves denied access to the financial advantage of **REAP** currently available, but I have too often seen homes built by owners who have no idea of electricial practices (or plumbing, roofing, insulation and other practices) only to finally realise the nightmare they have created and sell out to some poor unsuspecting low-income family and let them deal with it. I could write a book on all my experiences of do-it-yourselfer's; one day I just may.

Really, I think that all homes should be inspected by a qualified inspector prior to issuing of a occupancy certificate, regardless of whether they are grid connected or not. A secondhand car has to undergo a roadworthy inspection and have a certificate issued prior to being sold. Something along these lines should be able to be implemented for houses.

This may save at least some of the 50 or so Australians killed each year by electrocution.

Noel F. Bates,
Gippsland Energy Alternative
Bairnsdale **VIC**



Letters are edited for length and clarity – please try to keep your contribution brief.
In order for us to publish your letter, we require that you supply your name and address.
You can, of course, request that your details not be printed with your letter if you wish.

While it is not possible for us to publish every letter that we receive, we try to select letters covering a broad range of topics.

The views and opinions expressed in these letters in no way represent those of the Editors of Soft Technology or the Alternative Technology Association, and we accept no responsibility for the accuracy of statements made by any contributors.

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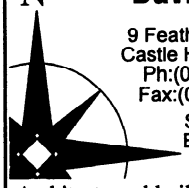

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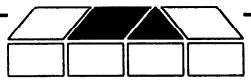

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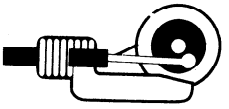

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Magazines, journals and newsletters

EcoReDesign

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More information:
Centre for Responsible Design
PO Box 73
Rozelle NSW 2039 Australia

Sustainable Energy News

A quarterly newsletter that reports on the promotion and use of sustainable technology in the different regions of the world. It pays particular attention to the social and political developments that are associated with this technology.
More Information:
International Network for Sustainable Energy
PO Box 2059
DK - 1013
Copenhagen K, Denmark
E-mail: ove@pns.apt.org

Australian Energy Management News

A quarterly magazine that promotes energy management in industry, commerce and government with concise articles on initiatives, as well as case studies.
More information:
Energy Programs and Fisheries Division
Dept of Primary Industries and Energy
GPO Box 858
Canberra ACT 2601 Australia

Rocky Mountain Institute Newsletter

The Rocky Mountain Institute (RMI) is a non-profit organisation which focuses on seven areas: agriculture, economic renewal, energy, green development, security, transportation, and water. Its newletter contains articles on RMI projects and publications and other developments in RMI's areas of interest. The RMI newsletter is published three times a year.
More Information
Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass
CO 87654-9799 USA
E-mail orders@rmi.org

Solar Cookers International Newsletter and Solar Box Journal

For all those into solar cuisine, this newsletter reports on this increasingly popular way of cooking. In doing so it examines the different contexts in which solar cooking is practised throughout the world.
More Information:
Solar Cookers International
1724 11th Street, Sacramento
CA 95874 USA
E-mail: sbci@igc.apt.org

Electric Vehicle News

A monthly newsletter which keeps it readers abreast of innovations in the world of electric vehicles.
More information:
Australian Electric Vehicle Association
GPO Box 4622SS
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Organisations and centres

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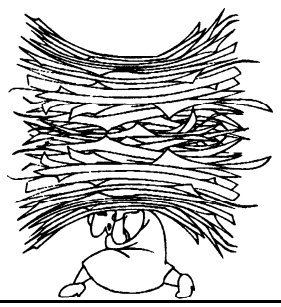

BEHIND THE SCENES

Wind power in Victoria

The Alternative Technology Association invites everyone to our windgenerator open days which are held on the third Sunday of each month. Each open day begins at around lpm.

You can climb 22 metres up the internal ladders to inspect the machine in operation if you dare! (No, we don't have bungee jumping as an optional activity!)

See *Melways* key map E between Bar-won Heads and Torquay, about 18km south of Geelong.

For more information contact Michael Gunter on ***ph: (03)9376 7515.***

Energymobile Tasmanian Tour '95

The Energymobile.spent most of May in Tasmania and had a very successful tour.

The tour was partly sponsored by the Federal Government's *Visions Of Australia* grant program. This fund assists touring cultural exhibitions attend locations across Australia.

The Energymobile attended the *Ag Fest* field days at Carrick near Launceston, spent six days at high schools and one at the University of Tasmania. There were also eighteen appearances at various city and regional town displays throughout the state.

The EM travelled over 2,500 kilometers with mostly beautiful weather and no rain. It received a good welcome, lots of interest and very positive support. One measure of success was the doubling of ATA's membership and subscriber base in Tasmania.

The ATA would like to say thanks to the following people for their role in helping to plan and organise the tour, staff the displays and conduct presentations:

* Mark Mather, Peter McCormick and Rob Wells
* Debbie Black the education officer from the Integrated Energy Management Centre in Hobart
* Members of the Australian and New Zealand Solar Energy Society
* local ATA members

Help wanted on the Energymobile

Can you handle a change of pace and a bit of adventure? We need people with a good knowledge of renewable energy to help operate the vehicle and displays throughout Australia. If you also have an articulated vehicle drivers licence, presentation and communications skills and get on well with people, then you are an urgently needed addition to the Energymobile team.

If you are competent and reliable and enjoy this sort of activity and adventure, we can even pay you something for your efforts.

It is also possible to attend some displays as a voluntary assistant without having to shoulder too much responsibility. Who knows what adventures it might lead to?

Any interest? Talk to Monty Russell on ph:(03)9744 2697.

Local ATA group for Tasmania?

There is a good possibility that a local ATA actvities group will be formed in Tasmania. It would co-operate with existing networks such as the ATA membership and subscriber list, the Solar Energy Society, the Energy Management Centre, and arrange a program of activities such as meetings, information nights, visits, workshops, etc.

For more information, contact Mark Mather, Box 37, Snug TAS 7054 ph:(002)67 4141 or 018 123 890.

ATA events

Electric Vehicles

21 September - 7:30pm
Going Solar - VIC

Phil Happ of the *Australian Electric Vehicle Association* will talk on developments in electric vehicles. This is a joint meeting with AEVA.

Visit to RAPS solar house

24 September - 1.00pm
Kangaroo Ground - VIC

This visit will be to see Neil and Jenny Taylor's large PV and wind power system, 800ah 48V battery bank and sine-wave inverter.

Windgenerators: large and small

19 October - 7:30pm
Going Solar - VIC

Michael Gunter will give a talk on the Breamlea windgenerator while Monty Russell will discuss smaller machines.

Battery developments

16 November - 7:30pm
Going Solar - VIC

Kevin Woodhouse of the AEVA will discuss storage batteries for electric vehicles and RAPS systems.

For more information on any of these events contact Chris Moss on ph: (03)9885 2105.

Canberra

Electric vehicles - 27 September

Keep up with the latest developments with various vehicles including bicycles.

For more information contact Ron Tito ph:(06)235 9172 or Gordon Elliot ph: (06)288 6038.

Sydney

Practical workshop - 15 October

The two topics proposed for the day at this stage are:

* sizing and designing a PV system for your home

Contact Otto Priboj ph: (02)724 ***3801.***

* rewiring an alternator for low-speed applications.

Contact Peter Moore ph:(02)638 2815.

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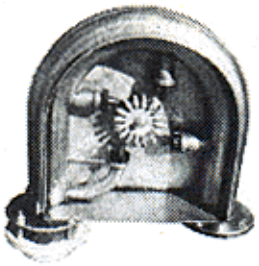

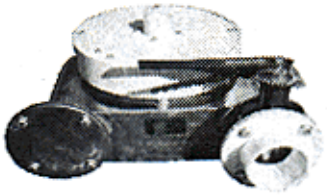

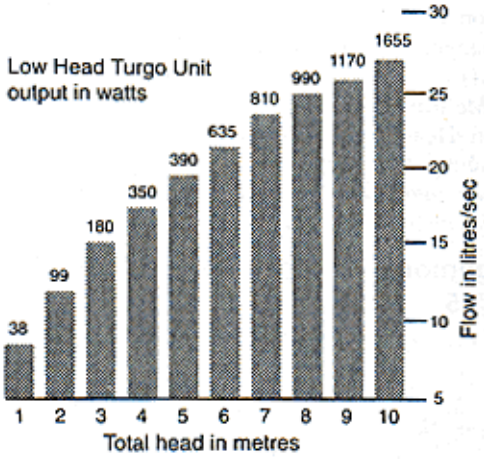

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