FRIENDS OF THE EARTH'S

chain reaction

SOLAR ISSUE

OUR REPLY TO THE 1ST RANGER URANIUM REPORT
SOLAR WATER AND SPACE HEATING FOR THE HOME
SOLAR ENERGY UP NORTH • SOLAR TECHNOLOGY
AND SOCIAL CHANGE • JACK MUNDEY INTERVIEW

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EDITORIAL

We applaud the First Report of the Ranger Inquiry as a useful reference work for the wide public debate which must take place over the coming years on the question of what to do with Australia's uranium resources. We note that the Report calls for such a debate in its final recommendation, and urge all concerned people to do everything they can to prevent the Government from ignoring this clear call for public participation in making a decision of such complexity and gravity.

Any full objective reading of the Report immediately dispels the notion that it gives a 'Conditional go ahead' for the mining and export of Australian uranium. The initial misinterpretation by almost the entire media of recommendations 1 and 2 concerning the hazards of mining, milling and 'normal' reactor operation has reportedly greatly disturbed Mr Justice Fox and the other Commissioners.

The Commissioners state explicitly in the body of the Report that they have not been able to determine "whether it is preferable to delay coming to a decision about mining for a period of several years or alternatively to proceed with carefully planned development of the industry". But revealingly they do say that "delay (is) an option which might reasonably be followed". They also accepted the crucial submission by nuclear opponents that the spread of 'peaceful' nuclear power is contributing to increased risk of nuclear war.

We echo the call for a public debate with full confidence that the more people know about nuclear power and its unique hazards, the more they will realise that it is a wise and moral decision to let uranium rest safely in the ground. On the other hand, the government and nuclear proponents, anxious for a rushed decision, obviously fear the reaction of an informed public. In this *Chain Reaction* we publish a guide to the Ranger Report which should help people make up their own minds on the issue.

This *CR* is also a solar energy special, examining in detail how solar energy can be used in Australian homes. If a non-nuclear future is to become a reality we believe it is essential that people take the initiative for themselves — acting wherever possible as a community — and begin the transition to using clean, free, decentralised and endless sources of energy such as that from the sun. People can do this directly in the domestic sector.

In later editions we hope to look at alternative energy policies in the industrial, commercial, agricultural and transport sectors. In time though we envisage that these approaches at different levels — national and household/community — should begin to converge as energy production and consumption, and production of goods and services generally, become much more decentralised and more directly controlled by the communities involved.

It is important to realise at this early stage, however, that there are unlikely to be *technical* restraints preventing construction of giant solar power stations similar in nature to the large electricity power stations of today. Large-scale centralised technology — solar or nuclear — will invariably mean a society in which effective political power is also centralised and concentrated in the hands of a relatively small ruling class. Whether we go for large-scale or small-scale solar technology is therefore a decision with profound political implications.

Every effort made by people to involve themselves in designing and constructing alternative technology especially suited to local needs can help us move towards a society which provides much more local autonomy, and one which lives in harmony with its environment.

They Sun does arise
And make happy the Skies

William Blake
Songs of Innocence (1789)

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Chain Reaction is the quarterly magazine of Friends of the Earth Australia, publishing feature articles and news on national and international environmental issues, and searching for the way towards a sustainable, convivial society which lives in harmony with its environment.
This issue was produced by Mark Carter, John Andrews, Mick Waters and Graham Barron, with greatly appreciated help from Olga O'hannessian, Peter O'hannessian, Woody, Alison Parks, Neil Barrett, Joe Camilleri, Jack Mundey, Barbara James, David Allworth, Linnell Secombe, Emma Moodie-Young. Alan Beesey, Alastair Machin, Frank Muller, Paul Marshall, Sandy Poulsford and Julia .
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Original contributions to Chain Reaction — articles, news snippets, leaks, photos, drawings, cartoons, poems or short stories with some sort of environmental association — are very welcome, but we can only guarantee to return them if they are accompanied by a stamped addressed envelope.
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If you'd like to help us by distributing/selling *Chain Reaction* and earn a bit of money for yourself at the same time, contact your local FOE group right away (see page 40 for addresses).
The next issue, Vol.2, No.4, will appear in February 1977. Sorry it's a bit late but we were late getting the first issue out this year.

EARTH NEWS

Jimmy Carter's Energy Policy

"Our dependence on nuclear power should be kept to an absolute minimum," writes Jimmy Carter in a policy paper on the subject released during the US presidential contest. "We ought to apply much stricter standards as we regulate its use. We must be completely honest with our people concerning any problems or dangers.

"Nuclear reactors should be located below ground level," he adds.

"The power plants should be housed in sealed buildings within which permanent heavy vacuums are maintained. Plants should be located in sparsely populated areas and only after consultation with state and local officials. Designs should be standardized, and a full-time federal employee, with full authority to shut down the plant in case of any operational abnormality, should always be present in control rooms.

"We should remember that we only have enough oil available as an energy source for another 30 years. We must make a major shift to coal and substantially increase our use of solar energy. With proper national planning, energy conservation can be increased and we can keep our dependence on nuclear energy to an absolute minimum," concludes Carter, a former nuclear engineer in the US Navy.

He repeated his call for "nuclear power as a last resort" in the first of his three TV debates with President Ford, and stressed that coal would have to be used more efficiently and more cleanly as an alternative to oil.

Carter graduated as an officer in the US Navy in 1943. He worked on experimental naval vessels and submarines before returning to supervise the engineering work on the Navy's first postwar ship, the USS 1, at New London, Connecticut.

A graduate in reactor technology and nuclear physics, be became aquainted with Admiral Hyman Rickover, known as the father of the nuclear submarine navy, and worked with him to develop the second US nuclear submarine.

Then, in 1953, his father died of cancer and he returned home to Georgia.

In his autobiography, *Why not the best?*, Carter opens chapter 12 as follows; "With the exception of reorganisation itself, I spend more time preserving our natural resources than on any other one issue."

Asked by *Time* magazine about what he learnt while campaigning across America, he said: "Well I've broadened my experience in agriculture, which is my own business. Also in government. I know infinitely more about the proper interrelationship that ought to exist in a system of federalism than I did before, although I have served seven years in local government and eight years in state government and have been a very close observer of the national scene. I could go down a tremendous litany of things that have been added to my knowledge in the last 24 months for example in the areas of environment, transportation, energy. It has been a very good education process for me."

Reactor Sales Slow Down

Only four nuclear reactors were built in the US in 1975, compared to 22 in 1974, and 46 in 1973.

During 1975, the electric utility companies cancelled 23 reactor orders and postponed another 125.

Westinghouse Corporation, the leading reactor builder in the world, and the only company to sell a reactor in the US in 1975, was also reported as having made "questionable payments" to foreign officials through its sales representatives.

Not Man Apart, Mid-April, 1976.

The Plutonium Connection

"Current transactions in the Nuclear market place demonstrate that what prevails now in nuclear policy is not statesmanship but salesmanship," says Walter C. Patterson, author of the newly published book **Nuclear Power,** and a recent visitor to Australia.

Writing in the **New Statesman** he argues that the spread of nuclear power is the most pressing issue on the international agenda.

"The US is proceeding with plans to sell reactors to Eygpt and Israel; agreements were initialled on August 4 and 5. Neither Egypt nor Israel is a party to the Non-proliferation Treaty.

On August 6 France signed a contract to build two nuclear power stations in South Africa, beating a joint bid from the US, West Germany and the Netherlands. South Africa is not a party to the NPT.

On August 4 France announced an agrement to sell two nuclear plants to South Korea.

On July 4 West Germany signed contracts to build two nuclear plants in Iran; France is in the running for two more, and the US for eight.

"By 1990 the amount of plutonium produced in civil nuclear installations in developing countries alone will probably be enough to make more than ten atom bombs a day," warns Patterson.

NEW STATESMAN.
27 August
1976.

Industrial Danger

"Increasing industrialisation threatens the existing chemical composition of the atmosphere" warns CSIRO in its 1975/76 Annual Report.

The report says "The recent growth in the burning of fossil fuels is releasing chemical substances in quantities which may corrode building stones, stunt development of vegetation, endanger health or even affect climate by scattering and absorbing radiation entering and leaving the earth".

"Photochemical smog, well known in places like Los Angeles, is now being experienced by the larger cities in Australia".

Sydney is Australia's most smog-bound city, the Report states.

In Melbourne CSIRO measurements show the average low-altitude concentration of ozone, one of the main constituents of photochemical smog, has doubled between 1965 and 1973.

And higher up in the atmosphere, 25km above the earth's surface, the Report stresses the need to keep monitoring the concentration of the naturally produced ozone layer, since "so many products of our everyday life are capable of destroying it". Examples are the chlorinated hydrocarbons used as dry-cleaning solvents and the freons used as propellants in aerosol cans.

The atmospheric ozone layer plays an essential role to life on earth by filtering out harmful ultraviolet radiation from the sun.

Fusion Problems

In an article on nuclear fusion research in **Science**, William D. Mertz reports on conceptual studies for a 2100 MW fusion reactor, Tokamak.

He found the "Fusion reactors built with present-day materials seem to have many of the problems that fission reactors have, made much less manageable in some cases by the complexity of the reactor . . . Fusion is still a basic research enterprise. No device, Tokamak or other type, has yet produced the plasma conditions (temperature and confinement time) needed for a practical reactor."

Mertz also mentioned "unprecedented maintenance problems, e.g. in replacing the inner wall as its life span was identified as only 2-3.5 years," which he said would "undermine the already shaky economics of fusion."

"There would be a considerable potential hazard from radioactive materials," and "a waste-disposal problem," he said.

SCIENCE, 2 July 1976.

How Long?

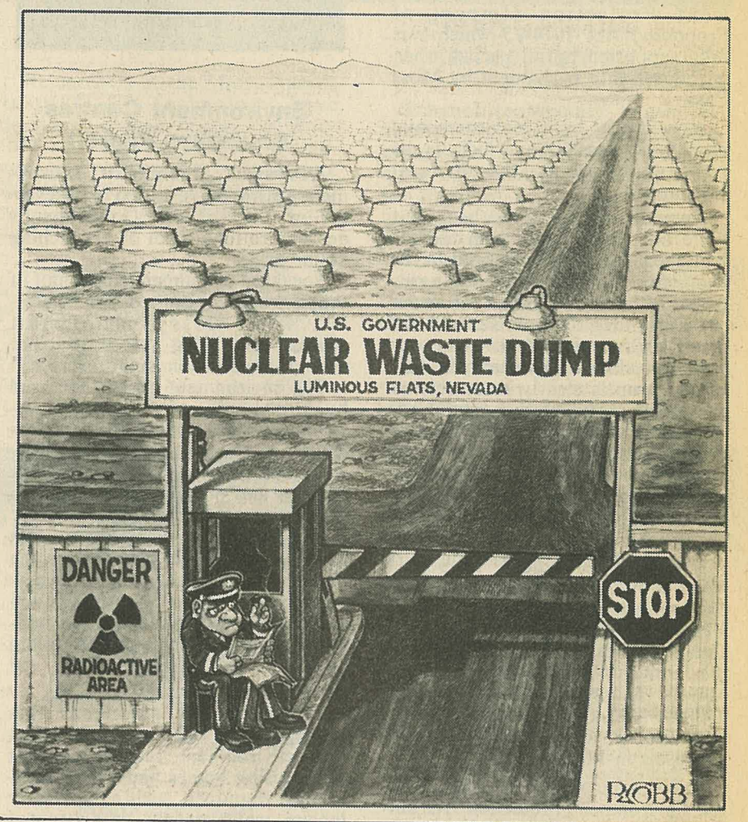
Earlier this year in Washington, the Congressional House Joint Committee on Atomic Energy heard charges by the nuclear engineers who resigned from General Electric, and from other witnesses, on the hazards of nuclear technology.

Witnesses told the committee that there are presently 11 land disposal sites for radioactive waste in the US. Six are commercial, and five are run by the Energy Research and Development Administration. Together they contain more than 50 million cubic feet of solid radioactive waste generated over the past 30 years.

By the year 2000 more than one billion cubic feet of such waste will have been produced, equal to covering a four-lane coast to coast highway one foot deep, estimated one witness.

The representatives were told of 'migrations' of wastes at three sites, where facilities that had been planned to contain the wastes for hundreds of years had begun leaking after only 12 years.

Not Man Apart, Mid-April, 1976.



Environmental Legislation under Attack

Country Party Federal ministers Anthony (National Resources), Sinclair (Primary Industry) and Nixon (Transport) are spearheading a campaign to hand environmental assessment of projects involving the Commonwealth back to the States.

Mr. Anthony gave an undertaking to State mining ministers early this year that he would have the Federal Government pulled out of environmental assessment of mining projects. Such a change would involve watering down of the Environment Protection (Impact of Proposals) Act 1974-75 which was fully supported by all parties when introduced into parliament by Moss Cass.

No States have environmental protection legislation which is as comprehensive as the Federal legislation.

Environmentalists realise that there are many faults with the existing legislation as evidenced in the Ranger Inquiry where pro-mining interests were able to utilize enormous research, legal and secretarial resources compared to the environmentalists. However, the existing set-up is clearly preferable to one in which all environmental assessment lies with State governments led by the 'chop it down, dig it up' mentality of premiers such as Court and Bjelke-Petersen, who have been pressurizing the Federal Government to pull out.

Major development proposals which would be subject to reduced environmental assessment include Yeelirrie uranium, Marandoo Iron Ore and Kwinana Freeway in W.A., the Bowen Basin coal projects, MIM's MacArthur River project and the Aurukun bauxite project in Queensland, and various freeway proposals in Melbourne.

Cabinet has three times discussed the Environment Protection Act but each time come to a non-decision.

The latest non-decision, however, has put State development interests into a strong position to get rid of the Act, and Environment Minister Newman has been making ominous noises about the need to avoid Commonwealth-State duplication.

In the meantime the Environment Department is not able to apply the Act, and as a result Harris-Daishowa's Eden woodchip project has been given a further twelve-months worth of export permits.

Environment Centres Shutdown Feared

Australia's community environment centres have called for a reversal of the Federal Government's decision to fund them on a matching dollar basis.

Speaking in Canberra on behalf of the environment centres, Frank Muller, said, "Many environment centres fear being forced to close down if the decision is not reversed."

The environment centres are used by thousands of voluntary environmentalists, school teachers, students, ecologists and naturalists. They are resource and information centres, and do not make policy or statements on issues.

Up till now environment centres have received direct grants from the Federal Government. Under the new scheme the Federal Government will match each dollar raised from non-Government sources with two dollars up to a level agreed to by the Minister.

Frank Muller said that this scheme didn't account for the fact that environment centres are not fund-raising bodies and utilise community resources, such as volunteer labour, which cannot be accounted for as dollar income. He added that the change being sought does not involve any increase in the budget allocation which is only $400 000.

In calling for a reinstatement of direct grants to environment centres, Mr Muller warned cabinet against succumbing to 'development for development's sake' interests who wish to silence environmentalists in the community.

Released on behalf of all Australian Environment Centres.

Oil Price Gusher

The price of a gallon of petrol could rise by about 3 cents a year, between now and 1985, if the Federal Government accepts the recommendations of the inquiry into oil prices by the Industries Assistance Commission, released in October.

The inquiry recommended that the price of Australian crude oil, and therefore petrol, be lifted to world levels by 1985.

At present, the price of Australian crude is only about one fifth of the world rate.

Bass Strait crude costs about $2.30 a barrel plus $2 excise, while Barrow Island oil is $2.70 plus excise. The world parity price is $11 a barrel.

The IAC price-rise schedule would bring the price of Australian crude in line with world parity by 1985.

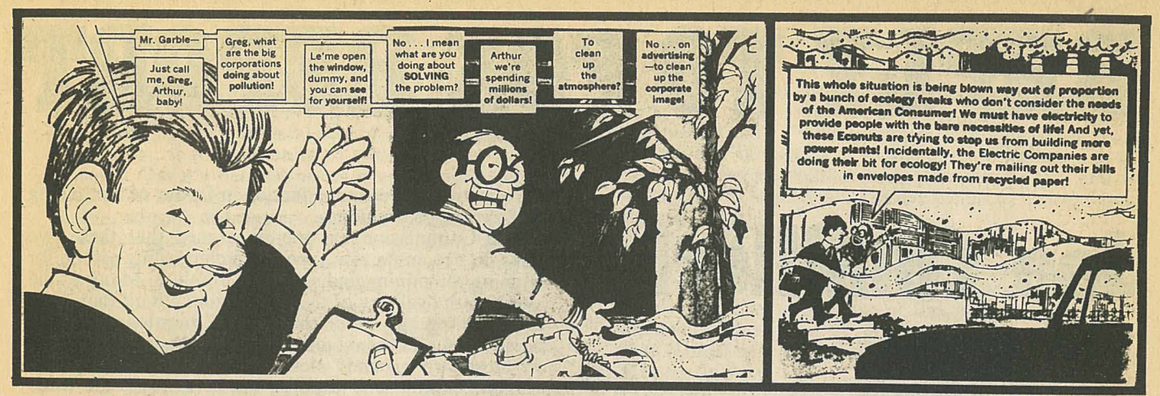
Their report argues that the present low price of Australian crude encourages the increasing consumption of scarce resources, and also serves to delay investment in alternative energy sources.

Solar Loans

Californian voters will have a chance in November to approve a low-cost loan program for home-owners who want to instal insulation or build solar heating systems.

Referendum propositions 3 and 12 would allow the Energy Resources Conservation and Development Commission to establish standards for solar heating and cooling devices, and provide the lower than market rates loans to home-owners. The interest earned will finance the Commission's activities.

It is expected that there will be little opposition to both propositions.
Not Man Apart, October, 1976.



Energy in the fields

In the latest issue of the ANZAAS magazine *Search*, Dr. Ken Newcombe of the Australian National University's Ecology group, and CSIRO scientists question the common assumption that modern intensive agriculture give better yields than pre-industrial methods.

Citing Hong Kong as an example, Dr Newcombe points to vegetable farmers who have switched to western technology over the past 15 years. Their total energy consumption has risen by 58 per cent, while their total yield has increased by only eight per cent — a tremendous loss in real production per unit energy input.

Assessing agricultural efficiency calls for a complex energy equation. Accounts are taken of the fuel used by tractors and agricultural machinery, the muscular work done by people and animals, and also the energy used in the manufacture of the machinery, in making fertilisers and providing irrigation water and so on.

By far the highest "energy ratio" (food energy output to fuel plus human and animal energy input during production) recorded by the CSIRO is achieved by the peasant farmers in China.

Rice farming in the US rates lowest in energy efficiency in their survey.

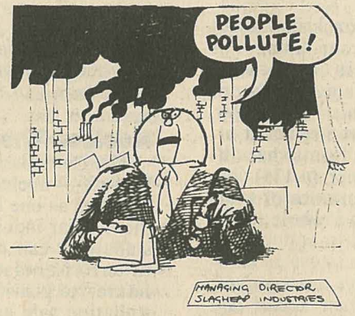
Australia ranks high among the western countries in agricultural energy-efficiency terms because nitrogen based fertilizers are not widely used here, but our efficiency is still far below that of the peasants of Asia.

Cheaper Solar Electricity

Researchers at the Massachusetts Institute of Technology have developed a solar energy converter that may solve the problem of high-cost photovoltaic cells by increasing the intensity of the sunlight reaching a cell by a factor of between 500 and 1000.

This substantially reduces the number of cells necessary. It is supposed to produce energy as cheaply as conventional methods and will be on the market by the end of 1977.

Not Man Apart, Mid-July, 1976.



"Velovolution"

Les Amis de la Terre organised bicycle demonstrations across France on June 5th. In Paris, 5000 cyclists blocked the centre of the city, shouting "Only one solution — the Velvolution!" ("Velo" is a French word for bike).

Les Amis have also been actively campaigning against the Phoenix Breeder Reactor.

Not Man Apart, October, 1976.

CSIRO promotes alcoholic driving

Ethanol (commonly known as alcohol) could be obtained from the cellulose in trees and used to provide about 38% of Australia's fuel needs for transport in the year 2000, according to the CSIRO Solar Energy Studies Unit.

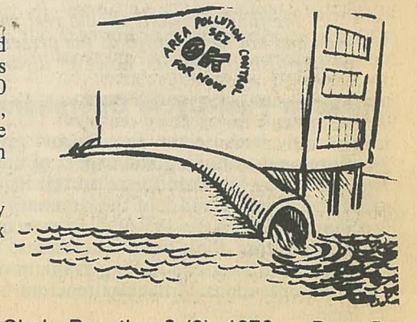
The suggestion is made in a recent submission by CSIRO to the Enquiry into Solar Energy being conducted by the Senate Standing Committee on National Resources.

The remaining 62% of transportable fuel needs would be met by oil obtained from coal, so that Australia would become completely independent of imported crude oil by the year 2000.

The CSIRO Submission says that the cellulose can be produced from woodchips and converted by fermentation and distillation into alcohol.

CSIRO estimate the scheme would require 13 million hectares of forest plantations, about 2% of Australia's total land area, to generate enough wood chips.

The scenario allows for a total end-use energy consumption of 2.8 times the 1972 level, involving a doubling of the energy consumed by transport.



REPLY TO FOX REPORT

Joe Camilleri

The First Report issued by the Ranger Uranium Environmental Inquiry headed by Mr Justice R.W. Fox has given anything but the green light to the mining and export of Australian uranium. Indeed, far from encouraging any 'go-ahead', as mining interests and some of the less reputable media would have us believe, the Fox Report has properly concentrated on "the hazards, dangers and problems of and associated with the production of nuclear energy".

While its recommendations lack the clarity and vigour one would have desired, there is no disputing the fact that the Commission has accepted the main thrust of the evidence submitted to it by the opponents of nuclear power. It thus concludes:

"Policy respecting Australian uranium exports, for the time being at least, should be based on a full recognition of the hazards, dangers and problems of and associated with the production of nuclear energy, and should therefore seek to limit or restrict expansion of that production."(p.185)

Having come to such a far-reaching conclusion about one of the most crucial questions of our time, it is perhaps disappointing that this otherwise valuable Report should nevertheless contain a number of ambiguities and inconsistencies. This limitation, however, is acknowledged in the Report itself and attributed, at least by implication, to the "somewhat different views" held by each Commissioner (p.175). No doubt, it is this appreciation of the importance of value judgments which led the Commission as a whole to the conclusion that

"Ultimately, when the matters of fact are resolved, many of the questions which arise are social and ethical ones." (p.6)

From this premise it follows naturally that

"... the final decisions should rest with the ordinary man and not be regarded as the preserve of any group of scientists or experts, however distinguished." (p.6)

Risks in Fuel-Cycle Operations

Precisely because the Fox Report gives so little encouragement to mining and export of uranium, the pro-nuclear lobby has been forced to rest its case almost entirely on points 1 and 2 of the summary of findings and recommendations (pp.185-6). However, on close scrutiny it is clear that these two conclusions, relating to the hazards of mining and milling uranium on the one hand and the operations of nuclear reactors on the other, do **not** constitute a recommendation in favour of the mining and export of uranium.

The Commission has merely argued that these two risks do not, in its view, provide a compelling reason for banning the mining and export of uranium. Many would question the validity of this conclusion, but all that it entails is simply the notion that, if the Commissioners were satisfied on all other counts, they would not feel justified on these two grounds alone in recommending against uranium mining and exports. As it happens, the three Commissioners make it clear that they are far from satisfied that the many other risks, dangers and costs associated with nuclear power can be easily or effectively overcome. In any case, the Report insists on "close regulation and constant surveillance" (p.177) and admits that such controls are likely to be adequate only in relation to "the hazards involved in the *ordinary* operations of nuclear power reactors" (p.185). Presumably an altogether different and unacceptable set of hazards could arise in the event of technical or human failure, war, an act of deliberate sabotage (p.95), earthquakes and other geological disturbances (p.97).

Radioactive Wastes

The Report readily admits that the disposal of low-level and intermediate-level wastes could pose a serious problem in the future "if supervision were relaxed, or if the operation became too widespread, or the bulk too great" (p.177). As for high-level wastes, the Commission concludes:

"There is at present no generally accepted means by which high-level waste can be permanently isolated from the environment and remain safe for very long periods." (p.110)

Nuclear Theft and Sabotage

The Commission regards the possibility of theft and illicit use of nuclear materials and the sabotage of nuclear facilities as one of the most serious dangers surrounding the nuclear industry. It does not believe that nuclear installations can currently withstand determined assaults by terrorist organizations, or that it will be possible in the future "to provide sufficient defences to render every installation safe against attack by even small numbers of well-armed, trained men" (p.152). In the light of evidence submitted to it, the Commission accepts the view that

"... a terrorist group could use reactor grade plutonium to make a bomb with good prospects of giving a yield of several hundred tonnes of TNT ... An explosive yield of a few hundred tonnes of TNT might be sufficient to destroy a very large skyscraper with severe loss of life. The ionising radiation released and the subsequent fall-out would also kill and injure many people."(p.154).

Proliferation

In the view of the Commission the most serious danger is undoubtedly that of proliferation of nuclear weapons. In this regard, the inadequacy of the safeguards provided by the Non-Proliferation Treaty (NPT) are readily recognized. The Commission argues, in fact, that both the NPT and the International Atomic Energy Agency (IAEA) have contradictory objectives in so far as they seek to promote the peaceful uses of atomic energy while at the same time attempting to restrict its war-making potential. India's detonation of a nuclear explosive in May 1974 is cited as an illustration of the many difficulties surrounding any attempt to implement a fully effective safeguards system. The Commission concludes that "a commercial nuclear program, particularly if it can be designed to include enrichment or reprocessing facilities, or both (on however small a scale), does offer a satisfactory 'half-way house' to a military objective." (p.127.) Hence the blunt statement:

"The nuclear power industry is unintentionally contributing to an increased risk of nuclear war." (p.185)

The Fox Report leaves no doubt that, in its view, the existing NPT safeguards system is both weak and deficient. Further, given the inescapable realities of national sovereignty and profit-oriented policies, it is difficult to see how any improvements to existing safeguards arrangements can, in practice, mitigate, let alone eliminate, the fundamental weaknesses of this system. In this regard it is worth quoting the comprehensive summary of these weaknesses provided by the Report itself:

"... the failure of many states to become parties to the NPT; the inability of safeguards to prevent the transfer of nuclear technology from nuclear power production to the acquisition of nuclear weapons competence; the fact that many nuclear facilities are covered by no safeguards; the existence of a number of loopholes in safeguards agreements regarding their application to peaceful nuclear explosions, to materials intended for non-explosive military uses, and to the retransfer of materials to a third state; the absence, in practice, of safeguards for source materials; the practical problems of maintaining effective checks on nuclear inventories; the ease with which states can withdraw from the NPT and from most non-NPT safeguards agreements; deficiencies in accounting and warning procedures; and the absence of reliable sanctions to deter diversion of safeguarded material." (p.147)

Little wonder that the Commission is forced to the conclusion that "these defects, taken together, are so serious that existing safeguards may provide only an illusion of protection" (p.147).

It is therefore somewhat surprising to find the Commission recommending that, in the event of Australia deciding to sell its uranium, such exports "should be subject to the fullest and most effective safeguards agreements, and be supported by fully adequate back-up agreements to the entire civil nuclear industry in the country supplied" (p.185). In so doing, the Report is merely advocating the very course of action on which it has itself cast the most serious doubts on the grounds of technical, political and economic impracticality.

Wider Social Consequences of Nuclear Power

Although one of the most disappointing aspects of the Report is its treatment of the social consequences of a plutonium economy, it is worth noting that the Commission was sufficiently concerned with the issue to regard it as an important reason for reducing the growth in energy consumption (p.35). Significantly, the Commission received no evidence contrary to that submitted by the critics of nuclear power who argued that increasing dependence on electricity distributed through a centralized grid "would require administration by a remote and bureaucratic technical elite, lead to a great concentration of political and economic power, and be vulnerable to large and expensive technical mistakes and failures" (p.35.

Economic Considerations

If the pro-nuclear lobby was hoping that the weakness of its case on the wide range of safety questions would be partly offset by acceptance of the claims regarding the economic advantages of uranium mining and exports, then it must be terribly disconcerted by the findings of the Ranger Inquiry.

In the first place, the Commission has firmly rejected the argument that the industrialized Western world is currently facing or is likely to face in the foreseeable future a severe energy shortage. On the contrary, the Report explicitly states:

"... while the economies of countries heavily dependent on imported oil have been adversely affected by increases in world oil prices, **it is incorrect to say** *that there is a presently existing world energy crisis which will create disastrous economic effects ... and it is clear that it* **is incorrect to suggest** *that there are energy impoverished nations which need Australian uranium for survival." (p.164).*

In this regard, the Report makes the pertinent point that "total world coal resources are so large that they will not be approaching depletion for many decades, even if the rate of energy use continues to increase exponentially as it has this century" (p.164).

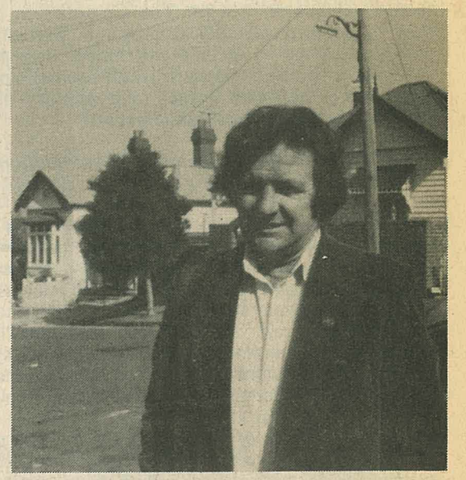
The only major immediate world problem in the energy field identified by the Commission is the availability of liquid fuels. If this is an accurate assessment of current energy needs, then it is difficult to disagree with the Commission's view that Australia's uranium can do little to improve the situation (p.164). The Report indicates that, without recycling of fuels, reserves of uranium would amount to only about 5% of presently-estimated fossil fuels (p.39). It is precisely for this reason that the three Commissioners have argued that the most valuable contribution that Australia could make would be to concentrate on such alternatives as the production of liquid fuels from coal and the provision of coal at economic prices as a replacement for oil. In the longer term, the Commission advocates the development of technology to utilise solar energy with a view both to low and intermediate grade heat applications as well as electricity generation.

In addition to its stress on the need for the rapid development of alternative energy resources other than nuclear power, the Commission repeatedly emphasizes the value and the feasibility of energy conservation. It notes that "the major energy consuming nations have embarked on energy conservation programs of varying intensity, and that they are being given high priority" (p.34). Extrapolating from present trends, the Report predicts that energy conservation "will have a significant effect on total energy consumption by the end of the century" (p.35). Believing that "societies may come to value more highly in future things not included in conventional measurements of economic activity" (p.33) and that zero economic growth may become a socially feasible and desirable goal, the Commission advocates the introduc-

Continued on page 11.

CHAIN REACTION INTERVIEW

JACK MUNDEY



Jack Mundey became one of the best known, and most controversial, unionists in Australia as one of the leaders of the NSW Builders' Labourers Federation during their 'Green Bans' on environmentally destructive construction projects in Sydney between 1971 and 1974.

The Green Bans movement was an at first sight unlikely coalition between mainly middle-class residents and builders' labourers, but they took on the giant property developers, and won. Their success struck a resonance among environmentally concerned people of all classes in cities around the country and in many other parts of the world.

Jack, a Communist and enthusiastic advocate of workers' control and real participatory democracy, has since been in great demand as a speaker and writer on the role of the workers' movement in environmental issues, both here and in Europe and North America. We spoke to him for the *Chain Reaction Interview* **soon after he returned home after representing Australia at the UN Habitat Conference on Human Settlements held in Vancouver earlier this year.**

FOE. Jack, you've often said that you don't see a solution to the worsening environmental crisis under capitalism, but how much do you think that the type of technology that industrial countries throughout the world are using — both so-called socialist and capitalist countries — is also to blame? There's been a growing interest throughout the world recently in alternative technology. Could you give us your opinions on this development, and in particular on those people who have moved out of the cities and gone back to the land and are trying to lead low-energy low-consumption lifestyles?

Jack Mundey. On the question of thinking people in our society moving out of big industrial cities and going back to the land, I think this is very good by way of example, but whether we like it or not we've had an industrial revolution, we've now got very highly industrialised societies, we've got a world in which in 1950 only 20% of the people lived in cities, and now it's 40%, and by the turn of the century it'll be 50%.

. . . we've got to make our cities habitable. I don't think it's possible for everybody to return to the land and abandon cities — that's an extreme position. We can't all go back to Nimbin.

The International Labour Office figure for unemployment is now 300 million in the world, and by the turn of the century they say it'll be 1000 million unemployed out of a total population of 7000 million.

So that certainly raises this whole question of not only technology, though that's to the forefront, but also the work ethic, the question of work itself, and I believe this to be the most neglected area of workers organisations' thinking — the question of the social responsibility of labour, which labour we should be performing, in the interests of present society, and also in the interests of future society.

I believe that up to now workers organisations and political parties — of the left as well, socialists, communists and social democrats of their various hues throughout the world — have all been very neglectful of what to do with labour.

There's been plenty of talk about winning control of the means of production, but very little about what sort of production we should have, and what are the ends of that production.

And to me it would seem that we have to turn that the other way round. And that if a great debate takes place on these things among the workers, I think there you will start to get discussion about alternative technology and what should happen.

As it is now, most socialists would consider, as has happened in Russia, that you just change from capitalism to socialism and the means of production will go out of the hands of private ownership to allegedly public ownership despite all its weaknesses in the Soviet Union and the heavy bureaucracy.

But there again, the Russians have continued to make many of the same products, and they've poisoned their rivers and lakes, and make rotten cars, for example, in much the same way as capitalist industrial societies. And I don't think that's the answer.

Now about going back to the land, I come down in between. I think we've got to make our cities habitable. I don't think it's possible for everybody to return to the land and abandon cities — that's an extreme position. We can't all go back to Nimbin.

Whether we like it or not we've got Melbourne with 3 million people sprawling for miles, we've got the same in Sydney.

So I think the real challenge to urban environmentalists is to make cities places in which there's a new spirit, in which there's a new attitude to work, a new attitude to which technology we should be using.

At the same time I believe those who have gone back to the land can by example teach those of us who remain in the city a lot.

FOE. Some workers who do seem to be discussing the social consequences of their labour are the staff of the Lucas Aerospace company in the U.K. When threatened with mass redundancy as a result of defence cuts by the British government, they didn't demand that their jobs should be safeguarded so that they could go on making components for military aircraft. Rather they got together and drew up an alternative corporate plan under which they would transfer their skills to designing and making more socially useful products — including wind-electric generators and special vehicles for the physically handicapped. You've talked with the workers involved in this initiative, Jack. What's the latest news?

JM. Well the first reaction of management to the alternative corporate plan was complete rejection and hostility that the workers should have the audacity to suggest that they should make products of their own choosing.

And have in mind that it was the more skilled workers who first brought forward the idea. They were the draftsmen and those in the design department that are doing highly skilled work. And they then went to the workers on the job, and got the, shall we say, semi-skilled workers to endorse the plan.

Workers are naturally concerned about jobs and the work ethic is still strong. So I think the first demand must be the retooling of factories — even if it is on large complexes — to make products that are socially useful.

And then they had discussions, and the semi-skilled workers put forward other ideas of what they should be making.

Now the reaction of management was understandable under the capitalist system. They said no, we're running the society.

The workers have now put forward a wage claim which includes a demand to make the products they've suggested.

So I would imagine, though it's a matter for them of course, but I've had many, many discussions with them, that the next stage will surely come when the workers will refuse to do certain work and will demand to do alternative work.

And if they, for example, could even start doing that work it would be great. The company would then have to come in and have them arrested for doing this alternative work, or something like that.

You can't have real change unless you have the workers discussing it, and then you've got to have examples. That's where this Lucas initiative is so important.

And that's also where the Green Bans were so tremendous in a worldwide sense — because it showed you that concerned workers, and concerned citizens in an area, could block the political power of big business and of governments.

Thus in Sydney you've got Centennial Park, the Botanical Gardens, the Rocks still standing, and that was thousands of millions of dollars.

I don't think you'd have the ban on uranium that we got at the last ACTU Conference, even though it might be a bit dodgy now, but I mean the very fact that we got it through is terrific.

And on Fraser Island — I doubt if those things would have occurred if the Green Bans controversy had not preceded them.

FOE. To what extent do you think it's essential for productive units to be small for there to be real democracy in the work situation, for real worker control?

JM. I haven't thought sufficiently about that. It seems logical but again, starting from the position we've got now, like giant complexes, I think there's got to be conviction of the workers first that that should be broken down.

Workers are naturally concerned about jobs and the work ethic is still strong. So I think that their first demand must be the retooling of factories — even if it is on large complexes — to make products that are socially useful.

That is a starting point and I believe the ensuing discussion and practice will show that there is a need to come back to smaller units as your question proposes.

Seeing that we've got workers in the industrialised countries with the expectations of consumerism, the second car, the chandelier, the thicker carpet, the goody-goodies and all the inbuilt obsolescence that exists in our society, part of the problem is an ideological thing of breaking with that, and from what is called the standard of living, and thinking instead of the quality of living.

But you'll appreciate that workers are brainwashed from childhood into believing that this is the norm, and what I'm saying is that if you're going to take those workers from that position to a position we're talking about, it's a huge task.

And I think it can only be done by a hell of a lot of discussion and convincing the workers that the planet cannot go on this way, that we can't go on destroying resources at the rate we are.

FOE. What would your advice be to Australian unions on the question of the mining and export of Australian uranium?

JM. The whole question of mining uranium is probably the most political issue confronting humankind. The people who see the solution as going nuclear so-called are probably the most dangerous that exist, because there are now numerous examples that we cannot afford the dangers, particularly the waste products.

And besides, when you consider the terrible waste of energy that we now have anyway, the whole question shouldn't even be on the agenda.

So I believe the most important thing that can be raised to win more workers to the anti-nuclear position would be to point out their responsibility to future generations and the terrible dangers of waste products.

I believe there's no contradiction between the enlightened middle class and the enlightened working class, and as the ecological crisis gets worse, it's throwing those people together.

FOE. What other action would you like to see from Australian unions on environmental issues?

JM. I think we've got to try and connect up the workplace with where the worker lives. For too long there's been this slicing off.

The worker hits the factory of a morning, performs certain work for a number of hours, then he goes out and ignores the fact that the environment in cities is being destroyed, that the transportation systems are terrible.

So there must be this intervention in issues beyond what we call pure economic. We've got to get workers using their industrial strength to force cities to be non-polluted, to force companies to put in more pollution control, and to force the bringing back of trams, for example.

FOE. Would you say from your travels that Australian unions are very much in the lead compared with those overseas so far as acting on environmental issues is concerned?

JM. No question. Those of us in the environment movement might think that the Australian unions could be a hell of a lot better, but there's no doubt that the general level of understanding and activity of Australian unions on environmental issues is better than anywhere else in the world.

FOE. How do you view the class relationships between those involved in the environment movement?

JM. I consider the greatest weakness of the international environment movement is its failure to influence the working class.

And I notice going round in England that there's this suspicion between the middle-class element in the environment movement and the industrial working class, and that's got to be broken down.

I believe there's no contradiction between the enlightened middle class and the enlightened working class, and as the ecological crisis gets worse it's throwing those people together.

But then again you get some of the middle class who do adopt an elitist and somewhat snobbish approach to the industrial working class and on the other extreme you've got some of the working class who treat the middle class with suspicion — there's this anti-intellectualism.

Over the years, I suppose since the Green-Ban movement started, I've been subject to criticism from the more dogmatic of the left wing — the Sparta society, strange grouplets that have no real influence on political life. But to say that ecology is a middle-class issue, a trendy issue, not a working-class issue, well! When you consider builders labourers went to jail to save houses that would have been in the path of freeways — to me that's pretty political! I can't think of anything more political.

So what I'm saying is that all of us have to find a way to bring more and more of the working class into the environment movement.

FOE. At the end of the 1960s there was a lot of Doomsday thinking as many people throughout the world began to realise that our non-renewable resources were being used up at an alarming rate. How optimistic are you about the future? Do you think perhaps that the resource shortage could be the instrument for forcing radical change in our industrial societies?

JM. I think that is a very interesting question and my general position is that it is very late in the day. I wouldn't consider myself a Doomsday prophet, but I believe those environmentalists who are concerned about the ecological crisis and I think it's a serious crisis, a global crisis.

I think we've really got to act and that the degree to which we really act during the rest of this century will determine what sort of future we've got.

And I think that the non-renewable resources crisis — also I believe there's a food crisis and a water crisis — these are not just going to affect the poor two-thirds of the world, but they are going to affect the richer third as well.

I mean all these things are the only hope we have of rapidly changing people's thinking and consciousness if in fact there's going to be a future.

I'm open about it. I think those of us who are environmentally aware have a tremendous job to do, and I know myself, being in the workers' movement, how few when you take the totality of the millions of industrial workers, how few even think about it at this stage.

But then again, if you go back six or eight years, well there was virtually no discussion about it within the workers' movement, whereas now at least it's on the agenda.

You might think I'm talking a bit much about the workers' movement, but I think it's the key, because if you've got these great terrible multinational industrial complexes, it's not going to change — I can't see capitalism having that much soul to change in time.

I stand for socialism where real decision-making rests with the ordinary people, and socialism, as Dubchek said, "with a human face", but I think it's got to have one other ingredient too — it's got to have an ecological heart.

Though as I said before, I'm not dogmatic about capitalism. It has shown that it has the ability to be quite resilient and to change. But it's always got as the reason for that change the maximising of profits. It's a predatory system, it's a rapacious system, and I can't see capitalism changing from that.

That's why I argue that there's got to be a form of socialism, but not a socialism that takes over and runs these huge complexes in much the same way as multinationals run them. Thus the need for new technology, thus there's the need for workers to demand self-management.

And so I stand for socialism where real decision-making resides with the ordinary people, and socialism, as Dubchek said, "with a human face", but I think it's got to have one other ingredient too — it's got to have an ecological heart.

And this notion that too many socialists have had about conquering nature, that's a terribly arrogant notion and it's got to be scotched forever.

We've got to find a way in which humankind can harmonise with nature — that's the great test of our time.

And since we've built up these great giant factories and complexes, well then, unless you get the workers there to change their thinking, how can you ever effect change? Because it's playing right into the hands of the owners who will go on making the products they shouldn't be making anyway, unless we get a large section of the workers to rethink their position. ●

RANGER REPORT *Continued*

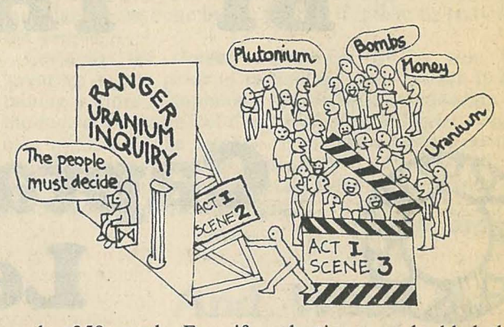
tion of additional policy measures "to achieve desired reductions in the growth of energy consumption" (p.35), and makes one of its principal recommendations a national programme of energy conservation (p.186).

Another argument suitably squashed by the Report is the preposterous suggestion that nuclear energy is likely to solve the economic problems of underdeveloped countries. According to IAEA projections, which have had to be revised downwards, by the year 2000 the Third World would still account for only 10% of world nuclear capacity (p.53). The obvious point to note about these countries is that large power-generating units are not suited to their needs, and that the much smaller units required are generally uneconomic if based on nuclear power. Where nuclear energy grids exist they are more likely to supply electricity for the affluent minority in the cities than the rural masses. Accordingly, the Commission's main recommendation in relation to underdeveloped countries is not for Australia to make available its uranium resources, but rather to participate "in international efforts to develop those forms of solar energy technology most suited to the needs of developing countries" (p.56).

Regarding the future of the nuclear industry in the advanced industrial countries, the Report once again presents a much less optimistic picture than the pro-nuclear propaganda would suggest. Having noted the marked reduction in the number of new orders for nuclear power stations which occurred during 1974 and 1975, the Commission goes on to indicate the high probability of a reduced rate of commissioning of new stations during the next decade (p.45). The Commission also questions the cost efficiency of large nuclear stations and concludes that "smaller-scale coal-fired generating plants may prove to be more economic than large coal-fired or nuclear generating units" (p.49).

As for the direct benefits that are likely to accrue to Australia from the sale of uranium, the Report estimates that additions to national income generated by uranium exports would rise from less than 0.1% of projected national income in 1980-81 to about 0.5% in 1990-91, and would fall to about 0.4% by the end of the century (p.79). In relation to foreign-exchange earnings, it is estimated that uranium exports would grow to 5% of total earnings in 1991-92 but would subsequently decline to about 3.4% at the end of the century. In this context it is worth noting that the Commission rejects as too high the estimates of potential Australian uranium sales presented to it by the Australian Uranium Producers Forum, the Australian Atomic Energy Commission and Pancontinental Mining Ltd. (p.66)

Even more sobering are the Inquiry's findings in relation to the possible contribution to employment. It is calculated that, at an initial production rate of 3000 tonnes of uranium oxide per year, the Ranger operations would employ about 600 people during the construction period of two years. Thereafter the operation would



employ 250 people. Even if production were doubled, the impact on labour requirements would be minimal, resulting in additional employment for 400 people in the first two years and 150 people thereafter (p.77). To the extent that the operation would draw largely on skilled or semi-skilled workers from the south, the mining of uranium cannot be expected to have anything but the most negligible effect on the national or even local level of unemployment.

Public Debate

The last recommendation of the Report gets to the heart of the whole issue:

> *". . . that no decision be taken in relation to the foregoing matters until a reasonable time has elapsed and there has been an opportunity for the usual democratic processes to function, including, in this respect, parliamentary debate." (p.186)*

For this purpose, the ordinary person must be made aware of the relevant facts. But there is much more to it than that. To be in command of the facts is one thing, to arrive at a considered and responsible judgement in relation to the facts is quite another. It is highly significant that after one year of solid deliberation, the Commission, composed of three distinguished men and assisted by several experts and advisers, was **not** able to determine "whether it is preferable to delay coming to a decision about mining for a period of several years or alternatively to proceed with carefully planned development of the industry" (p.181).

But they do say that, when taken in conjunction, many factors in the uranium debate "**make delay an option which might reasonably be followed.**" (p.180)

Given the gravity, the complexity and the unforeseeable consequences of the nuclear project, it is only prudence and common sense to insist that any decision should be preceded by the widest public and parliamentary debate. The responsibility is too large to be entrusted to interest parties in the nuclear industry, to the experts or to the government. What is at stake is not only the future of this generation but that of countless generations yet unborn. ●

TECHNOLOGY FOR THE PEOPLE BY THE PEOPLE

Captain Eddy's Legacy

Out of the many domestic household solar hotwater systems I've been to look at in Melbourne over the past month — rather, out of the few I've been able to find — I think Marie Nurse's up in the suburb of Heathmont is going to stick in my mind longest.

Marie, who remembers as a girl in the industrial north of England "being woken up by the clang of clogs against cobbled streets as the women walked to the mills and the men to the mines," is a kind old lady of 81. She's never heard of alternative, soft, low-impact, radical or whatever-you-want-to-call-it technology. Yet she enthusiastically sings the praises of solar hot-water systems, knows all about pesticides and pollution, and composts all her kitchen wastes for a little vegetable garden which a friend now helps her keep going.

I went to see her because I'd been told about the ingenious rotatable solar collector made by her husband Eddy well over ten years ago. And indeed it turned out to be quite an invention, and a very pleasant visit.

The collector is really one rectangular metal panel, about 4 metres by 1 metre in area, set in a wooden box and covered with glass — double glazing over the top 2/3rds. A metal pipe running through the centre of the box is fixed at one end to the eaves of the house, then supported by a piece of 4"x4" timber near the eaves, and again by a short stub of 4"x4" at the other end near the ground. The pipe serves as a pivot about which the whole collector can be rotated.

A flexible plastic pipe bringing cold water in at the top runs inside the box of the collector to the base, so it's kept well-insulated. The water is then heated and rises up the collector, and on via another flexible pipe to a hot-water storage tank in the roof.

Marie still moves the weighty collector around during each day to follow the sun and she proudly showed me

Marie Nurse and her rotatable solar collector.

how easy it was to do, securing the collector in any one position by means of a dog chain hooked over a nail.

"First I point it over towards the east to get the morning sun," she said. "Then I have it flat for the midday period, and over towards the west for the setting sun. My husband always said you have to chase the winter sun. In summer you can just leave it flat, and there's plenty enough heat. Sometimes it gets too hot, you know, and you have to turn it away form the sun. We've even had the water boiling on a very hot day."

The system also has an electric booster, which is needed on cold overcast days in winter, but only occasionally in summer.

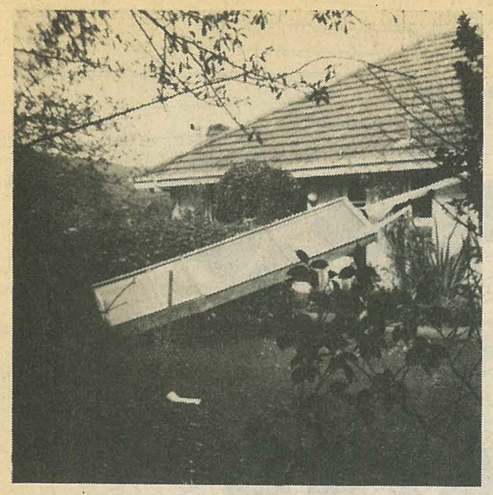
Marie's husband Eddy was a captain in the Australian navy. He died four years ago, but he is still very much in the forefront of Marie's memory, and lives on in the numerous ingenious inventions around the house.

Although he did a course in engineering in his youth, Captain Eddy was essentially an 'amateur' inventor, not a professional engineer or scientist, and it's something of that tradition which I think must be rediscovered if increasing use of solar energy is to fulfil its many promises. There is no doubt that creative technological and scientific skills are distributed much more widely among the population than our educational classification scheme and division of labor would have us believe, and there seems every indication that alternative technology must largely be done **by** the people, if it is to be truly **for** the people.

Certainly the deeper experiences to be won by 'creating' a new piece of technology and through it attaining a more harmonious, sympathetic relationship to the environment are lost if say a solar water heater — one of a million all the same — is simply bought over the counter and installed 'professionally'.

Whatever you think of Captain Eddy's solar system — you've got to admit it's original!

John Andrews



And What Do The Solar Companies Say?

Sandy Poulsford of FOE (S.A.) interviews John Hibell, Marketing Manager of Beasley Industries Pty Ltd, Adelaide, the largest Australian manufacturer of solar hot-water systems.

FOE: What do you see as the main barriers to increased use of solar energy?

J.H.: I think there will always be a problem with the price of raw materials involved in any hot water system. The first object will always be to keep costs down.

If we could have reduced our pricing on solar to only 50% more than an electric system, the market would have developed to a great extent long before this, so I think we have to say that cost is the major factor.

FOE: In South Australia the government is looking at the possibility of legislation to require new houses to install solar water heaters. Is this a realistic move at this stage?

J.H.: I think it is very realistic. Already the local Housing Trust has indicated very strong interest in solar hot-water systems, and only three or four weeks ago quite a number of our units went up to Whyalla to be installed for a testing period.

I would say without doubt that if the government is satisfied with the performance of these units over the next 12 months, then for a start every government home in this state would have a solar hot-water system installed.

Eventually, this may pass into the consumer area. But we're still up against this cost factor. That's the main thing to the consumer.

FOE: How do the economics of solar compare with conventional systems?

J.H: If you look at total supply and installation of an average size family unit, you are probably looking at around double the price of replacing an existing electric hot-water system and installation. From what we know of current power costs in this state, the extra outlay for solar would probably be recouped in round about five years assuming that the power authorities raise their charges on the same scale as they've done over the last 2 or 3 years. If they go over that, obviously the recovery period is a lot shorter.

FOE: Who constitutes the main market at present for solar hot water systems?

J.H: The market for solar in Australia is still, I believe, in the domestic side, probably 99%.

FOE: Do you see the main impetus for change from fossil fuels to renewable energy coming from government, or from companies like yourself, or only by gradual public acceptance.

J.H: The consumer, or public acceptance, is going to force the government into this anyway. Let's face it, every government in the world is very aware of this. We've had so much talk about the energy crisis over the last couple of years particularly. And I've got no doubts in my mind that governments world-wide are now treating solar energy, very, very seriously.

FOE: Coming back to Beasleys—is this just another job to staff and factory workers, or do you feel part of some sort of historical process?

J.H: Very historical. A lot of our factory workers and our staff are long-standing employees of Beasleys. They go back to the days of the founder of the company. Some of the employees in my division have been here 18-22 years. It's very much a family concern. We suffer probably the least amount of industrial strife of many industries.

RENEWABLE ENERGY INCOME FROM THE SUN

SOLAR WATER HEATING

John Andrews

TAKING THE INITIATIVE

The area of solar water heating is particularly suited to participatory creative technology on the part of people with no specialist training in engineering or the sciences, or in metal working, plumbing etc. In the bargain people can initiate directly a change in patterns of energy consumption, and become a bit more independent of centralised energy-production agencies. Solar water heaters are small-scale devices, reasonably inexpensive (and can be incredibly so if you're good at recycling throw-away materials), and they are not too complex for ordinary people to understand. However, so many variations in design are possible that they are great for bringing out the inventive talents which are so suppressed in most people's working lives today.

Compared with the **total** primary energy consumption[1] in Australia at present, the percentage that would actually be provided by the sun if all houses were fitted with solar water heaters is quite small — only 1.5% of the total[2]. Currently, however, a meagre 0.01% is obtained from solar collectors, most of these being in Western Australia and the Northern Territory. The total energy consumption here though refers to industrial, commercial and household use, and when you limit consideration to just the household sector, the energy saved by fitting solar water heaters begins to look more significant.

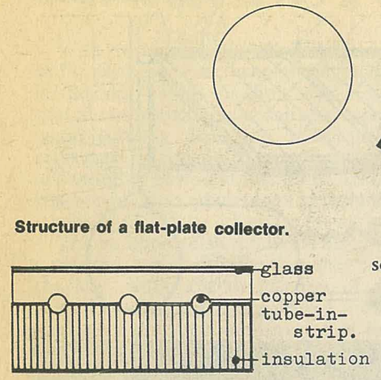
In the average house in Australia, about 50% of energy consumed is for space heating, 25% for water heating, and 25% for cooking, lighting etc[3]. Water heating is thus the second major energy consumer in the home and by fitting a solar water-heating system between 60 and 90% of this demand can be met by solar energy, the precise value depending on where you live.

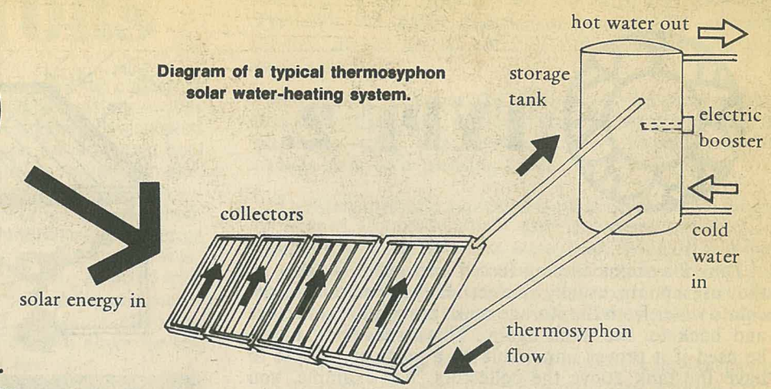
In the last *Chain Reaction* the idea of whole energy analysis was described[4], so: How long does it take for a collector to absorb a quantity of energy equal to that needed to produce the copper, glass, insulation etc., which have been used to make the collector? Well, CSIRO say[5] it's only about six months on the average in Australia, and with an estimated lifetime of a collector of 20 years, that's a very favourable energy balance.

Further, a recent estimate by CSIRO of the total quantity of primary energy in the form of low-temperature (<150°C) heat which could in practice be supplied by solar collectors by the year 2000 suggests that there would be no materials-shortage problems — e.g. with copper or glass — if all houses were to be fitted with solar water heaters by the end of this century[6].

SYSTEMS

The following is an attempt to review information on solar water heating which is relevant to the Australian situation. The review is far from comprehensive, but references are given where points merely mentioned in passing here can be followed up in detail. Mainly I hope to communicate the principles behind the design of solar water heaters and then to give a few ideas and practical hints for people to improvise on for themselves.





TYPE 1.

There are two main types of solar hot water system. *Type 1* relies on natural circulation, called thermosyphon action.

The sun's rays heat the blackened collector plate which in turn conducts heat to the water in the vertical tubes soldered to the plate. The density of the water falls so it rises up the tubes, to the horizontal 'header' pipe at the top, and on up the insulated pipe to the hot-water storage tank. Meanwhile cold water flows from the bottom of the tank down to the lower header pipe of the collector, and so the cycle begins.

During the day hot water gathers in the upper part of the storage tank. Provided the top of the collector is below the bottom of the tank and the connecting pipes are well insulated, the circulation stops when there's no sun.

This is the type of system CSIRO have done most work on and which is used in the majority of commercial solar water heaters available in Australia. Unfortunately the 1964 CSIRO Circular No. 2, *Solar Water Heaters*, which gives full constructional details of such a system, is now out of print and I was told that there were no immediate plans to publish an updated version[7]. We therefore intend to publish do-it-yourself plans for a CSIRO-type thermosyphon system in a later *CR*.

A solar hot-water system tucked away at the back of a house in Surrey Hills, Melbourne.

TYPE 2.

Type 2 systems employ forced circulation — that is, they use a pump, usually an electrically driven one, to circulate water from the storage tank through the collectors and back to the tank again . This arrangement has to be used if it proves impossible on a particular house to have the tank above the collectors. For example, you would use this arrangement if fitting a solar water-heating system in a house which already had a hot water tank at ground level and you wished to have the collectors on the roof.

A complication is though that you require a thermostatic control system which stops the pump when the temperature of the collector plate falls below that of the water in the tank — otherwise the water would continue to circulate on cold days or at night, radiating the heat collected back into space to warm up the clouds! A suitable control circuit is described in ref. 8. Ref. 8 also tells you about pumps, which need only be small, 3 watts or so, if the collectors aren't too far above the tank.

A neat alternative to a control system is to use a small pump powered by a 6 V, 0.3 A silicon solar cell, which automatically will operate only when the sun shines, and it requires no external power source[8].

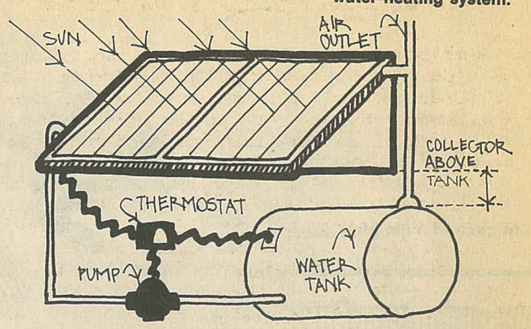
Another form of forced-circulation system uses the sloping roof of a building as the solar collector. This arrangement, first proposed by Harry Thomason in the USA (see ref 9 for three solar houses he's built), has been used by Biotechnic Research and Development (BRAD), originally a group of 10 adults and three children, on their communal house in Wales[10].

Unlike many 'experimental' autonomous houses where the interest is entirely on the hardware, the people in the BRAD commune actually have to *live* with the results of their work, and of course live with each other. As Phillip Brachi, one of the group describes[10]: "Experiments to gauge the roof's performance, for instance, are enlivened (poor Brum would say hampered) by such things as others in the community wanting to wash their hands, cloudy Montgomeryshire days, and the demands of bees, goats, and hay-making upon one's own time."

Back home, the 'Autonomous House' built in the grounds of Sydney University by a group of seventeen 2nd and 3rd year architecture students is again an eco-house which is lived in, full-time. The house was designed to provide permanent living space for four people, and it continues to evolve as the occupants directly experience the social and technical implications of the 'alternative' building they've created. (See *Comtec* for their comments and illustrations).

The clever solar hot-water system they use has a blackened 44-gal. drum doubling up as the absorber and storage tank. Reflectors either side concentrate solar radiation on to the drum, hence increasing the effective collection area. Improvements planned at present include an insulated cover to the system which can be opened during the day and closed up at night, and the use of a longer, narrower drum as absorber.

Diagram of a forced-circulation solar water-heating system.



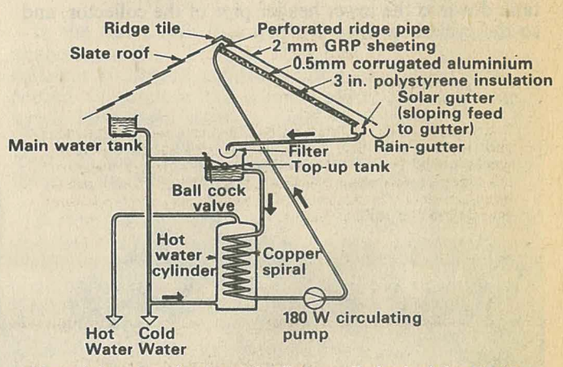


Photo (above) and schematic diagram (below) of the BRAD commune's solar roof in Wales, U.K.

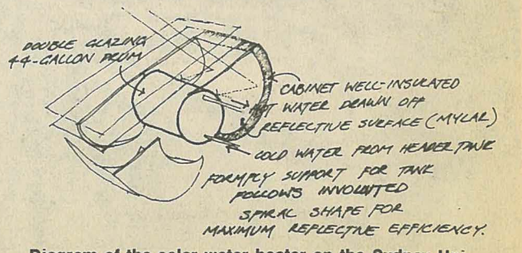


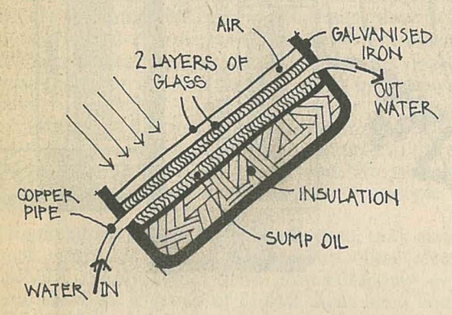
Diagram of the solar water heater on the Sydney Uni autonomous house.

COLLECTORS

With the exception of the last system, all the collectors so far described have been of the flat-plate variety — that is, they don't focus the sun's rays. It is generally accepted that these are the most suitable type for domestic hot-water systems. Focusing collectors — parabolic dish reflectors or parabolic mirror cylinders (see below) — allow higher temperatures in the absorber to be reached, but this is of no advantage for simple hot-water systems where 57°C is quite adequate for all household purposes.

The parabolic dish reflectors also have to be fitted with a tracking mechanism so that they follow the sun across the sky, while the orientation of parabolic cylinders should be changed about once a month to allow for the change in the sun's path over that period.

Another disadvantage of focusing collectors is that they cannot make use of the diffuse component of sunlight. This is what you see when the sun goes behind a cloud, and it consists of solar radiation which has been scattered in all directions by the earth's atmosphere. Typically, the diffuse component accounts for between 20-40% of the annual total of radiation reaching the earth's surface.



A collector using old sump oil (the more carbon the better!) as the absorber. The designer claims the sump oil works better than a flat-black surface on copper because the steep temperature gradient across the black surface is avoided, and convection of the heated oil improves heat transfer to the riser pipes.

Above 60°C, however, the efficiency of flat-plate collectors falls off rapidly, so that if this 'higher grade' heat is required — e.g. in a solar cooker — it's necessary to change over to a focusing type..

The structure of a typical flat-plate collector is shown on page 15. Copper is usually used in preference to steel or aluminium as the absorber plate, even though it is more expensive, because of its resistance to corrosion, and its ease of soldering and forming. A thermal paste can be used to ensure good thermal contact between riser tubes and absorber plate if aluminium or steel is used.

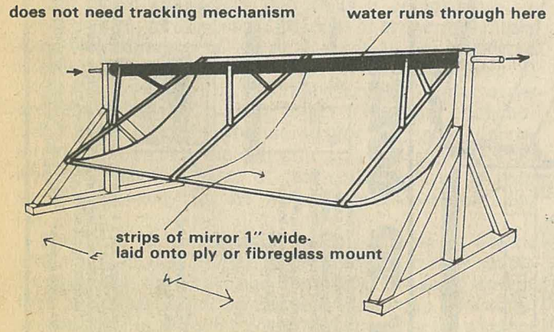
Other promising ideas for DIY collectors include using old pressed-steel central-heating radiators, painted matt black and set in a polystyrene box", and using old sump oil in a tray with double glazing[12]. See also ref. 13; and refs. 4-7, of Solar Space Heating article.

A good flat-plate collector transfers about 50% of the energy reaching it to the water flowing in the riser tubes. However, when heat losses from the connecting pipes and storage tank are counted, the overall collection efficiency drops to about 40-45%.

Over the past years a lot of work has been directed at improving this efficiency. The problem is that copper surfaces painted matt black are good absorbers of solar radiation, but they are also good emitters of heat — infrared radiation — as well. To reduce this infrared emission CSIRO have developed 'selective black' surfaces which are excellent absorbers of sunlight, but poor emitters in the infrared. However, the efficiency of the collector is only improved about 5-6% by this treatment and three large tanks with heaters are required to prepare the selective surface on copper plate, making the process very expensive for the do-it-yourselfer. It doesn't sound too difficult though, and practical details are given in ref. 14.

Long-term measurements of solar radiation have shown that the best setting for a flat-plate collector at a particular location is to point it north, with its plane at an angle to the horizontal of 0.9 x latitude of place.

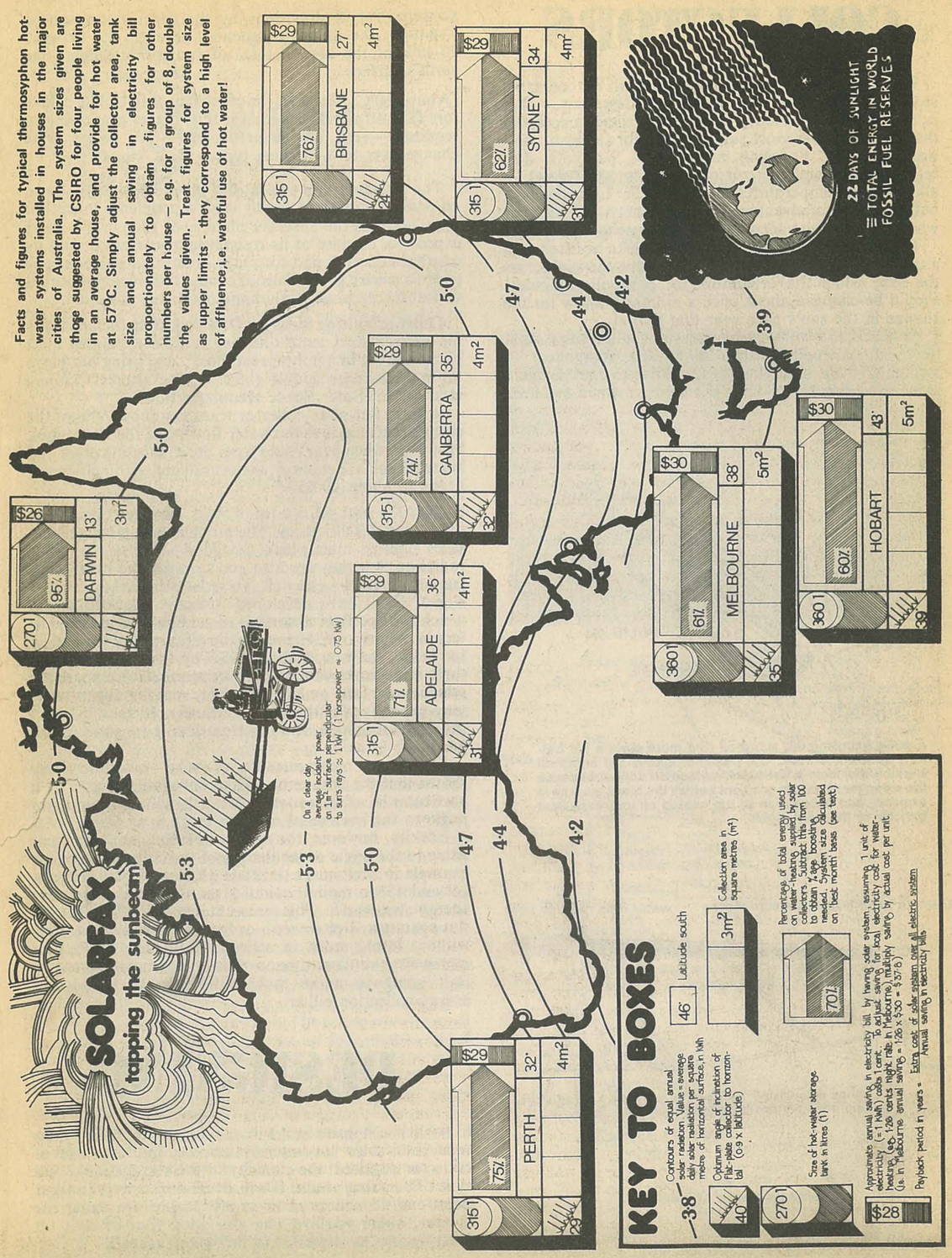
Luckily, however, the energy absorbed isn't too sensitive to the angle of inclination of the collector, and for example in Melbourne (latitude 38°S) anywhere between 25° and 45° to the horizontal gives about the same total energy absorbed[15].. This means that you can fit collectors flat against a ¼-pitch roof, or better, instead of the tiles, without losing much in collection efficiency[16].. Plus or minus 5° or so from true north (n.b. not magnetic north) isn't going to make much difference to year-round energy-collection either.

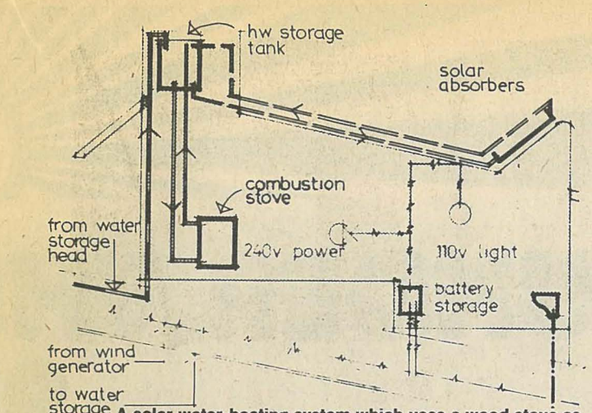


A parabolic mirror cylinder.

DESIGNING

Basic decisions to make if you're going to build a thermosyphon solar hot-water system are: the total area of collector required; the capacity of the storage tank; and type of boosting needed if any. Now the answers to these questions depend on how many people are using the system, where you live, and also upon your lifestyle (at least insofar as it relates to hot-water usage!).





A solar water-heating system which uses a wood stove as a booster. (See page 23 for photo of house.)

The *Solarfax* map opposite should help you to make these initial design choices. The values quoted were obtained from CSIRO publications and refer to an average family of four in an average house. The tank sizes given allow 1½-2 days supply of hot water to be stored, assuming a daily hot-water usage of 45 litres per person. Larger tanks are recommended for higher latitudes since in these regions overcast periods tend to be more prolonged.

It's best to treat these values as upper limits since they correspond to pretty high comfort levels and allow very flexible — wasteful? — use of hot water. By changing your patterns of hot-water usage to harmonise with the sun's rhythms — e.g. using hot water mainly in the early morning — smaller systems can be used. The system size really depends on the adaptability of the people concerned.

To amend the figures for collector area, tank size and annual saving in electricity bill, for other sizes of household, simply adjust them proportionately — e.g. double them for a group of 8, half them for a couple.

The systems shown were designed on a 'best month' basis. This means that the system would supply all the energy your hot-water needs during the best month of the year for solar radiation (Dec.-Jan.), but for the rest of the year some form of boosting would be needed to keep the water temperature up to 57°C. Values for the annual percentage of energy used for water heating which is supplied by the collectors are included on the map. Subtract these from 100% to find the amount of boosting needed.

The use of a booster represents a compromise — usually a compromise in the interests of economics rather than fuel conservation — so it needs to be considered carefully. The problem is that, in southern parts of Australia especially, considerably larger collector areas are required if you're going to get 100% solar contribution all the year. In Melbourne, for example, approximately three times the collector area is required for an all-solar system[17]. Most of this collector area is then superfluous except for the two or three coldest months of the year.

Nearly all the commercial systems employ an electric immersion-heater booster in the storage tank. It should be noted that the heater and thermostat in a solar storage tank are fitted higher up the tank than in an all-electric system, and in different positions depending on whether the supply to the electric heater is continuous or off-peak night rate only (see refs 17,18). For a neat way of fitting solar collectors to an existing all-electric hot-water tank, requiring no extra holes in or fittings to the tank, see ref. 8.

One of the best solutions to the boosting problem — avoiding the use of electricity altogether — is to use a slow-combustion wood stove as the booster. Such a stove is used most in winter, for cooking, heating etc., and this is just the time when you need the extra heat for the hot-water system.

ECONOMICS

The economics of domestic solar water-heating systems are a complicated business, and (excuse the puns) not a very profitable exercise.

A lot is made of the so-called 'pay-back period'. This is usually found by working out the **extra** capital cost of a solar system over and above an all-electric hot-water system, and then finding out how many years it takes to recoup this extra outlay by your savings in electricity — at current electricity prices. If you assume an extra capital cost of $100 per m² of collector, the values for electricity saved given on the *Solarfax* map allow pay-back periods to be calculated for cities around the country.

More sophisticated analyses of economic viability take into account the fact that you could have invested this extra capital spent on a solar system, so that the interest you would have received each year should be counted as an annual cost of the solar system[17]. They also consider maintenance charges, though these tend to be very low (especially if you clean the collectors yourself!).

Alternatively some analyses suppose that you *borrow* the extra capital required, and count your yearly repayments plus interest as an annual cost. Nicholls[21] has done a detailed analysis of the latter type for N.S.W., and concludes that "solar energy is far cheaper than electrical energy for low-temperature heating purposes, if it is given capital at the same price as that enjoyed by the electricity generating industry."

In summary then, economic viability depends critically on the cost of the energy you're saving with your solar system, and on the interest rates on your capital expenditure.

The cost of the fuel saved is really the key factor. For example, if you double the cost of off-peak electricity, you half the pay-back period. It's the fact that electricity for water heating in Perth is three times more expensive than in Melbourne (3.85 c compared with 1.26 c/kWh), not so much that Perth is so much sunnier, that gives solar water-heating systems in Perth a 3-4 year pay-back period compared with over 10 in Melbourne.

Rising costs of conventional fuels over the coming years are therefore likely to make any estimate of pay-back period for solar systems wildly inaccurate. Furthermore, if you make your collectors for yourself you'll save a great deal of money and recoup your extra outlay much more quickly than with a commercial system.

Economic analyses of solar energy are most notable for what they leave out. Most of the real benefits in going solar just cannot be expressed in economic terms. How can you estimate the monetary value of leading a life closer to natural rhythms which feels better? Of using a clean endless source of energy? Of gaining greater individual autonomy?

Continued on page 22

UNDER THE TROPICAL SUN

DARWIN TAKES OFF ON SOLAR POWER

Barbara James

It is perhaps ironic that Darwin — within 250 km of some of the world's richest uranium deposits and thus potential nuclear-energy source—is almost certainly the world's most enthusiastic per-capita user of solar energy.

Solar hot water systems, for instance, have virtually become an accepted part of the "Darwin way of life" and have been increasing in popularity ever since the introduction of the CSIRO-tested units in the early 1960's. And the fact that the Department of Northern Territory has chosen to continue its policy of installing the systems on all government homes following the devastation caused by Cyclone Tracy is persuasive testimony to their long-term economic sense.

Let's look at some relevant figures.

According to a Department of Housing and construction estimate, the total annual cost of using a solar system in Darwin/Alice Springs over a 15-year period is approximately half that of using an electric unit over the same time period. This is despite the fact that the capital cost of solar systems in the Territory is several hundred dollars more than electric systems.

The difference is accounted for in annual operating costs—nil for the solar system and an estimated $220 for the electric system. For instance, according to available figures, the approximate cost (including installation) of a 270-litre solar hot-water unit in the Territory in 1974 was $990 while for the electric system it was $600.

Over a 15-year period, the fixed charge (calculated with an 8.5% interest rate) for the solar system per year would have been $118.8,, while for the electric system it would have been $72. However, added to the cost of the electric system was about $177 per year operational costs, making the total yearly cost of the solar system $138.8 compared with $269.4 for the electric system. A price of $20 has been added to both figures to account for maintenance. The total daily cost for the solar system was estimated at $1.91 compared to $3.71 for the electric system.

By 1978 it is estimated the daily cost of a 270-litre solar unit will be $2.66 while for the electric system it will be $4.69. The fact that domestic electricity charges rose by between 39-50% in Darwin last July is strong testimony that operational charges are not likely to get cheaper.

All right, so solar systems are the better long-term economic proposition, but do they work? Again, let's look at the figures.

Prior to Cyclone Tracy, there were about 2270 solar hot-water systems on government homes in Darwin. Most of these, of course, "went with the wind". But because of the economic sense and satisfactory performance of the systems the government immediately reimplemented its policy of installing the systems on all new and rebuilt government homes in the city. It is estimated that by the end of this financial year almost 2200 government homes will again have the solar units.

In addition, there are 102 solar units on government homes in Katherine, 52 in Tennant Creek and 386 in Alice Springs, making a total of another 540 units in major Territory centres outside Darwin. By July next year that total is expected to increase to about 700. As well, there are another 968 solar units which have been installed throughout the Territory on what is described as "defence and other" homes. Thus within another year there will be near to 4000 solar hot-water units officially installed in Territory homes.

Add to this several hundred more for private sales from Darwin firms or agents and another hundred or so for private sales through southern firms — as well as larger units operational on several hostels, hotels and similar institutions—and the figures rise again. It would probably be reasonably safe to say that between one-fourth and one-third of Darwin homes have solar water units — surely an indication that they are not only 'economical' but also very satisfactory.

It does help of course, to be living in a tropical belt which averages 8.5 hours of sunshine daily, reaching a peak of 10.3 hours in August and a low of 5.9 in January and February. It has, for instance, been estimated that the rate of solar hot-water efficiency (the percentage of the total energy used to heat water supplied by solar means) in Darwin is 90-100%, compared to 80-85% for Alice Springs, 75-80% for Perth and Brisbane, 70-75% for Adelaide, 65-70% for Melbourne and 60-75% for Sydney.

It should be remembered, of course, that Melbourne is on approximately the same latitude as much of California where solar-energy usage is increasing quite dramatically at present. And, for those concerned about cloudy days, it should be pointed out that most collectors now can store at least a day's supply of hot water in an insulated storage tank — and that, if really necessary, electric boosters can be installed along with the solar units as "back-up" supplies.

Many people up north, the residents of Darwin in particular, are becoming interested in living more self-sufficient lives The cyclone which virtually destroyed Darwin in 1974 gave many residents the opportunity to reassess and to then change their values and lifestyles, and some interesting and exciting things are beginning to happen here. For one thing, many residents who are privately rebuilding their homes are trying to utilise as much salvaged cyclone material as possible — even if it only comprises a small part of the total home — i.e. doors or walls. Others are taking low-energy — low-cost ideas even further and designing their homes with more thought to incorporating natural ventilation systems and shading devices to help control the sun's heat, rather than be dependent on artificial cooling systems. Still others are attempting to become as self-sufficient as possible while maintaining a lifestyle more in harmony with the natural environment.

At least three families, for instance, have purchased 'eco' toilets which purport to achieve continuous, uniform and biological decomposition activated by mesophilic micro-organisms, and receive organic kitchen refuse, newspaper and waste paper as well as human waste. The toilets produce a fertilizer and a soil amendment and also reduce domestic water consumption.

Another family, who have purchased a five-acre block outside of Darwin, have dug their own water bore and have used salvaged cyclone material for much of their building program. To keep costs down they purchased a steel frame for a demountable house and have bricked it in for the necessary sheltered rooms such as toilet and pantry. The ceiling is to be made from discarded timber from glass crates and the verandah is comprised partially of salvaged louvre frames. The home is designed to catch maximum breezes and require as little centralised power as possible.

Another young family building a home on a five-acre block near Darwin plans to use the absolute minimum of 'artificial-type' power. For instance, they intend to experiment with growing cassava, the rootstocks of which yield a starch which can be used to produce alcohol for power and lighting purposes.

The Darwin Sun Club is awaiting approval of a 53-acre lease near Darwin where they hope to build a clubhouse, sports course and a few cabins for use by visiting sun-club members. Being obvious nature enthusiasts they are trying to design a system which will most retain the natural aspect of the area they hope to manage. They are investigating ways to use sewerage (i.e. as a fertilizer) and wind energy. They intend, for instance to use windmills to pump the water for the swimming pool they will build and would like to incorporate wind generation for power and lighting if they can get approval from the appropriate authorities!

Another group of people is examining the feasibility of building a fully autonomous house in the near Darwin area with cooking and lighting powered by solar, wind and other alternative energy sources. They will emphasise an integrated, decentralised self-sufficient system. As a start they have built a five-foot solar cooker, using mirrors for the reflective surface, and report that it is an excellent solar 'crock pot', letting food cook slowly all day.

The group which is perhaps dealing with the low-energy — low-cost concept most seriously and on the most ambitious scale is the Northern Territory Environmental Council. The Council, through a "low-energy alternatives" project it has initiated under the name "Solarwise", is examining aspects of designing, building and costing a total energy village for about 50 people in a semi-rural tropical area. Local architects as well as architectural students from queensland University are assisting with the feasibility study. There has also been interest and co-operation from government officials.

It is envisaged the project village would house between 20 and 50 family groups and incorporate such concepts as solar power, residential conservation, a sewerage system maximising the efficient use of wastes and recycling excess water for agricultural purposes, and a recycling garbage system. It would also make maximum use of shared facilities and equipment. More details of this solar village, as it is being unofficially termed, will be made available as plans progress.

The Environmental Council has also been promoting the concepts of soft technology, solar in particular, by organising workshops and seminars with acknowledged experts in the appropriate fields. Author-architect, Mr Steve Szokolay, of Queensland University; Dr Don Close of North Queensland University; and Dr Mat Darveniza, of Queensland University have been among those assisting to enthuse the Darwin public about alternative energy sources. They have discussed in detail solar storage, cooling and collectors as well as solar power systems for isolated rural dwellings.

So that at least in Darwin, and some other Territory centres, the public is being informed of alternatives to nuclear and other high-energy sources. And until many of those concepts become more widely used and readily available to people throughout the world, it is encouraging to see at least part of Australia taking great advantage of its greatest natural resource — the sun.

Commercially-made Solar Water Heaters

SOLAR WATER HEATING
Continued

Below is a list of the principal commercial manufacturers and distributors of solar hot water systems in Australia — a list I include with mixed feelings. As argued earlier, many of the rewards of solar energy are lost if you're not participating directly in the whole process of design, manufacture, installation, as well as using a solar device. Only this way do you get a deeper understanding of your relationship both with technology, and with the sun itself.

But, being realistic, I can't see most people at present having the time, resources (money, tools?), or inclination, to construct solar devices for themselves. On the other hand it remains important that solar energy is used right away: in Australia, mainly to reduce demand for electricity and hence conserve fossil fuels and reduce pollution at the power station end; overseas, to prove that nuclear power is unnecessary as well as being so undesirable.

In the short-term then, I think the solar - energy industry has a role to play — hence the list! — but longer-term, we should look for alternative modes of production, involving alternative relations of production. Detailed discussion of this possibility will be published in future articles in *Chain Reaction.*

A few notes on the list of commercial firms:

The Beasley collectors are the only ones to have a selective surface and are widely regarded as the most efficient of those manufactured in Australia. Each collector is 0.75 m^2 in area and costs (at present) $77.25.

Typical prices of storage tanks suitable for solar systems and fitted with electric boosters range from approx. $210 for a 180-litre tank to $270 for a 370-litre tank.

Many commercial systems now have the collector and storage tank combined in one unit for ease of fitting to the roof. Interesting new developments include the Philips evacuated tube collector, an Israeli design which has closely spaced black fins around the riser tubes (like the panel at the back of a refrigerator) so that incoming sunlight is 'trapped' by multiple reflection and absorption[19], and a fibre-glass reinforced plastic collector[20] designed by Applied Research of Australia which has two sheets of glass above a layer of black plastic, the water to be heated flowing between the plastic and the inner glass sheet.

But beware! In the words of Bob MacDonald, Laboratory Manager at Melbourne University's Department of Mechanical Engineering which is engaged in solar energy research and development, "A lot has happened in the area of commercial solar systems in the past few months and a lot of rubbish has come on to the market." No one I spoke to had a good word to say about the imported plastic collectors which have recently appeared in Australia, though Applied Research claim high efficiency for their new design.

There is one situation that I think should be changed. CSIRO have done tests on the performance of most of the commercial solar water-heating systems available but are not able to release these details to the public. There seems no reason why this information should not be publicly available.

SOME MANUFACTURERS AND DISTRIBUTORS OF SOLAR WATER HEATERS

NEW SOUTH WALES

Braemar Engineering Co (NSW) Pty Ltd
167 Bonds Road
PUNCHBOWL, 2196

Solarhot Water Systems
34 Flinders Road
EARLWOOD, 2206

Solar Boost Australia Pty Ltd
80 Wentworth Road
HOMEBUSH, 2140

Sunray Solar Systems
292 Pittwater Road
NORTH RYDE, 2113

George Wills & Co Ltd
45 Clarence Street
SYDNEY, 2000

Australian Solarway Pty Ltd
59 Hunter Street
HORNSBY, 2077

P.G. Solar Plates
10 Old Lake Road
PORT MACQUARIE, 2444

QUEENSLAND

Braemar Engineering Co (Qld) Pty Ltd
Bilsen Road
GEEBUNG, 4034

Queensland Solar Systems
Lot 141, Herbert Street
SLACKS CREEK, 4127

Solar Heating Services
14 Aerodrome Road
MAROOCHYDORE, 4558

Thermax Electric Water Heaters Pty Ltd
15 Curtin Avenue
HAMILTON CENTRAL, 4007

George Wills & Co Ltd
146 Mary Street
BRISBANE, 4000

SOUTH AUSTRALIA

Beasley Industries Pty Ltd
Bolton Avenue
DEVON PARK, 5008

Applied Research of Australia
13 Durant Road
CROYDON PARK, 5008

Braemar Engineering Co (SA) Pty Ltd
Findon Road
KIDMAN PARK, 5025

TASMANIA

Braemar Engineering Pty Ltd
14 Wenvoe Street
DEVONPORT, 7310

George Wills & Co Ltd
57-63 Canning Street
LAUNCESTON, 7000

VICTORIA

George Wills & Co Ltd
203 King Street
MELBOURNE, 3000

Wilson Solarlite
16 Thornton Crescent
MITCHAM, 3132

Yazaki Pacific Pty Ltd
16 Eastern Road
SOUTH MELBOURNE, 3205

Autonomous Energy Systems
25 McLachlan Street
MOUNT WAVERLEY, 3149

Earth Resources
74 Henderson Road
NORTH CLAYTON, 3168

Somer Solar Installations
Sandy Point Road,
SOMERS, 3927

WESTERN AUSTRALIA

S. W. Hart & Co Pty Ltd
112 Pilbara Street
WELSHPOOL, 6106

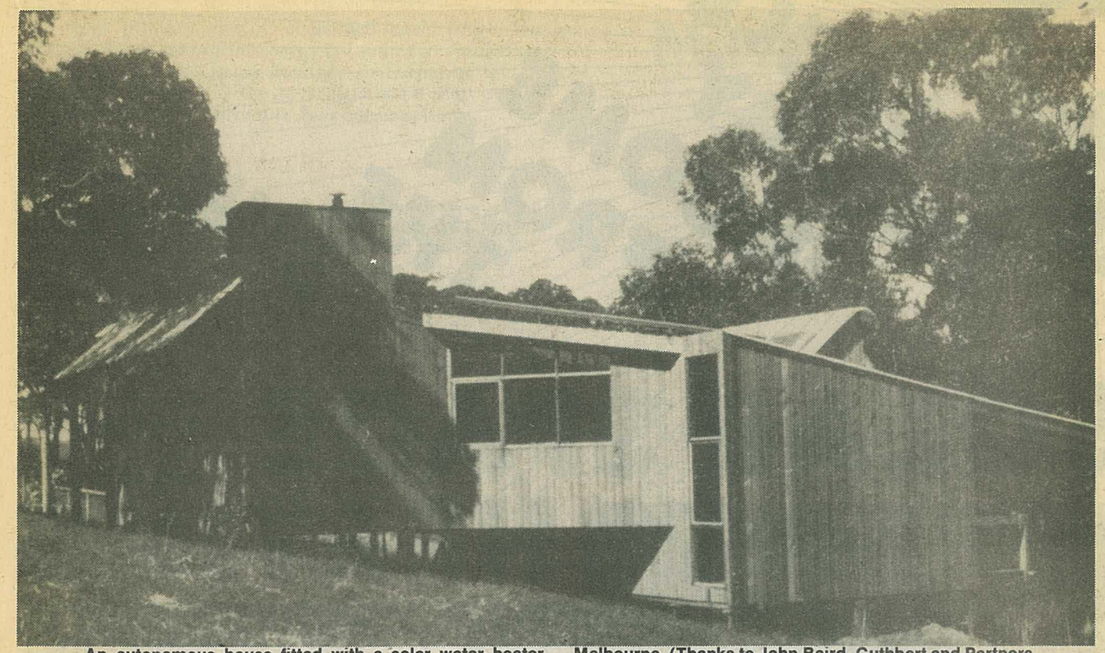
Smalls Solar Heeta Co
10 Goongarrie Street
BAYSWATER, 6053

Sola-ray Appliances
6 Boag Road
MORLEY, 6062

Western Iron Works Pty Ltd
1 Strang Street
SOUTH FREMANTLE, 6162

George Wills & Co Ltd
136 Fitzgerald Street
PERTH, 6000

Solar King
4 Collingwood Street
OSBORNE PARK, 6017



An autonomous house fitted with a solar water heater, wood stove, wind-electric generator and methane digester, located near Flinders on the coast south of Melbourne. (Thanks to John Baird, Cuthbert and Partners, the architects of the house, for photo and diagram on page 19.)

STORMING IVORY TOWERS

Finally here are a few suggestions for getting more information about solar energy generally, and a way of making professional solar scientists more aware of the community's needs.

Although most solar scientists do not have much contact with the general public concerning their work, usually when you speak to them over the phone or go to see them they are more than willing to talk about their projects and help you out with technical problems. A comprehensive list of Australian solar scientists together with their area of specialisation is given in ref. 22.

Choose a scientist working in the area you're interested in, and get in touch. It should be a mutually rewarding activity.

NOTES AND SOURCES.

1. Primary energy — fuels such as petroleum products, coal, natural gas and hydroelectricity. Any gas or electricity manufactured from a primary fuel such as coal is classified as a secondary fuel.
2. CSIRO Solar Energy Studies Unit, Submission to Senate Standing Committee on National Resources, Enquiry into Solar Energy, 28 May 76, p.5.
3. *Energy Costs of Dwellings*, E.R. Ballantyne, 5th Australian Building Research Congress — Resources *.
4. *Chain Reaction*, **2** (2), 30-3.
5. Estimate by R.N. Morse, CSIRO Solar Energy Studies Unit.
6. Ref. 2 states that there is no technological reason why 1 x 10^{18} Joules of heat per year could not be provided by the year 2000 from solar collectors. This quantity is about 5x the energy needed to satisfy the 1972 level of Australia's domestic *space plus water* heating demand, leaving 4/5ths of the solar energy collected for industrial use.
7. You might find it in libraries, though.
8. *The addition of Solar Collectors to Domestic Hot Water Systems*, J. T. Czarnecki, 1975*.
9. *Solar Energy and Building*, S. V. Szokolay, 1975 (Architectural Press, London), 81-3. This book has a good illustrated review of solar houses around the world.
10. *Sun on the Roof*, P. Brachi, *New Scientist*, 19 Sept. 74, 712-4.
11. *DIY Sun, Undercurrents*, No. 10.
12. Clive Coogan, CSIRO Div. Chemical Physics, Melbourne, has constructed a test-model sump-oil solar collector.
13. Over the past few years *Popular Science* has published many new ideas for solar collectors.
14. *Spectrally Selective Blacks for Solar Energy Collection*, E. A. Christie, International Solar Energy Society Conference, Melbourne, 1970.* *Selective Surface Studies*, A. F. Reid, K. J. Cathro, *Solar Energy Progress in Australia and New Zealand*, No. 14, July 75, p.15. See also H. Tabor, *Selective Surfaces for Solar Collectors*, ch. IV of ref. 30, "Solar Space Heating" article in this *CR*.
15. Yearly solar irradiation tables are available for about 20 locations from CSIRO Solar Energy Studies Unit, P.O. Box 89, East Melbourne, Vic. 3002.
16. *Solar Water Heating in Australia*, E.T. Davey, International Solar Energy Conference, Melbourne, 1970.* Quite a few helpful practical hints in this short paper.
17. *Solar Water Heaters*, CSIRO Div. Mech. Circular No. 2, 1964, p.11.
18. *Domestic Solar Water Heating*, CSIRO Div. Mech. Eng. leaflet, 1976.*
19. Available through Autonomous Energy Systems, 25 McLochlan St., Mt Waverley, Vic. 3149.
20. Made by Applied Research of Australia, Adelaide.
21. *An Economic Case for Solar Energy*, J. Nicholls, Total Environment Centre, 18 Argyle St, Sydney 2000.
22. Solar Energy Progress in Aust. and N.Z., No. 14 July 75. Costs $3.*

* Available from CSIRO Division of Mechanical Engineering, PO Box 26, Highett, Vic., 3190.

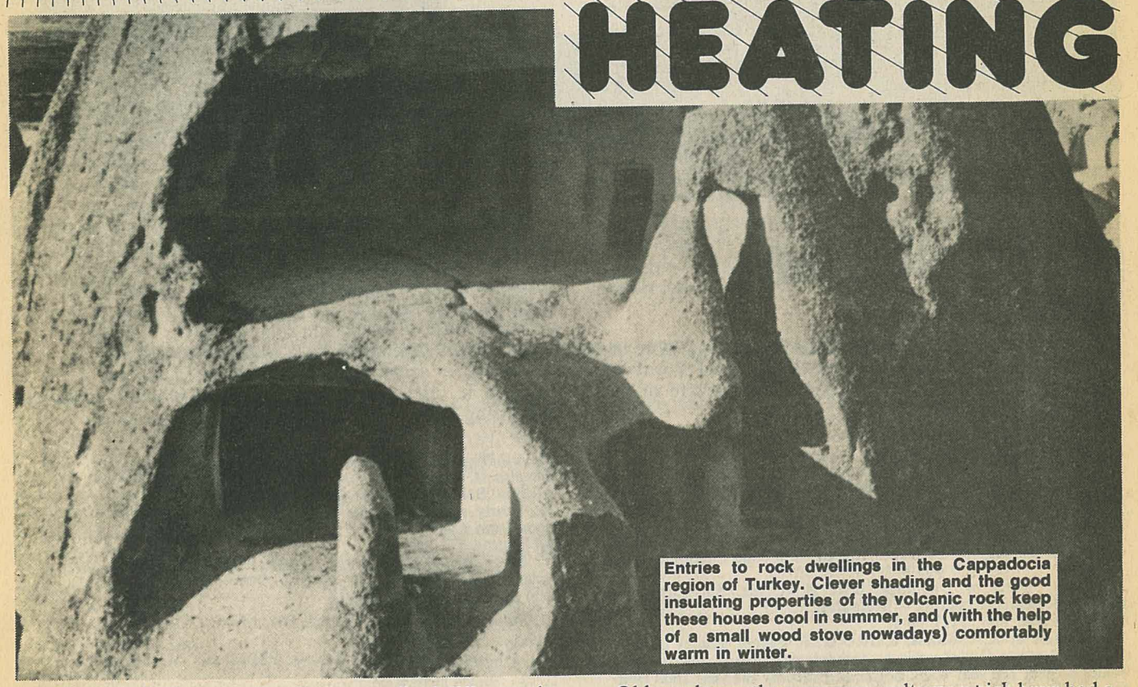
OTHER LITERATURE

1. *Energy Primer* (Portola Inst., Menlo Park, California) has a useful chapter on solar energy, plus a good bibliography and a detailed appendix on theory.
2. Another useful solar (and alternative technology generally) bibliography is given in Peter Harper's "Directory of Alternative Technology" published in the UK Journal, *Architectural Design*, Nov. 74, April 75, May 75).

RENEWABLE ENERGY INCOME FROM THE SUN

SOLAR SPACE HEATING

Peter O'Hannessian
John Andrews



Entries to rock dwellings in the Cappadocia region of Turkey. Clever shading and the good insulating properties of the volcanic rock keep these houses cool in summer, and (with the help of a small wood stove nowadays) comfortably warm in winter.

Fossil fuels for space heating or cooling? Who needs them? From Hobart to Darwin, from Perth to Sydney, in fact wherever you live in Australia, if your house is well designed it should require very little fuel for either space heating or space cooling. Fuel consumption for these purposes can be kept to a bare minimum by using a wise mix of shading, glazing, wall, roof and floor materials, and insulation, and design so that the sun's warming rays enter the building and are absorbed when you want heating, but are reflected away when you want to keep cool. Conversely, the extent to which you simmer inside your house on a hot summer's day, and how often you reach for the heater switch in winter, are direct indicators of how badly your house is designed from a thermal performance point of view.

Older cultures than our own, cultures which have had a much deeper respect for nature, show copious examples of architecture which is well adapted to the prevailing climate. Particularly vivid examples include the American Indian adobe buildings, the Sudanese mud huts, the Aegean Island Villages, the cool narrow alleys of Marrakesh, and the underground suntrap dwellings in the provinces of Honnan, Kansu etc. in China[1]. But in modern western architecture, the abundance, till recently, of cheap fossil fuels for powering space heating and cooling appliances has too often been the excuse for almost totally ignoring the sun in architectural design.

In this country, largely as a result of rising comfort levels, the domestic sector has become the fastest growing energy consumer[2], accounting for some 13 per cent of the total primary energy consumed each year[3]. On average 50 per cent of the energy consumed in Australian homes is used for space heating, so taking action to reduce this demand is the most significant step people can take directly to promote fuel conservation.

SOLAR HOMES

Solar energy is ideally suited for space heating. Firstly sunshine is uniformly spread over a given area, for example a city, and each building can act as its own solar collector. There are therefore no problems in distributing the energy to its point of use from central production stations as is the case with electricity, gas or oil. Secondly house heating needs only 'low-grade' energy, that is, a large amount at low temperatures, so the use of a 'high-grade' energy such as electricity for this purpose is very wasteful from an energy-efficiency point of view. 75 per cent of the energy content of the fuel used to produce electricity is actually lost before the old amps and volts get to your power point.

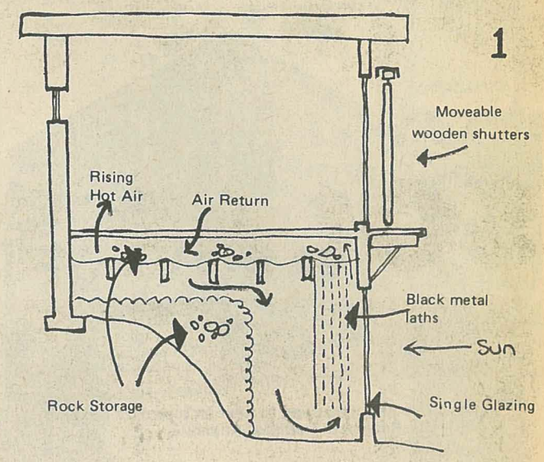
In a sense then all houses are 'solar' houses. They are subject to incident solar radiation throughout the year and the manner in which they respond to this, and to the surrounding air by losing heat, will largely determine their thermal performance and hence the amount of auxiliary heating they require. For example, in Melbourne a well-insulated house with a large area of north facing windows, with a suitable overhang of the eaves to shade out the higher summer sun, will use far less energy and be more comfortable than one with the same area of south-facing windows with little or no insulation.

Of course, some houses are more 'solar' than others and here we're going to be concerned with those which satisfy a large proportion of their heating demand by solar means. In the discussion that follows we'll distinguish between (a) **passive systems** in which by careful building design solar energy is used for heating purposes without the addition of special equipment; and (b) **active systems** in which solar collectors are installed to capture solar energy and this is conveyed by some means to the space to be conditioned or to an energy store. In type B systems the heat-transfer fluid may be either air or water, the latter having the potential of being used for both heating and cooling.

PASSIVE SYSTEMS

These are the simplest and most elegant solutions to the problem of heating a house by solar radiation. Passive solar houses can be built using 'low-technology' systems and can therefore be reasonably cheap. There are some very beautiful examples of houses of this type now in existence, so here's a quick review of some of these which should also show the basic design principles involved. (Note that the references given allow a follow-up of the detailed design of these houses.)

Masterson Studio[4]



1. The Masterson studio.

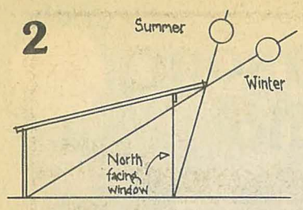
This is a one-storey one-room pottery workshop designed and built in 1972 by Mr and Ms Masterson at La Cienega, New Mexico, USA (lat. 35°N). Solar radiation is used in two ways. Firstly there's a large south-facing (we're in the northern hemisphere now!) single-glazed window allowing sunlight to enter the building directly, and keeping the heat in by the greenhouse effect. Two sliding covers, like barn doors, that can be closed manually are used to shade the window during summer and prevent excessive heat losses at night.

Secondly there's a vertical south-wall collector below the south window. This collector has a single layer of ordinary window glass at the front and the absorber is a corrugated steel sheet painted black. Four layers of black metal lathes between the glass and the sheet serve to increase the heat-transfer area. All air flow is by natural convection.

Air from the collector rises and flows through a layer of stones (20 tonnes) underneath the floor. Some heat is retained by the rocks, while the rest rises up through the floor by conduction, or through registers, into the studio above. Colder air falls into the basement space and back to the base of the collector.

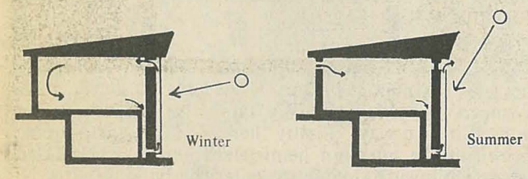
The percentage of heat supplied by the solar system has been estimated as 80 per cent with a wood stove providing the rest. The solar system has been found to provide heat to the studio even on snowy winter days.

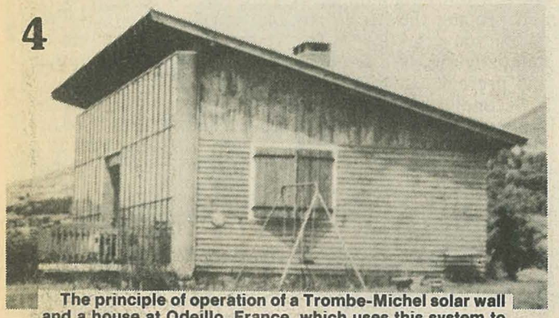
A somewhat similar system has been used to heat a building at the Waite Research Institute[5, 6] in Adelaide, with the important design change of using an overhang of the roof over the north (back down under again) - facing windows to shield the inside from the summer sun (diag. 2). This building is used only to house insects and plants but then they too like to keep their little bodies at a pretty constant temperature! (diag. 3).



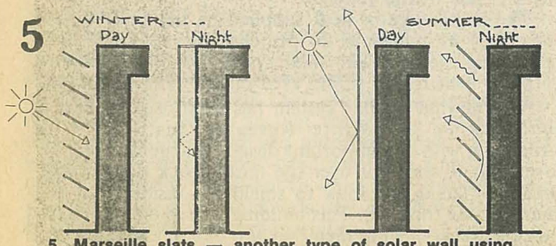
2 **With a suitable roof overhang, the summer sun can be shaded out from a north-facing window (southern hemisphere), while the winter sunlight enters to warm the house.**

3 **The above principle used to heat an insectary building at the Waite Research Institute, Adelaide.**





4 **The principle of operation of a Trombe-Michel solar wall and a house at Odeillo, France, which uses this system to supply 60-70 per cent of the annual energy needed for space heating.**



5. Marseille slats — another type of solar wall using louvres to give four heating/cooling modes.

This overhang design can be used throughout southern Australia but note that it isn't suitable for use in locations of low latitude, e.g. Darwin, where the sun is always high in the sky during the important mid-day period.

On a larger scale, another interesting building which uses the large mid-day sun-facing window principle is St George's Secondary School at Wallasey near Liverpool in the north of England. For over 20 years now no auxiliary heating has been required for the classrooms and labs inside (7).

Odeillo Houses[8,9]

Almost in the shadow of the giant French 1000 kW solar furnace, these houses (31 of them) were built by the Centre National de la Recherche Scientifique for some of its employees at Odeillo, high up in the French Pyrenees (altitude 1300m, lat. 43° N). They use the Trombe-Michel solar wall principle (diag. 4), which is hard to beat for simplicity and effectiveness.

In Australia a house of this type would have a north-facing concrete wall (recommended thickness 25cm) with a dark surface on the outside, and single glazing in front of it leaving a space for air convection. A roof overhang shades the summer sun from the wall, as in the insectary described in the previous section.

Air in the space between wall and glass is heated and rises, passing into the building at the top through a port, while cold air is drawn out of the building through a lower port into the air space to be warmed. Hence a natural heating cycle is started, which can last for two or three hours after sunset depending on the amount of energy received from the sun during that day. Heat also enters the building by radiation from the storage wall, after a time period for conduction through the wall depending on the thickness and nature of the wall material.

One of the authors (Peter) is studying the performance of a Trombe-Michel system at the Department of Mechanical Engineering, Melbourne University, and present indications are that a 25cm wall thickness gives the best all-round effect[10]. This thickness is in fact considerably less than that used at Odeillo. Odeillo also experiences much lower temperatures than say Melbourne, so double glazing in front of the concrete wall was employed on the original houses.

The most recently built houses at Odeillo receive about 60-70 per cent of their annual heating energy from the solar wall, the rest coming from auxiliary electric heaters. However, a wood stove can also be used, as at similar Trombe-Michel systems at Chauvency-le-Chateau in France[11].

OTHER SOLAR WALLS

The following are three more novel design ideas for solar walls which should be useful as a basis for improvisation, either in designing complete new buildings or adding solar walls to existing ones.

Marseilles Slats[12] A neat way of getting four heating/cooling modes from a plain old concrete (or other absorbent) wall with a dark exterior surface, by having a set of aluminium (or perhaps wood covered in aluminium foil) louvres in front. The illustration (diag. 5) should be self-explanatory.

Baer Barrels[13] [14] Designed by Steve Baer, this wall has been described in most of the alternative technology books (e.g. [15] [16]) and consists of 55-gallon steel drums filled with water, stacked in racks behind single glazing with their axes pointing south (we're up north again, in New Mexico, USA). A large insulating door, hinged at the lower end of the wall, covers the drum wall completely, and it is lowered in the morning in winter to allow the sun to shine in and warm the barrels. At the same time, laying flat on the ground the door acts as a reflector to intensify the heat from the sun. The door is raised when the sun goes down to prevent heat loss, and the barrels lose their heat to the inside of the building. During summer the door is kept closed, the cool water in the drums acting as a sink for the heat inside and keeping the room at a comfortable temperature.

This wall provides 75-85 per cent of the building's heating needs, wood stoves making up the difference. The one drawback with the system is the problem of corrosion of the steel in contact with water. Anti-corrosive additives can be added, but it remains to be seen what the lifetime of the drums will be.

Beer Bottles. You can see a nascent version of this type of solar wall outback of any true ocker's home, but as yet the solar potential of this structure has not been so widely realised. At Sydney University 'autonomous house', however, a group of architecture students have recycled those dark-brown beer bottles as one of their north-facing walls inside a glazed 'greenhouse' area. The bottles, water-filled with their tops pointing outwards, act as a heat store (See **Comtec** for illustration). But those living in the house aren't happy with the wall's performance and are considering replacing it with heavy curtains and a dark masonry floor inside the building, exposed to northern sunlight during the day.

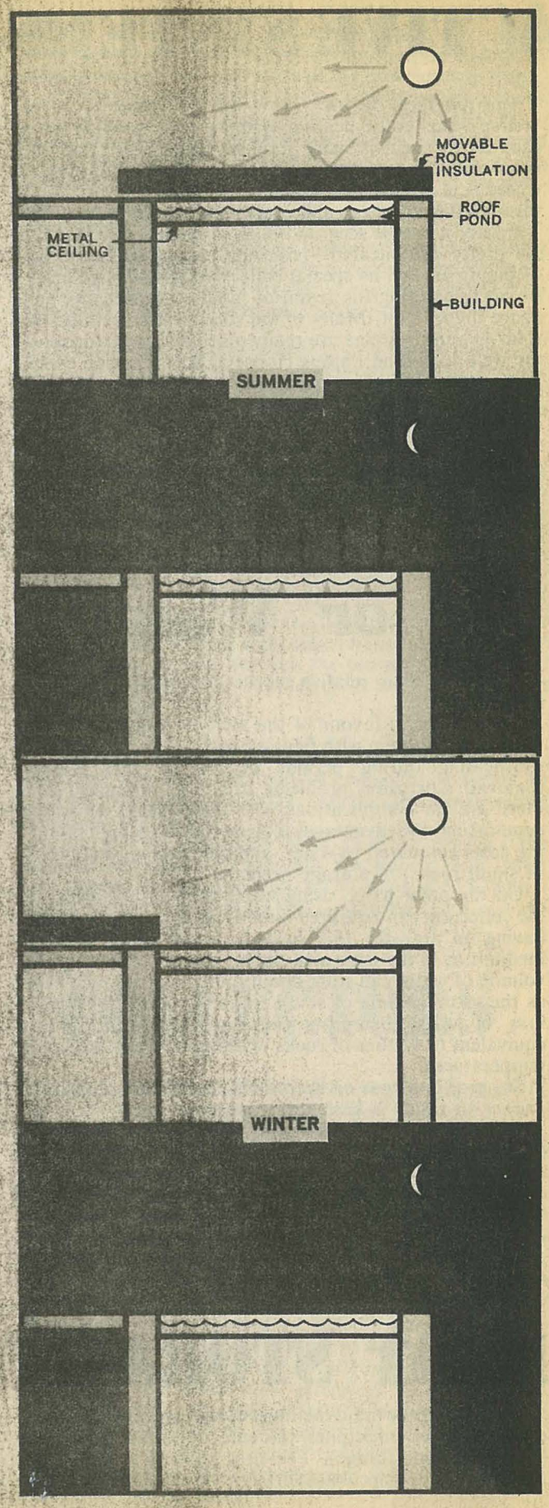
SOLAR ROOFS

Haystacks. Harold Hay [17] [18] [19] designed this system of natural air conditioning which has been used successfully in a house at Atascadero in California (lat. 35°N; n.b. Sydney is 36°S). Also called "Skytherm", it provides 100 per cent of the house's needs for heating and cooling throughout the year.

Water is stored in PVC (0.1mm thick) bags on top of a metal roof. Above each bag there's a transparent UV-resistant PVC sheet sealed to the bags along their edges and held (by air pressure from below) so that there is an air gap to provide top insulation. Beneath each bag there is a black PVC sheet which rests on top of the metallic roof. Panels of insulation can either be drawn over the bags to cover them, or stacked at one side to leave them exposed.

The illustration shows the various heat-transfer modes available. On a winter's day the bags absorb heat and transfer it to the room beneath; this continues at night when the insulation panels are drawn over to prevent outwards heat loss from the bags. On a summer's day the bags are covered, preventing heat from entering the house from above; then at night the covers are removed and the cold water acts as a sink for the heat inside the house, and radiates energy back out again.

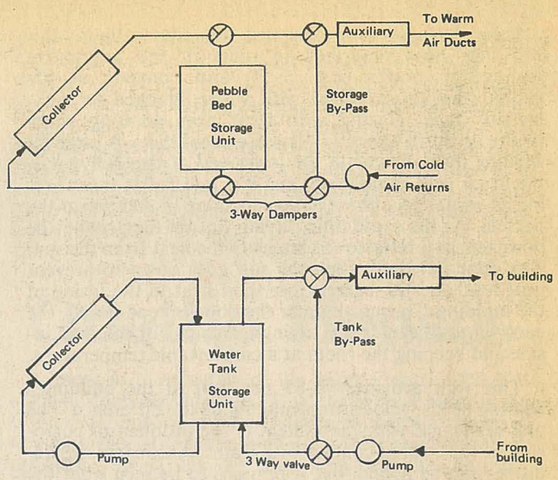
The horizontal roof collector is a disadvantage for winter heating in regions of high latitude, though such a system could probably be used over most of Australia.



ACTIVE SYSTEMS

The diagrams below[20] show the two basic types of 'active' solar house-heating systems: one in which air is used as the heat-transfer fluid to carry heat from the solar collector to a pebble-bed storage unit or to a room where it is needed, the second in which water circulates through the collectors and is also used as the heat store.

Firstly it can be seen that both of these active systems are pretty complicated—requiring pumps, valves, a lot of piping as well as special collectors and storage units. So we're entering the realm of 'higher' technology, and hence higher cost. Many of the solar houses with active solar-heating systems are really glorified laboratories — the well-publicised Philips House at Aachen is an excellent example. It may prove impossible, however, to use a passive system in a particular location (for example, north-facing wall or window types require a very open site to the north), or on an existing building. In such a case some form of active system would have to be considered, since with the collectors as separate components greater flexibility is possible in their positioning on the house.



Schematic diagrams of basic solar space-heating systems using air (above) and water (below) as the heat-transfer fluids.

Air or Water ?

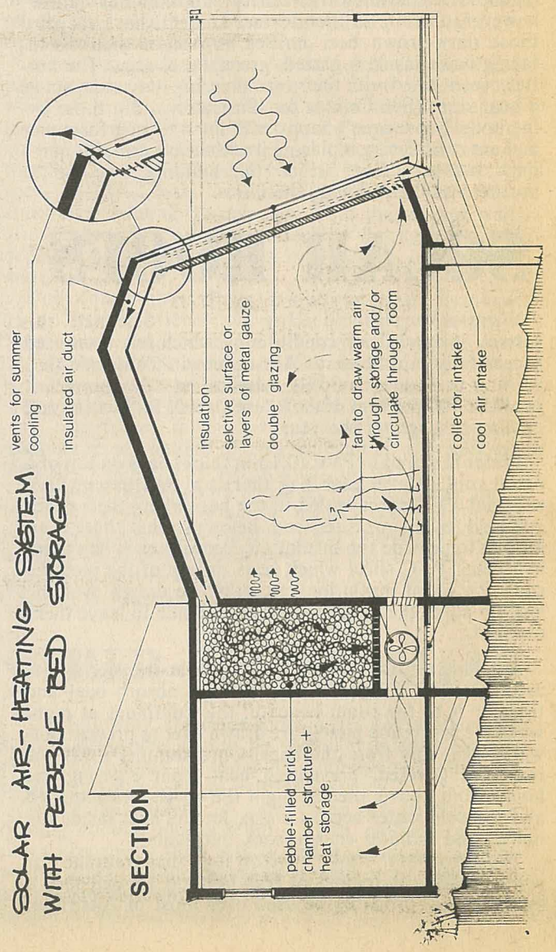
What are their relative merits and demerits as heat transfer fluids?

Advantages in favour of the air-type system are that there is no problem with freezing in the collectors or with overheating during periods of low or zero energy removal. Corrosion problems are also minimised and there are no complications with water leaks or water penetration. Disadvantages include relatively high pumping costs compared to water, and the large volumes (e.g. of small rocks) of storage needed.

On the other hand, using water the heat absorbed in the collectors can be stored directly as hot water, without having to transfer this heat to some other storage medium as is the case with the air system. Also a given volume of water can store about four times as much heat as the same volume of small rocks. Roughly, 2000 gallons of water operating between 32 and 65°C are equivalent to 42 tons of rocks working between the same temperatures!

So, pros and cons on both sides, and there's no simple answer to which is best, air or water.

Solar houses using these two types of system have been described in detail in many places, therefore, to save trees, here we'll just give references to a good example of each. Dr G. Lof's residence in Denver, USA, uses a combination of air collectors and rock-bed storage for space heating[21] [22] [23], while the Colorado State University's first solar house uses water collectors and a water storage tank to provide most of the required energy for winter heating and summer cooling[24].



HEAT STORAGE[25]

There are three main methods of heat storage in use today: hot water, rock piles and eutectic salts (also called heat of fusion storage). The first method is obviously used when water circulates through the collectors, the latter two when air is the heat-transfer fluid. Water and rock storage are well-proven methods, while storage in eutectic salts is still very much at the experimental stage.

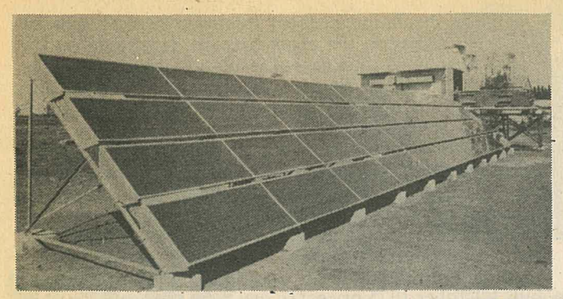
A solar air-heating installation together with a rock-pile storage unit has been operating at the CSIRO Division of Mechanical Engineering at Highett in Melbourne for several years[26]. The system heats a section of lab and office space during the winter months, and the thermal storage is also used for summer cooling by evaporative cooling of the rock pile at night. The pile consists of three galvanised iron tanks (total volume 32m³) filled with 17mm basalt rock screenings. Approximately 56m² of solar air heater (collector area) are required to condition a working area of approximately 130m².

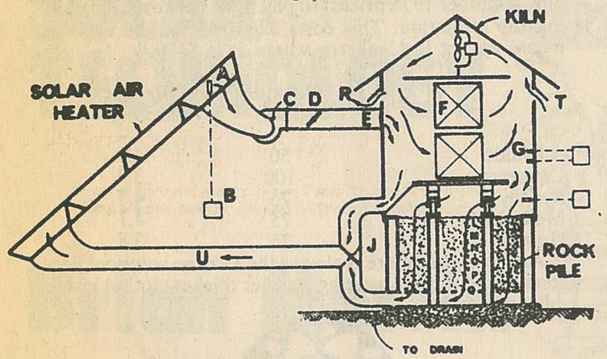
Small rocks, usually basalt or granite pebbles, 1.3-2.5cm in diam., are used in a rock-bed store to increase the area of contact of air with rock and so give good heat-transfer properties (ref. 15 gives a diagram of a typical pile).

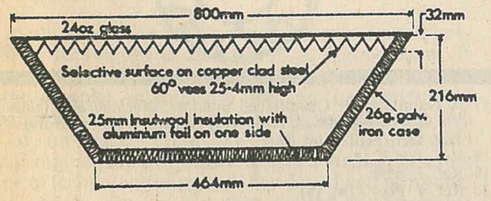
Some eutectic (low-melting point) salts, e.g. Glauber's salt (sodium sulphate decahydrate), are useful for heat storage because they freeze/melt at convenient temperatures for space-heating purposes — in the case of Glauber's salt, around 32°C. As this salt is heated through 32°C, a great deal of extra heat is absorbed as it changes from a solid to a liquid. This heat is released again on cooling and solidification. Glauber's salt is in fact capable of storing eight times more heat than water of the same volume between the temperatures of 25°C and 37°C. This system of storage is used in Dr Mario Telkes' Dover House[27].

Problems emerging with eutectic-salt heat storage, however, are that the melting temperature seems to change with repeated cycling, and that the salt corrodes its metal containers.

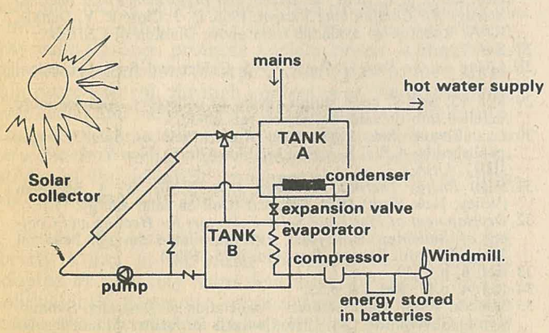
To end with, two more quick ideas for storing heat: eutectic mixtures of metallic fluorides[28]; and what about good old paraffin wax, which melts at 55°C with a latent heat of fusion of 40 Watt hours/kg — i.e. a lot of storage capacity?[28]







CSIRO's solar air heater and its use in a timber-drying kiln at Griffith, NSW.



A heat pump can be used in winter to raise the temperature of water from solar collectors to a useful level. The heat-pump compressor could be powered by a wind generator, as shown.

COLLECTORS

Flat-plate collectors for water heating are discussed in the Solar Water Heating article in this *CR*, and the same type can be used for water-circulation space-heating systems. As detailed a review of both water and air solar heaters as any one should require is given in refs. 29-32.

In this country CSIRO have developed a simple solar air heater which is used on their lab heating-cooling system already described, and on an experimental solar timber drying kiln at Griffith, NSW[33].

The use of solar collectors in conjunction with heat pumps is currently arousing a lot of interest. In one arrangement water is heated by collectors and stored in a tank and then a heat pump (think of using the heat coming out the back of a refrigerator!) is used to draw off heat from this store and 'pump' it up to a higher temperature for getting even hotter water, or for higher-temperature air heating. The attraction of the heat pump is that the quantity of heat transferred to a higher temperature is several times greater than the energy required to run the pump.[34]

TECHNICAL FIXING

So far we've been largely looking at the design of whole new solar houses, but in conclusion we'll transfer attention to what can be done to enlarge the solar contribution towards heating existing houses, and to improve their thermal performance generally.

First, if you're lucky enough to have a suitable north-facing wall, or can add one, any one of the solar walls described previously could possibly be incorporated into an existing building.

Also, overhangs from north-facing windows can easily be fitted to houses as an extra, and dark-coloured floors or walls behind such windows will further improve the solar heat gain through them during the winter months. Or outdoor blinds over these windows could be used instead of an overhang to keep the summer sun out. Indoor blinds, white on the outside surface, also do this, but not so well as outdoor ones.

It is not difficult to conceive of a 'Haystack' Skytherm roof pond being added to a flat-roofed building. Alternatively, with many houses a substantial solar contribution could be obtained by fitting one of the 'active' solar air-heating systems described earlier.

However, with all these solar space-heating systems, and with fossil-fuel heating systems, it's not much sense getting the heat in if it's going to leak out just as quick through the walls or ceiling. If a house isn't already insulated then, putting in at least ceiling insulation is **the** most fuel-conserving action you can take.

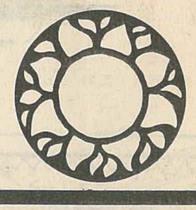
Ceiling insulation can cut domestic heating bills by about 40 per cent, the exact amount depending on the house design and thickness of insulation installed. Higher percentage savings can be achieved if the walls are also insulated[35]. Moreover, an insulated house stays much cooler in summer.

In Victoria it has been calculated that if all houses had adequate ceiling insulation now, there would be a 7.2 per cent saving in the States **total** secondary-energy requirements. (So much for Newport's necessity!)

The following table gives the recommended insulation requirements (using mineral wool batts) for some cities, together with the period it would take for savings in fuel bills (October 1975 prices) to pay back the cost of installing the insulation. This costs $260-365 for the average house, except in Canberra where it is $470.[35]

	Thickness (mm)	Payback Period (years)
Adelaide	50	4.0
Canberra	100	3.3
Sydney	75	4.7
Melbourne	75	4.1
Hobart	75	3.8

And of course there is always the Eskimo solution: personal insulation by wearing warmer thicker clothes inside during winter!



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18 Ref. 4, p.7, 18.
19 Ref. 7, p.94.
20 Ref. 4, Figs 7 (a), (b).
21 Ref. 4, p.9.
22 Ref. 15, p.10.
23 Ref. 7, p.73.
24 Ref. 4, p.11.
25 Ref. 15, pp.10-11, gives a short but helpful review of heat-storage methods.
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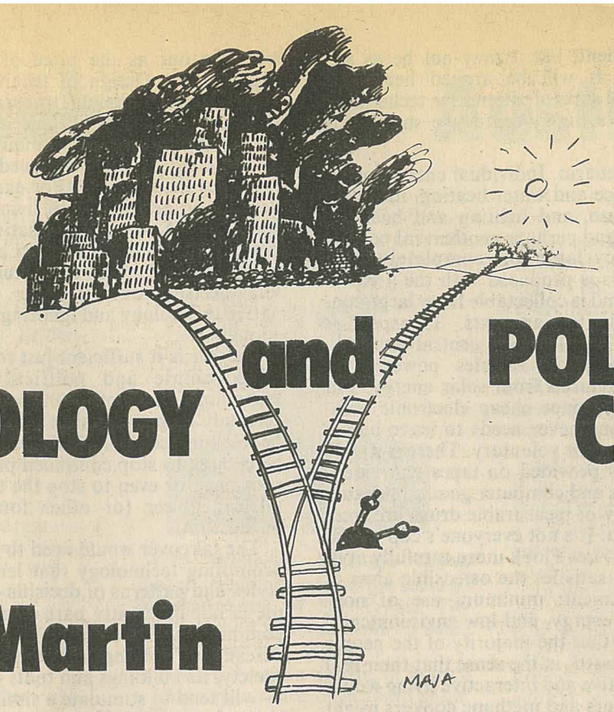
36 See note 1, Solar Water Heating article in this *CR* for definition of secondary energy.



SOLAR TECHNOLOGY and POLITICAL CHANGE

Brian Martin

with help from other members of FOE-Canberra

To many people in the environmental movement, low-level solar technology is assumed to be a good thing. Is this necessarily so?

In the complex relationship between the structure of society and technology, it is useful to separate out two sorts of influence. First, the social, economic and political organisation of a society has a strong effect on the type of technology imagined, developed and promoted in that society. One reason that present-day capitalist and state-socialist societies are promoting nuclear power is that this form of energy generation fits nicely into existing patterns of centralised economic and political control.

Nuclear technology is seen by elites to be desirable because it must be developed and run by experts (well-paid and docile): this effectively cuts off the possibility of community control of the technology. Another reason why ruling groups promote nuclear power is that it requires large amounts of capital; these groups then maintain more control, through control over the investment, over social and technological developments in the future. Last of all, the nuclear option is promoted because its very enormity and dangerousness seem to justify the existence of the scientific, managerial and political elites who promoted it in the first place.

The second sort of influence between technology and society works in the other direction: the technology adopted by a society helps determine the type of social, political and economic organisation of society which seems most workable and desirable. The widespread adoption of nuclear technology, for whatever reason, would reinforce the control of political and economic institutions by ruling elites, and foster an even more splintered and alienated social framework than already exists under present technology.

For many of those who promote low-level solar technology, the hope — whether explicit or implicit — is that solar technology will help promote a better society through this second sort of influence. The idea is first to introduce an energy technology which is environmentally safe and ecologically sound, inexpensive, simple to build and operate by individuals and small groups, and which is easily integrated into a life-style based on self-sufficiency and widespread participation in vital activities (growing and cooking food, making clothing and shelter, operating community-based health and education).

Establishing this technology hopefully will help lead to a society in which economic and political power is more widely distributed, in which people get satisfaction in doing those tasks which concern them directly, and in which a satisfying interaction between people, and between people and nature, is part of everyday life.

So Why Worry About The Social Implications Of Solar Technology?

To argue in this way is already to go beyond the promotion of solar technology for purely environmental and ecological reasons. But is it necessary to worry about the social and political implications: won't they take care of themselves? Surely low-level solar technology is so much better than its high-technology alternatives (fission and fusion, high-technology solar power as from massive desert collectors, and the energy-growth syndrome in general) that it is worth promoting without worrying too much about the economic and political techniques of doing so.

The attitude is convenient; but it may not be as appropriate as it sounds. It will be argued here that widespread adoption of all sorts of alternative technology is quite compatible with a highly-repressive social and political structure.

Let's take a possible scenario. Individual energy needs are provided by solar space and water heating, methane cookers powered by refuse, and lighting and back-up energy from hydro, wind and perhaps geothermal power. All containers are recyclable or completely biodegradable; food in shops is produced with the greatest abundance of nutrients, and is collectable from large containers in vurtially unlimited amounts. Transport is provided by a highly efficient public central network, augmented by small personal vehicles powered by methane or hydrogen produced from solar energy. But travel is not so necessary, since cheap electronic communication means that one never needs to leave home. Working hours are minimal or voluntary. There is a wide variety of entertainments provided on tapes and videodiscs, ranging from sports and computer games to drama and music. A wide variety of pleasurable drugs are free.

Enough of this scenario. It's not everyone's cup of tea, but it's just an illustration. Let's look more carefully at it. This hypothetical society satisfies the ostensible aims of the environmental movement: minimum use of non-renewable resources and energy, and low environmental impact. Yet it is possible that the majority of the people living in it would be repressed, in the sense that their real human potential for creative and interactive living would be submerged. Solar heaters and methane cookers might be sold or distributed just the way heating oil and electric ranges are now, perpetuating alienation from material possessions. Food might be centrally produced and processed just as it is now. The transport system might lead to just the same faceless anonymity as at present. The easily accessible entertainment and drugs might provide the same escape from an empty reality that is so prevalent today.

Many people in this hypothetical society would be 'satisfied'. No doubt many today would like to live in such a society. But the number of people actually stretched to their capacity, given the chance to involve themselves in challenging and rewarding activities, would be small — as it is now. The people so challenged mainly would be those who designed highly efficient solar heaters, who developed ecologically-sound and highly-productive agricultural techniques; who administered the public transport system. and who produced the wealth of diversionary entertainment.

What To Do?

Assume that a politically-minded environmentalist (or an environmentally-minded political activist) wishes to promote a society in which there is widespread community involvement in local decision-making and in producing the necessities of life, in which social roles and structures, technology, and moral codes are purposely designed by the community to maximise each individual's opportunities for a satisfying and challenging life, and in which life-styles are consciously put in harmony with the evolutionary needs and potential of humans and nature. (Isn't this high-sounding?) What is such a person to do?

It is not sufficient just to promote alternative technology, such as solar technology, in any way possible. By accepting uncritically the existing political and economic structures, it is likely that this technology will be introduced (if ever) in a way and in a form that leaves these structures essentially unchanged. Solar heaters will be sold on the market like other commodities: the poor will lose out as the price of conventionally produced energy rises. Design of technology and of community organisation (housing, transport, communication) will remain in the hands of the scientific-technological elites: the technology and community organisation promoted by these elites will be designed (unconsciously or not) to reinforce their power. (For example, capability for local design and production of living quarters will not be encouraged.) A social organisation will be encouraged that does not threaten those who hold power: people will be given entertainment and drugged escape, rather than vital decision-making power. So just promoting alternative technology and ignoring the political context is not enough.

Neither is it sufficient just to change the existing locus of economic and political control. For although technology does not *determine* the structure of society, it certainly helps to push it in particular directions. If the people took control of all work places today, it might not be enough to stop continued promotion of private motor transport, or even to stop the technological attraction of nuclear power (or other forms of centralised power production).

The takeover would need to be tied to a programme of promoting technology that lends itself to different life-styles and patterns of decision-making. Such a programme is not inherently part of a political stance based on community control (although in practice it is in many cases). The existing social and economic organisation of society, its buildings and tools — even its very knowledge — will tend to stimulate a similar organisation of society in the future, whatever groups are in control. That is, the ruling elites promote technology (such as nuclear power) that maintains their political power; this technology then makes the existence of ruling elites (of whatever origin) more natural and inevitable. This technology, as well as the ruling elites, must be replaced.

It has been claimed here that a society run using all the panaceas of alternative technology, and at the same time separating people from the activities that maintain their lives, is possible — in principle. But could present monopoly capitalist (or state socialist) society possibly survive the transition to such a society? For example, could a massive redirection of investment occur — as from nuclear to solar power—before disastrous environmental deterioration set in, spurring citizen action against the social order? It *might* be that environmental degradation can continue to be blamed on people, the same way that automobile accidents, universally are blamed on bad drivers and poor roads rather than on inappropriate technology backed by vested interests. Capitalism has surprising adaptive capacities in this and other areas, and it would be wishful thinking to believe that making the transition to low-level solar technology *automatically* will present insurmountable problems to the system. At the same time there *will* be serious problems for capitalism in making the transition while maintaining control by the few over the choices of the many. It will be the task of the politically-aware environmentalist to use these problems to work for a society run completely and directly for and by the community.

The conclusion here is obvious, so it might as well be short. What is needed is action based on an integrated perspective, aimed at changing the existing distribution of political and economic power *and* changing the existing technology that is both the product of and the prop for this distribution of power. Promotion of solar power and opposition to nuclear power both have this potential, but only if carefully linked with political goals. What this means in terms of tactics, however, is something that must be worked out by each individual and each group.

Bridenbaugh in Australia

For three weeks in September/October, Dale and Charlotte Bridenbaugh visited all Australian mainland capitals on behalf of the Australian anti-uranium mining movement. Dale, of course, created a sensation earlier this year when, along with two other senior nuclear engineers in General Electric, he resigned his $30,000 a year job to work with the anti-nuclear organisation, Project Survival, in California.

The Bridenbaughs' visit was a great boon to the movement here, partly because of the information and insights they imparted and also because of their great warmth, joyfulness and humility.

Dale and Charlotte were ably complemented by Adelaide pediatrician, Dr Helen Caldicott, who has spent most of the last year actively involved in the US anti-nuclear movement.

While Dale spoke of his experiences as 'Complaints Manager' with GE, Charlotte gave an account of the role of women in the movement in California ("Women are the greatest untapped source of political power", she said), and Helen literally scared the pants off people by informing large radio and TV audiences and public meetings of just what plutonium does to sentient beings.

Highlights of the tour included the refusal by the NSW Trades Hall Council to hear Dale speak for ten minutes after an hour-long debate on whether he should speak or not; the frenzied activity of Mr L. G. Kemeny, Lecturer in Nuclear Engineering at the University of NSW and friend of the mining companies, in following Dale to media interviews and offering himself as a debating opponent; the almost complete black-out on Dale by the print media (after all three of the directors of the Herald and Weekly Times are uranium miners!); and a well-attended luncheon for Labour MPs in Canberra which Dale addressed.

Just before the Bridenbaughts left to return to the US in a rather exhausted state, *Chain Reaction* spoke to Dale and here's an edited version of the interview:

CR: While in Australia you've almost certainly come across some of the statements of Sir Ernest Titterton. Could you comment on some of the things he's saying?

DB. I did have a debate, or at least a joint appearance on a radio show, with him, and I think he's presenting a completely one-sided view of nuclear power. He's talking to the public about the risks as a parent would to a small child. I think people of the world are adult and they need to know the risks that nuclear power represents. I'm not sure Sir Ernest understands the risks. Perhaps he's mentally blocked them out, but he certainly doesn't communicate anything except an extremely over-optimistic simplistic viewpoint and seems not to address the long-term waste-storage problem at all.

CR. What about his statement of risk comparisons where he used the Rasmussen Report and the International Atomic Energy Agency's figures to suggest that reactors are safer than lightning and so forth?

DB. Well, that's pretty much a standard approach which all of the nuclear proponents have taken. The Rasmussen Report on reactor safety has many deficiencies but I think one of the most serious is that it looks only at the accident consequences of the light-water reactor itself. It doesn't take into account any of the long-term affects that the production and discharge of radioactive material may have on future life. Also it doesn't address the problem of theft, terrorism, sabotage, breeder reactors, or waste disposal as I said. But the most basic deficiency is that it assumes the reactor design itself is correct. That's a very poor assumption in my experience because there are so many deficiencies in the design, so many unproven features, that we could have a catastrophe even if everything worked right.

CR. Could you comment on the similarities and dissimilarities between the Australian nuclear protest movement and the American one?

DB. In the US there are very few, if any, union people involved at present. There seems to be in Australia a broader spectrum of people involved, from the unions, to students, academics, and so on.

In both cases though it's the people against a highly organised and rich industrial-political complex. It's very slim resources in terms of finance and full-time commitment against a very heavy organisation that has a lot of resources.

So again I think we just have to get the word out to numbers of people because as we often described it in the Californian campaign: **It's our people against their money.**

WALT PATTERSON

Following close on the heels of the Bridenbaughs, Walt Patterson, one of the most respected nuclear critics in the UK and presently a staffer at FOE (London), flew into Australia on the last leg of a six-week world lecture tour.

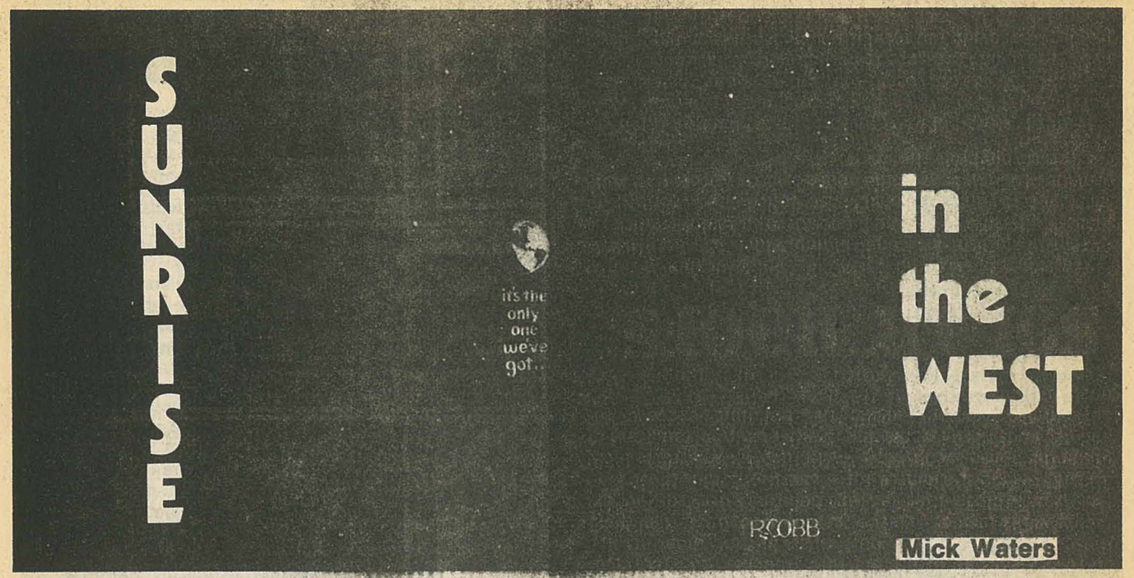
His short time here was spent on a jam-packed programme of public lectures and media interviews

The highlight of his visit was his authoritative and spirited radio confrontations with such nuclear proponents as Sir Philip Baxter over the recommendations of the First Ranger Report.

But Walt left Australia somewhat angry and thinking of law suits, after being called, without attempted argument, "an uninformed propagandist", and again without substantiation, having some of his statements dismissed as "lies", by Sir Philip Baxter in an ABC Radio interview on October 29th.

"We just don't have 'eminent' scientists behaving like that over in the UK," he said.

(See *Book Reviews* for review of Walt's recent book, *Nuclear Power*).



The Earth sails on through the starry sea of space. Our place in space is on our planet, circling our star, as we live and grow and experience the struggle to survive on Earth. If we could fly up and sit on the moon, we would see Earth is a rock rolling around the sun.

Millions of years have passed since time began for humanity on Earth. Animal and plant life that once was has passed away into the Earth, to become coal, oil or natural gas. We have learnt how to exploit these vast natural deposits of stored solar energy, and in doing so we have changed our environment. The technology we've created is forever bringing to life more and more machines, which guzzle more and more energy and raw materials each year, to produce more goods, to make some people richer, but laying the Earth to pollution and waste.

Our planet heads towards crisis on many fronts. Burning our fossil fuels as fast us we can threatens us with eventual ecological collapse, in the air, on the land and in the sea. The ever-growing amounts of waste heat being released into the atmosphere now seem certain to cause calamatous climatic change.

Technology has taken the industrialised countries to the point where the rich classes must now examine the benefits of their materialism in the light of the real cost. Billions of oppressed people pay for the rich world in starvation and hopeless poverty, but now the health, longetivity and future survival of the rich is also at stake. We need a slow-down in over-consumption so we can live a little longer. What we really need is a society wherein we can preserve what we've got while relaxing our reliance on technology that consumes more and pollutes more.

Let's zoom in on Australia. If we continue our present rates of growth our oil will last about 10 or 15 years more, our natural gas about 40 or 50 years, and even our coal only a few hundred. Within the lifetimes of our young people, these reserves will become more scarce and more precious, all the more reason to use them more wisely. After all, our children and their children might like to be able use a little oil or natural gas occasionally too.

But starting now, in fifty years time the face of Australia could be transformed. A combination of energy conservation and development of alternative technology could enable whole communities to become independent of reliance on the monopolised distribution systems that control our lives today. People could be involved in a creative and satisfying experience, building for long-term survival; incorporating solar, wind, water, wood and methane energy systems into the design of their homes and workplaces. Gradually the move could be made towards total self-sufficiency in food, warmth and shelter—needs basic to all people. The lessons learnt during the construction of simple 'soft' technology could well assist Third-World peoples in their struggle for survival too.

Both urban and rural communities could be adapted so that workplaces are closer to home; walking, cycling or better public transport could then eliminate the over-use of the internal combustion engine as a means of everyday transport. Local industry could serve local needs, local recycling centres could recycle wastes for re-use, and local markets could enable exchange of the fruits of labour without so much reliance on the present energy-intensive transport, packaging and advertising systems.

By growing more food in the form of vegetable protein rather than animal protein, Australia would meet its responsibilities in an increasingly hungry world. As friends of the Earth, we could plant many millions of trees on land that has been ravaged by herds for many years. Erosion, dust storms and floods have washed away much valuable topsoil and tree-planting, in conjunction with more labour-intensive farming methods could well arrest this denudation of our natural heritage. We were born here, to live all our lives.

Many things could be done to change our lifestyle from a consumer orientated rat-race, going nowhere, to one of independence and feeedom, the freedom to live and grow under the sun. But, we live in a capitalist society, one in which the power of money prevails. How can we change to a solar society, one in which the value of life is above that of profit?

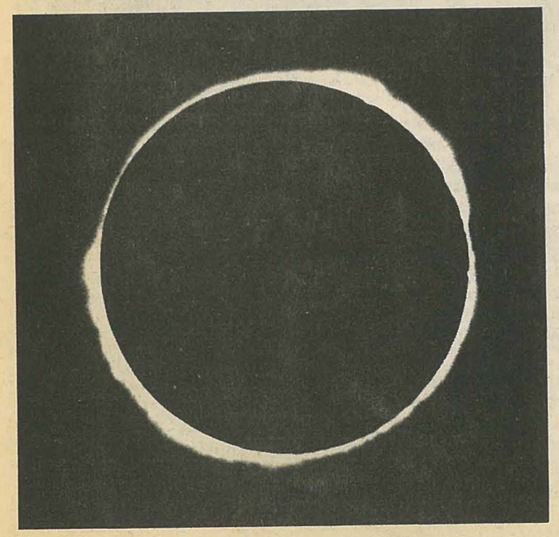
Rod Carnegie, the managing director of Conzinc Riotinto, Australia's biggest resident foreign-owned multinational company, has said that he doesn't think that solar energy will have much of an impression in Australia for the next 50 years. By then, we may take it from Rod, our reserves of conventional fuels will be almost exhausted, and we will need solar power. Why not start now, so that we can reap the benefits of clean free solar power sooner? It would seem an obvious alternative. Many young people could be employed in such a vital, the many unemployed. Areas of land could be set aside for those people who decided to leave the cities and cultivate alternative communities in the country.
alternative communities in the country.

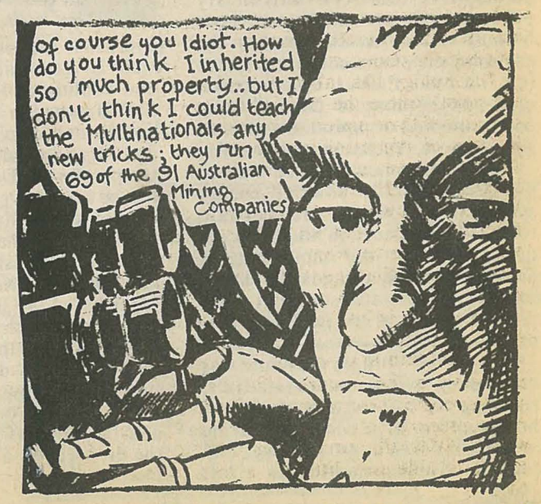
Australians, however, are basically hardened consumers and it might take drastic economic conditions for them to change their values. A resources shortage, such as the one in energy which we are certain to experience before the year 2000, might just be enough to show that the free enterprise promise of more and more each year is like the pot of gold at the end of the rainbow.

In all the western world, unemployment is rampant. Traditionally, wars have soaked up the unemployed in fighting and in factories. The Vietnam War may well have soured our appetite for any more such profit-making technological-boom periods. And so, what to do with the growing number of people who are being thrown out on the streets by the machines that are built to replace them?

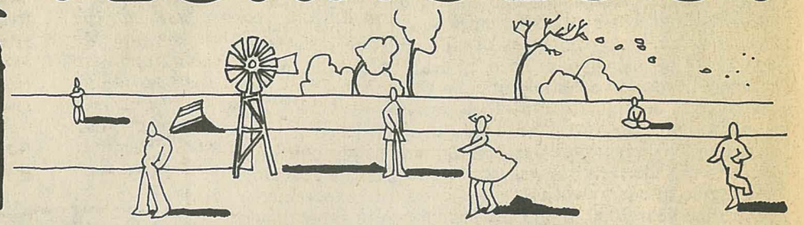
Change must come, hopefully for the better. The people must come to know that there is another way. In Australia, we are being armed with the knowledge of our need to survive big technology and those who control it. The struggle against uranium mining must succeed if we are to live into the future. The power of the Australian people must, if need be, rise up against the polluting powers that be, and prevent them from threatening future generations for the sake of passing profits.

As never before in our country, people must come together to fight a cause of common concern. If we join together, we will overcome. People everywhere can look up and see the light, brilliant in its power and its beauty. Life-giving, the Sun warms us. Its power could one day be our power — the power of the people.





COMMUNITY TECHNOLOGY



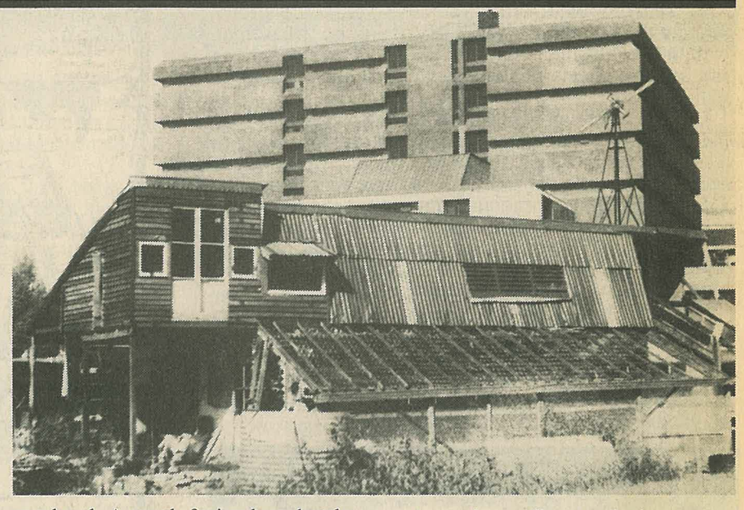
AN AUTONOMOUS HOUSE

At a time when it is becoming common knowledge that the sources of energy and materials which our society has taken for granted in the past are being rapidly exhausted, alternative technology, which is independent of finite resources, is becoming increasingly relevant to our future. Technology which has a 'soft' impact on the communiity's environment creates a constant flow of energy, as opposed to the existing "hard" technology in which energy is used once and never recovered.

The idea of building an 'Autonomous House' using alternative technology came to a group of 2nd and 3rd year Architecture students at Sydney Uni in 1974. They sought an ecologically responsible alternative to conventionally powered and serviced houses, both because of the overall impact on the environment of the corporate forces (e.g. on Lake Pedder, urban creeks, etc.) and because of the ruthlessly profit-oriented organisations responsible (e.g. A. V. Jennings Homes).

The Autonomous House was to use only naturally powered energy systems and, ideally, demonstrate total self-sufficiency in all energy requirements. At the same time it aimed to provide a standard of living for five inhabitants (students) comparable to that of the ordinary community.

Design and work on the house was undertaken by seventeen students, resulting in a rectangular-shaped house with a large communal living area and kitchen at ground level, and separate sleeping quarters in a loft

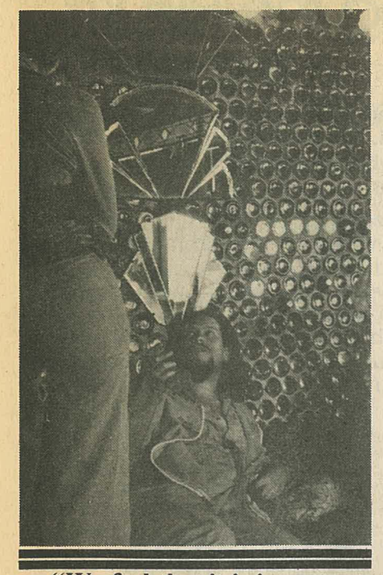


overhead. A north-facing beer-bottle wall is responsible for the heating and cooling of the house (the sun's heat is stored in old water-filled beer bottles and convection currents can be introduced to control the temperature). Doors and windows can be sealed to prevent heat loss and the house is equipped with fibreglass insulation, so that it is as thermally efficient as possible. Electricity for lighting and power is generated by a "Quirks" 12V/300W windmill and stored in batteries.

The floor of the house is made of rubble from a demolition site, the timber walls are built from scrap, the roof is old galvanised iron sheeting, and the floor of bricks comes from the driveway of a demolished timber factory.

A methane digestor is in use to convert human and organic wastes into a nitrogen-rich fertilizer, though a larger community system would be needed to produce enough methane gas for lighting and cooking. From just one house, too little waste is available to really get the system going. Rain water is gathered on the large roof area and stored in a tank for drinking and general use. A solar water heater is mounted on the northern side of the roof.

The Autonomous House is therefore built almost entirely from second hand materials, from what is normally treated as garbage. This ensured that construction consumed as little energy as possible — merely human energy and time.

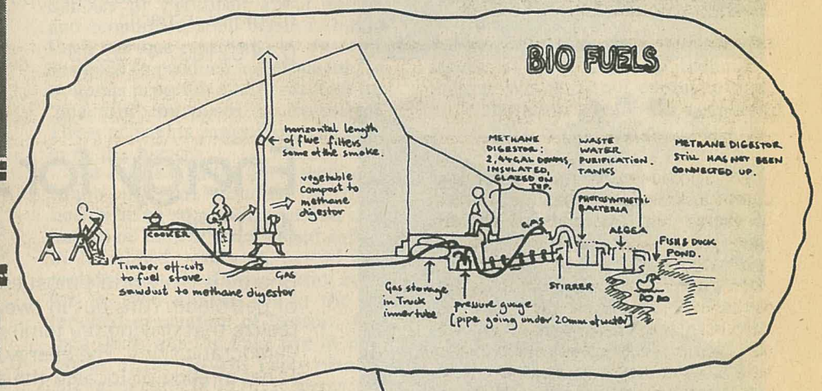


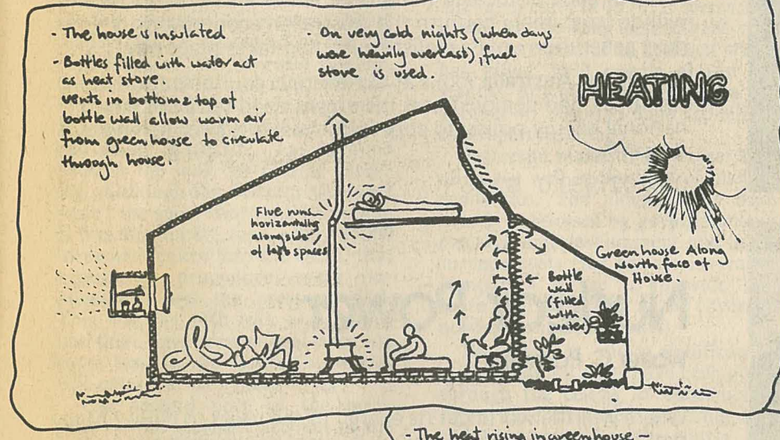
"We feel that it is important to begin living the alternative way now."

Here are a few comments from individuals who have experienced building and living in the Autonomous House.

"Most of our material resources in building in general are geared towards building barriers between one another, and yet, by circumstance or desire, people still live close to one another. The House is a small house (and uses less materials), yet inside there is still a feeling of spaciousness. The whole house is basically one room that can be adapted for our many uses, and we each have small visually-private alcoves between the rafters in the loft. A terrace house in the inner city for five people often seems crowded and claustrophobic, yet this house, at about half the size, feels spacious."

"It is very much a house of the present. Much of the interest in living in the House comes from a section of the present community that is aiming for an alternative lifestyle: a lifestyle closely sympathetic to the changing cycles of nature, seeking closer community with other people and greater fulfillment in all life's activities — aiming to embrace a wider range of activities in the fields of work and leisure and gradually eliminate the distinction between the two. An important aspect of this quest is to begin living the alternative way now. So, whilst seeking a reduction and scaling down of hardware, we seek an expansion of our software. As contacts between people in this search become more widespread, the products of their labours will surely become more refined."



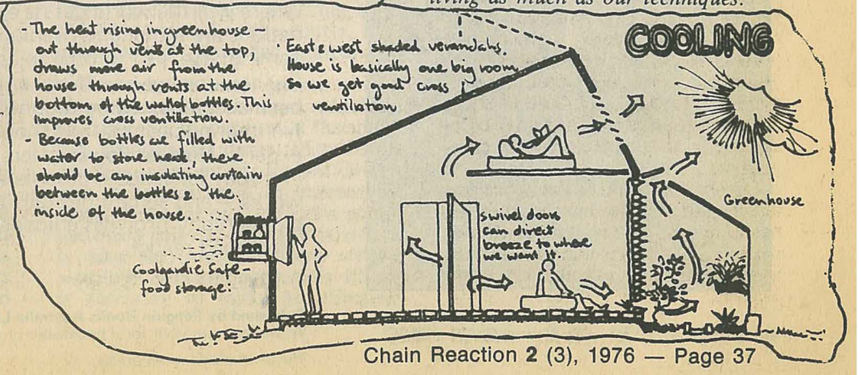


"Living in the House, I began to see more and more of both the workings of my needs, and of the technology created to satisfy these needs."

"If we really want to begin living in ecological harmony with the earth then we must reconsider our style of living as much as our techniques.

"The Autonomous House is not just a house with a series of technological systems used to supply an assumed amount of energy, water and shelter, but it is also one of our first steps in a search for a lifestyle more in harmony with the natural world and with other people."

"We feel that it is important to begin living the alternative way now."



BOOK REVIEW

Nuclear Power
by Walter C. Patterson
(Penguin Books, Hammondsworth, 1976) 304 pp.
$2.95.

If you've been thinking you'd like to have a nuclear facts book beside you as you listen to the bland assurances of Baxter, Titterton and Lang Hancock over the next few months, this book should be of interest.

Born in Canada and trained as a nuclear physicist, Walt Patterson now works with FOE in London. In the introduction to *Nuclear Power* he says that public participation in nuclear decision-making has either been tentative or desperate, largely because the issues seem to be cloaked in the most esoteric of scientific obscurity. Through this book, however, he has made a very successful attempt to make the nuclear fuel cycle and its problems comprehensible even to those of us who failed fourth-form science.

Part 1, "The World of Nuclear Fission", sets out the basics of nuclear physics, reactor types and the fuel cycle from uranium mining to the storage of wastes. Most readers will be unassured by the US experience so far in waste storage. On 20 April 1973, tank 106T at Hanford near Washington sprang a leak. It was not until six weeks later that a radiation detector was placed beneath the tank for routine checking. Although the detector went 'off scale', the supervisor took no action. It was only on 8th June, after 435000 litres had leaked into the earth, that emergency procedures were implemented and the press notified. This was the 11th leak at Hanford and there have been several since. At some time in the future the wastes will enter the Colombia River.

The second part of the book provides an excellent account of the development and testing of nuclear weapons, and the subsequent controversy which occurred as daring scientists began to challenge the US Atomic Energy Commission's deceitful claims.

Around 1957, concern about fallout began to mushroom. The AEC admitted that strontium-90 could enter the body via cow's milk (and not only via bone splinters in meat as it had previously claimed); scientists employed outside the AEC started to discover further radioactive isotopes in the fallout regularly breathed and eaten by Americans and others; a book describing the killing of a Japanese fisherman by fallout from the first H-bomb test in 1954 was published; and an AEC committee reported that nuclear tests in 1956 alone would for many years into the future cause between 2500 and 13,000 major genetic defects per year in the global population.

Chapter 6, "Reactors off and Running" would delight the most irresponsible of ghouls. For as pro-nuclear scientists attempted to assuage their feelings of guilt by developing the 'peaceful' atom, the bubbles of optimism about safety, and economics, soon began to burst. Each serious accident in reactors designed to produce materials for the weapons program and in reactors for 'peaceful' purposes is described. These accidents range from the grisly to the bizarre.

An accident at the SL-1 reactor in Idaho in 1961 resulted in three bodies being so radioactive that they had to be buried in lead-lined coffins in lead-lined vaults. A partial fuel meltdown at the Enrico Fermi reactor in 1966 almost led to the attempted evacuation of Detroit. And then there was the huge fire lit by a candle at the Browns Ferry plant in Alabama early in 1975. It seems that it will not be long before luck runs out and we read of an accident which has killed 5000 people almost instantly, provided a cancer dose for another 40 000, and done $20 billion of property damage.

Patterson makes it very clear that all is not well in the area of nuclear economics. The industry has been heavily subsidised by governments in research and development and in insurance costs (for private insurance companies refuse to provide any more than a fraction of the coverage needed by nuclear plants).

But perhaps most significantly, nuclear capital costs have been going through the ceiling as construction times have stretched, licensing hassles have erupted in the courts, and inflation has proceeded rampantly.

The ultimate bogey-person of the 20th century is plutonium, which is an inevitable by-product of the splitting of uranium atoms. Plutonium, which is aptly named after the Greek god of hell, is toxic to humans in doses of one ten-millionth of a gram and has a half-life of 24 000 years. It is also the material from which atomic bombs are made; only 10 kg is necessary to make an effective weapon. The magnitude of the problem is realised when we learn that one reactor produces 230 kg of the stuff every year and that in the year 2000 the nuclear industry's plans mean that 400 000 kg of plutonium will be produced. The necessity for safe-keeping from terrorists, wayward governments and the environment generally is obvious.

Despite this, the record so far is dismal. Patterson describes two celebrated incidents, the Rocky Flats plutonium fire in 1969 which sprayed plutonium over the population of nearby Denver, and the discovery in 1972 that plutonium stored in a trench at Hanford could form a critical mass and explode with catastrophic results.

The book covers a wide range of issues of a social and technical nature. We could not expect to find an elaboration of all the concerns which have been raised by critics involved in a wide range of disciplines. If there is scope for criticism of the content matter of this wide-ranging book, it would be that too little attention is given to the debate over nuclear power in the Third World. Currently the reactor manufacturers and the International Atomic Energy Agency are doing all they can to persuade Third World governments that nuclear power would solve their energy problems. So far the only countries interested are those that we may strongly suspect of wanting nuclear weapons. For the bulk of the Third World people, this form of energy is completely inappropriate. It is too capital intensive, plants now built in the rich countries are too big for the grid systems in the Third World, and it is a technology which will benefit the urban elite rather than the 80 per cent of people who live in rural areas and who don't even have a power point.

In the early days of the nuclear industry the corporations had a victory at a meeting convened to decide on the design of a symbol for "Danger Radiation". Union delegates wanted a grinning skull with wavy lines emanating from it. The corporations succeeded in gaining a majority for the innocuous circle with three leaves fanning out from the centre. Walt Patterson's book will do much to inform people of the solid body of evidence which has accumulated to reveal the myth of the peaceful atom. We ignore such information at our peril.

Neil Barrett

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FOE LEAK BUREAU

Given the way things are in government and industry, a great deal of information vital to the interests of the community never gets out. Some of it is simply not noticed by interested people because of limited circulation and some of it is purposely withheld.

FOE believes that those people who anonymously leak relevant information perform a public service of the first rank. Without their action, bureaucratic secretiveness and corporate self-interest too often succeed in suppressing information, and frustrating the process of informed and democratic decision-making in the community.

If you are a servant of government or industry, and you come across certain information that you consider the public really ought to know about, perhaps the *FOE Leak Bureau* can be of some help in passing such information on to the people who really ought to know about it.

Our thanks to the many people who have sent us information already. Keep it coming.

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PO Box 21, Edge Hill, Cairns. Nth Qld. 4870. PH: (070) 53 1806.
NEW ZEALAND
PO Box 39065, Auckland West, NZ.

FOE'S FOOD CO-OP

We are now using the front room of our premises in Carlton (Vic.) as a shop for our new food co-operative as well as display centre for books, posters, pamphlets and other literature on environmental and land-rights issues produced by FOE and other activist groups.

The Co-Op is an anti-packaging venture with whole foods at a minimal profit margin. Membership is $5.00 per individual or household. This allows us to buy a variety of goods in bulk without the burden of bureaucratic regulations applied to commercial shops.

Customers are encouraged to bring their own bags and containers as the food in the co-op is all in bulk quantities.

Here are some sample items and prices: Stoneground wholemeal flour — 14c lb; brown rice — 28c lb; soya beans — 27c lb; natural sultanas — 55c lb; dried apricots — $1.25 lb; almonds — $1.40 lb; peanut butter — 85c lb.

PUBLICATIONS

URANIUM DEADLINE

Uranium Deadline provides a comprehensive, up-to-the-minute summary of developments in the nuclear debate both in Australia and overseas, together with background information and commentary to set these developments in context. Compiled by FOE staff, it is the only way of keeping fully informed about the multi-faceted and immensely important nuclear power issue. All the vital information that has not appeared in the press, or on the radio and TV, you'll be sure to find in *Uranium Deadline*. Individual copies — 60 cents; subscription — $6 per year for individuals and libraries, $10 for other organisations/institutions.

CHAIN REACTION VOL.2, NO.1

Articles on: The Ranger Enquiry, The Pain of Minamata, Conservation in China, The Browns Ferry Incident, and the Chain Reaction Interview with John Price, co-author with Amory Lovins of *Non-Nuclear Futures*. Special offer to clear: 25 cents plus 25 cents postage.

CHAIN REACTION VOL.2 NO.2

Articles on the takeover by transnational companies of the energy field in the western world; a top scientist involved in the world's first atomic bomb programme speaks out on the dangers of the proliferation of nuclear power; do-it-yourself ways of finding the best site for a wind-electric generator; whole energy workshop (find your personal energy consumption) and energy shopping list. Price $1, postage 30 cents.

NUCLEAR POWER by Walter Patterson

To those who feel that nuclear matters should not be left to the battling experts, *Nuclear Power* offers essential support. In lively everyday language it describes nuclear technology and how it works — and sometimes fails to work. The author surveys the development of nuclear power worldwide, and delineates the issues, not only technical but also economic, social and political which now preoccupy the policy-makers. An extensive annotated bibliography provides guideposts to further investigation by the concerned reader. $2.95 plus 40 cents postage.

NUCLEAR POWER: THE FIFTH HORSEMAN by Denis Hayes with Australian introduction by Jim Falk

An excellent introductory booklet (70 pp) by Denis Hayes of the Worldwatch Institute, USA, to the arguments against nuclear power.

Hayes considers the environmental impact, the availability of uranium, the economics of nuclear power, the safety questions, weapons proliferation and the possibility of nuclear terrorism. He concludes that nuclear power is fraught with long-term dangers, and urges Governments to oppose the expansion of the nuclear industry and concentrate on developing alternative energy sources. Available soon.

INCREDIBLE FRASER ISLAND

This is a 56-page photographic documentary depicting the natural beauty of an island that was threatened by sand mining and timber getting. Published by A.C.F. Price $3.95 plus 40 cents postage.

THE INCIDENT AT BROWNS FERRY by David Comey

Reprint of *Not Man Apart* centrespread, an 8-page account of the worst reactor incident during 1975. The reactor came very close to a core melt-down. 20 cents plus 18 cents postage. Available from FOE Brisbane — see FOE address list.

NON-NUCLEAR FUTURES: THE CASE FOR AN ETHICAL ENERGY STRATEGY by Amory Lovins and John Price

The authors describe some economic and ethical matters that should no longer escape our attention. The book enables intelligent, concerned people to correct the executive's failure to take notice. In different ways, the authors explain the unattainable amount of capital needed for the nuclear dream, so unattainable as to be ridiculous, yet sought nonetheless because advocates have not bothered to do their sums carefully enough. (Co-published with Ballinger Publishing Company.) 224 pages. $5.00 plus 60 cents postage. (Price to FOE members $4.00 plus 60 cents postage.)

GIVE ME WATER

Stories and pictures of Hiroshima and Nagasaki after the holocaust. 60 pages paperback, 60 cents plus 18 cents postage.

INSIDE MICRONESIA — WHO GIVES A DAMN?

A reprint of a centrespread, this is a review of the new book in the *Earth's Wild Places* series, entitled *Micronesia — Island Wilderness;* The U.S. is trying to annexe the North Islands for Military Bases — and will possibly destroy the Micronesian people in the process. 20 cents plus 18 cents postage. Available from FOE Brisbane — see FOE address list.

IS RECYCLING THE SOLUTION? by Ian Pausaker

This new paperback is perhaps the most comprehensive and hard-hitting book available on the packaging and recycling rip-off in Australia. Full of facts, references and good ideas. Available from FOE at the special price of $1.20 postage included. 93 pages.

FOE CALENDAR 1977
$1 each
available from FOE (NSW)

LAND RIGHTS NEWS —

A newsletter for aboriginals and their friends.
Available from **Land Rights News**, P.O. Box 3046, Darwin, N.T. 5794.

NON-NUCLEAR FUTURES by Amory Lovins

This pamphlet is an excellent summary of Lovins' book. It is a reprint from a *Not Man Apart* 8-page centrespread, August 1975. 20 cents plus 18 cents postage.

THE RIDE AGAINST URANIUM MAY 77 IS ON!

ALTERNATIVE TECHNOLOGY GROUPS

FOE Melbourne have recently started a weekly "Alternative Technology Workshop" for people interested in making AT devices and in discussing the general philosophy behind their use.

Meetings are held at 6 pm on Wednesdays at the FOE building at 51 Nicholson St, Carlton (ring up to confirm time beforehand).

FOE Sydney have also got a Solar Energy Group going, which meets at 423 Crown St, Surry Hills (698 9714) on Thursday evenings at 8 pm. Again come along if you're interested.

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KEEP URANIUM IN THE GROUND

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