



Sun Power in 1977

E. R. W. Neale
*Institute of Sedimentary and
 Petroleum Geology*
 3303-33rd Street N.W.
 Calgary, Alberta T2L 2A7

Five hundred dedicated sun worshippers met for three and a half cold, cloudy, drizzly days in Edmonton (August 21-24) to exchange views and amass information on what to do on cold, cloudy, drizzly days when our oil, gas and coal runs out. The occasion was Solar Energy Update '77, the third annual meeting of the Solar Energy Society of Canada (SESCI). It attracted over 500 architects, engineers, geographers, physicists, housewives, handy men and women, home-builders and one geologist (at least I didn't see another I recognized as such)

Seventy papers were presented, commonly in three simultaneous sessions and these were interspersed with state-of-the-art reviews and business meetings. Content ranged from high powered mathematical simulations and monitorings of solar heating systems to simple, pragmatic illustrations of do-it-yourself ventures. The papers were classified under six topic headings: political, housing, engineering, science, agriculture and education. Attendance and participation at sessions was quite extraordinary, all rooms were crowded to capacity until the last lecture on the last day. People didn't come to this conference as an excuse for a subsidized holiday in Jasper, Banff and vicinity.

This was an encouraging, enlightening meeting for one who hasn't paid much attention to alternate energy resources except to moan "Why aren't *They* doing something about it?" as the price of fuel creeps up. It was refreshing to chat with people who were doing

something about it individually in their own back yards and collectively by publicizing potential energy sources and petitioning for government initiated research.

Probably the mood of the meeting was conveyed in a talk by E. E. Robertson of the Biomass Energy Institute who was elected as Treasurer of SESCO at this meeting. He pointed out that in the past century Canada's use of non-renewable energy has increased from 10 to 80 per cent. It takes energy to get energy and this shift initially required a large investment of renewable energy in order to produce the capital infrastructure to exploit fossil energy resources. It is now time to reverse the investment emphasis and to divert an increasing share of our present wealth into channels that will ensure an adequate supply of renewable energy - as recommended by the 1974 Pugwash Conference.

Solar Politics

Solar fans have to be interested in many things political - taxation, protection of access to sunlight, incentives and subsidies and government initiatives in research

In a paper by Adolph Feingold of the University of Ottawa's engineering faculty we learned that householders are not entitled by law to sunlight for generation of energy. A high rise can pop up beside you and leave you to freeze in the dark. In the U.S.A., several states already have or are in the process of achieving solar easements. Also, President Carter has proposed tax credits to help launch the solar industry. Several states anticipated him by concessions such as income tax cuts, exemption from property and sales tax and other financial inducements. In Canada, only Manitoba has shown any such inclination to encourage solar installations.

Popularization of solar energy applications can come from government endorsement, e.g., by installation of solar devices on government property. Again, Manitoba is in the forefront with a functioning solar heating device installed on the roof of its Legislative Building. Experiences with this demonstration project were described by retiring SESCO president R.E. Chant and his co-workers

Federal government research in alternative energy resources amounts to just over \$9 million annually. About half of this is being spent on direct solar heating by NRC and CMHC. The other half is spent on indirect solar energy research, e.g., wind, biomass, solar conversion techniques, etc. EMR has recently established a Renewable Energy Resources Branch under a Senior Advisor, Harry Swain, who addressed a luncheon meeting. He hopes to promote a program that will extend beyond the demonstration scale - most of the work will be contracted outside of government through DSS. J.R. Sasaki of NRC outlined the present federal program in solar heating which includes construction of 14 individual solar homes spread out between Halifax and Victoria, four contracts on monitoring the performance of completed homes and seven research contracts covering design, corrosion problems, research on heat absorbing paints and similar items. NRC's 1978 program will concentrate on multi-unit residential buildings and the monitoring of non-residential solar heated buildings.

No Place Like Home

It is astounding how we have misconstrued our homes in recent years when you realize that long ago a guy called Xenophon (ca. 430-340 B.C.) advised building the south side higher to catch the winter sun and the north side lower to deflect the winter winds.

The sessions on housing understandably outdrew all others and had to be shifted to a large theater to accommodate the delegates. Chiefly, they included case histories of houses from various parts of the country. These ranged from very detailed descriptions of palatial, rigorously monitored homes with skillfully placed collectors, carefully planned storage and complex circulation systems to informal, sometimes amusing accounts of retrofits of older homes. One lady who was enthusiastic about her solar water heater felt that solar kits would soon replace motor bikes as status symbols, resulting in far more children surviving the teenage years.

R. Argue, a Toronto consultant, advised that there are about 120 solar heated homes in Canada (summer of 1977) and 100 more in the advanced planning or early construction stages.

He has examined about 60 of these and found no two alike. Not surprisingly, he found the most efficient homes (up to 80% of heat supplied by sun) were those with the largest collectors, sophisticated heat pump systems and massive insulation. However, he had a good word for Xenophon's time tested system - some of the homes that relied wholly on passive systems, i.e., large south-facing windows, insulated shutters and heat absorbing floors and walls could save up to 30 per cent in fuel with no cost beyond intelligent initial design. Lack of communication between solar home owners was very noticeable. The only common thread seemed to be the American magazine "Popular Science"

Of the many individual houses described, some grabbed the fancy more than others. One such was a solar home of 2000 square feet under construction in Regina, sponsored by the provincial government. Its design and massive insulation (R60 ceiling, R40 walls and floor) will require only 10 per cent of the heat normal for a house of this floor area. The collector system uses evacuated tubes and a very efficient heat exchanger has been designed so that it is anticipated that 100 per cent of the space heating will be solar. This experimental house will be watched closely for it is designed to eventually sell at a modest price and is expected to be cost effective even at present fossil fuel rates

A number of homes described by Charles Simon of Toronto had appeal because they had all been designed primarily to satisfy the client's lifestyle and building lot but the architect had managed to build in many heat absorbing and conserving features. Highly efficient wood heated stoves or fireplaces provided the back-up heat in each case. Nik Wistinghausen of Sarnia described the ultimate in low cost solar homes - "the groundhouse" - a design that will obviously appeal to geoscientists and others in harmony with the Earth. A U-shaped bungalow, it has earth piled up on three sides and over the roof. The south wall consists of solar collectors which also form a greenhouse full of edible plants visible from the living room. Partitions are moveable and you can use as much or as little of the house as required by changes in size of family and in lifestyle. No arable land is lost as you cultivate

your roof soil. A windmill, compost heap and/or exercise can provide electricity. A heated swimming pool is an optional extra but, strangely, there is no provision for the three or four car garage that is a mandatory adjunct of gracious Calgary living. Still, I've picked this one as my retirement dream home.

The Nuts and Bolts of It

The engineering papers chiefly probed details of solar heating. They included: comparisons of collector types in different Canadian climates using a mathematical model, a computer model showing the benefits of south facing windows, calculations of net heat transfer through windows of different design, corrosion problems of solar collector systems, effect of collector tilt on solar heating performance and various methods of testing and monitoring the effectiveness of systems. It is reassuring to know that active programs of testing and experimenting are underway in engineering and physics departments in universities at Fredericton, Kingston, Thunder Bay, Saskatoon, Regina, Winnipeg, Edmonton, Calgary, Toronto and elsewhere.

A review of wind energy conversion systems by G. A. Fuller of Regina contained several surprising facts for novices like me. For example, did you know that since the middle of the last century more than 6×10^6 small windmills have been used on this continent? The NRC vertical axis egg beater-shaped turbine on the Magdalen Islands is the largest of its kind in the world and was singled out as best exemplifying the state of the art. It will develop 200 kw and save the islands 40,000 gallons of fuel. Storage of excess power may be accomplished by compressing air in excavated salt deposits. Fuller stated that wind turbines will remain as supplementary sources for some time to come, e.g., as a back-up to direct solar heating during overcast periods and the severest winter months (when winds are commonly strong).

Beyond the Obvious

It's a pretty safe bet that direct solar systems are going to eventually supply some or all of our space heating and water heating requirements with some back-up from indirect solar energy, such as wind, wood and garbage piles. But

how about direct conversions of solar power to make factory wheels turn and lights flick on? Many of the science session papers were devoted to these subjects and the outlook is not as cheery as it is for low grade heat.

The visible and short infra-red wavelengths of the sun's rays can be transformed to electricity by cells made up of crystalline substances. Cells such as the silicon photovoltaic cells developed in the U.S. space program proved to be very expensive. Cadmium, gallium and selenium cells are also expensive and very inefficient. Fine for powering a remote lighthouse but presently out of the question for a central power station. D.L. Pulfrey of U.B.C., in a comprehensive review paper, told of the most recent breakthrough, a cell constructed of granular silicon with an efficiency of 14 per cent. He said that the cost of solar cell arrays was cut in half between 1974 and 1976. It is now \$15 per peak watt and the present research goal is \$0.50 per watt by 1986 when it will be competitive with the price of coal and other fuels in many parts of the country if used in conjunction with other electrical generating facilities. Great independent solar generators based on satellite power stations are still far in the future.

Photoelectrochemical conversion can be obtained by chemicals that react due to absorption of light rays. The absorption of energy through chemical change and the later release of this energy by other reactions means that we have the potential for both conversion and storage - all of which is why W. E. Pinson and co-workers from Ottawa are working on a photoelectrochemical solar cell which they hope will produce either cost effective electricity or a storable hydrogen fuel some 10 years from now. Plants store solar energy by photosynthesis and Smith and Antos of Concordia and J. R. Bolton of University of Western Ontario are working on methods to duplicate this most efficient storage method.

Solar heat will expand fluids and by alternating expansion and contraction cycles a reciprocating piston can generate a circular motion. Presto - sunshine is converted to mechanical energy. We heard a report from Weichman and McKinnon of Edmonton on their experiments with a Stirling engine from which they hope to obtain a

power yield of 10 to 15 watts. The experiment seems promising although currently plagued with mechanical problems.

The science papers also included a study on heat pumps and a widely over-enthusiastic paper on the geothermal potential of the prairies. The latter was a gap-filler by a non-geoscientist which caught the attention of the press but did not divert the rest of the audience. SESCO members were already familiar with this subject through an excellent article in their newsletter 'SOL' written by Alan Jessop of the Earth Physics Branch (EMR).

Spreading the Word

This conference was preceded by a week-long course in the design of solar homes by a high-powered group from the Solar Energy Applications Laboratory of Colorado State University. Several people I talked to at the meeting had taken similar but lower keyed, more pragmatic courses at their local colleges or technical schools. We heard such a class described by R. S. Dumont who instructed 100 members of the general public at the community college in Saskatoon. We also heard of a full-time course, the energy option of the Physics Technology Program at Algonquin College, Ottawa, whose first graduates will appear in May, 1978 to satisfy obviously growing national need.

A fascinating story of public education was told by Long and Lee of Calgary: a solar heated shelter and greenhouse is being constructed by an architectural firm and the university with the full co-operation and manual participation of young and old from Inglewood, one of the city's oldest communities. I later checked this out on the site, found happy people with saws and hammers in their hands and was duly impressed.

The Future

A distinguished lecturer graced the conference, Professor Georgescu-Roegen, economist and savant extraordinaire. His message was gloomy: solar energy is widely dispersed and harnessing it on a scale to support our present population and living standards is not entropically viable. There are not enough fossil energy resources on hand to build the conversion hardware that will make solar energy self sustaining. His

articulate arguments held an audience of 500 in their chairs for two hours but did not daunt them. They all went cheerfully back to their lectures next morning and clapped enthusiastically as they heard of the attempts to extract 10 watts out of a little solar engine! Optimism seems inherent in mankind, it has carried us through several Dark Ages in our brief sojourn on Earth and will probably see us through the next one when the darkness might be caused by wood smoke! Such faith in the future has led SESCO to petition the government for an Institute of Solar Research with a budget of \$500 million to carry it over the next 20 years. If you wish to be buoyed up by approximately 3,000 fellow optimists, I suggest you join the Solar Energy Society of Canada by sending \$10.00 to P.O. Box 1353 in Winnipeg. You'll get a prompt reply because they now have a permanent secretariat supported by a generous grant from EMR - a much more generous grant than any geoscience society has ever received but they probably deserve it because they do try harder.

The proceedings of the Solar Energy Update '77 are available in loose-leafed mimeographed form from the Faculty of Extension, University of Alberta for \$22.00. Well worth having in your company or university library.

MS received September 6, 1977