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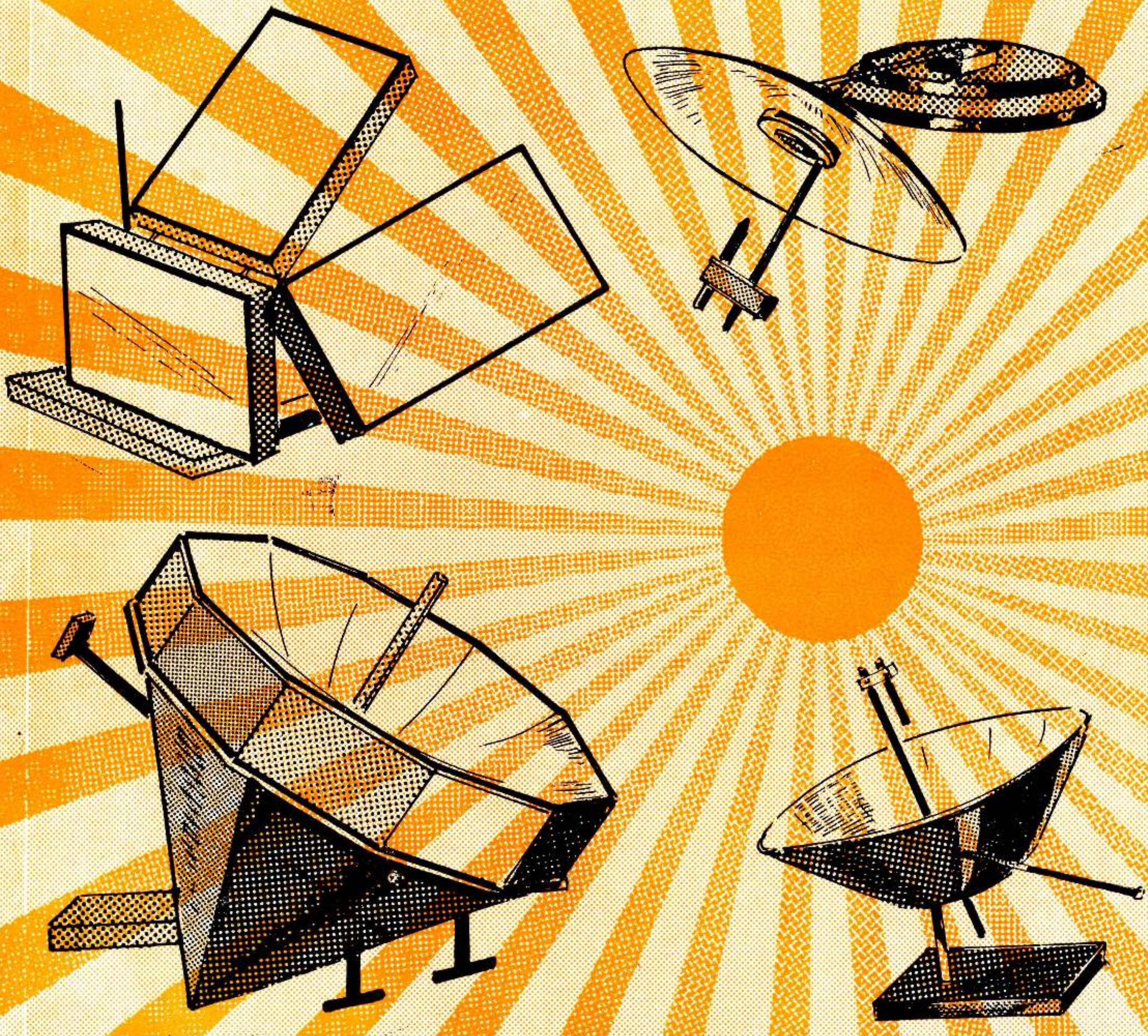
JULY 1979



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CONTENTS

** Cover picture*
Solar energy

In our next Issue

* Anodising
* Curing meat
* Nuclear energy boon or bane?

Edited by
Philip L. Ramenaden

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Solar energy—hope and challenge

By P. L. Ramenaden

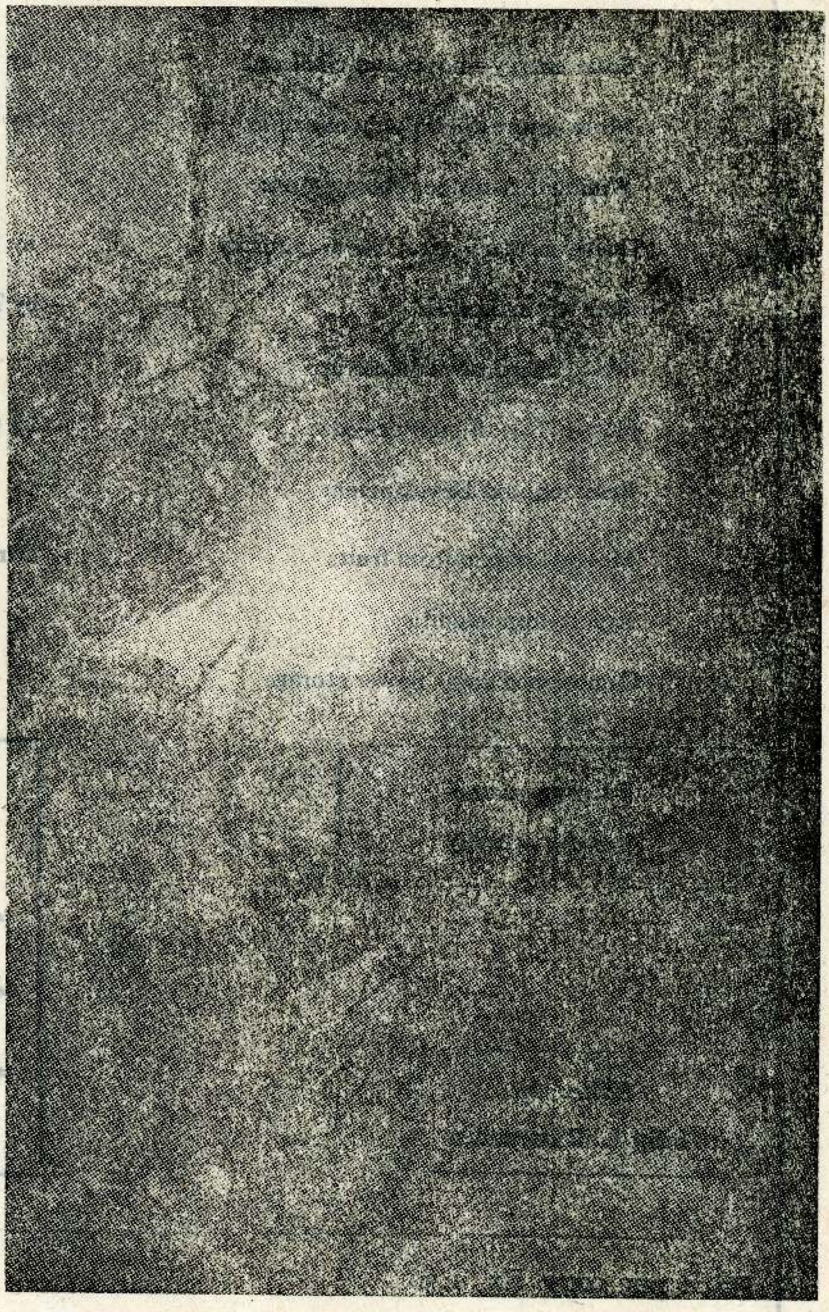
Except for the original work and the personal apprai-sals the author does not claim credit for the information included in this article. Such information is based on available technical literature, brochures and discussions held in specialised institutions. The views expressed in this article are the author's own and not the IDB's official thinking—Editorial panel.

From very ancient times, plants have converted Solar energy into living tissue, some of which was buried in the earth's depths to produce coal, oil and natural gas. Man has found many valuable uses for these complex chemical substances manufacturing from them plastics, textiles and various other end-products of the petro-chemical industry. These are of great value to man and the generations to follow.

However man in using these non-renewable natural resources has begun to burn them up in ever-increasing quantities so much so that in the space of a few more decades, the world reserves of natural gas may be depleted, oil will be gone and the world will also be without coal.

Other Sources

Today with the energy crisis assuming epic proportions with the traditional fuel sources dwindling, mankind is therefore casting around for some abundantly available, means of keeping both the wheels of industry moving and the home fires burning. In the highly developed nations as well as in the third world, the search for an alternate energy source is on with a zeal comparable to that of the quest for the Holy Grail.



Solar research is being carried on at NERD, and they have developed a solar heater. Tests are also being made on a sophisticated solar cooker.

Even in Sri Lanka, which unlike most other countries has had ample resources of timber and firewood and a benign government to cushion the blows of frequent fuel-oil price hikes, the tremors of disquiet are being felt, though still the urgency for conserving fuel or finding alternate energy sources have not reached fever-pitch. However in various research institutions and other organisations, the far-seeing have already realised that the time has come for us to take stock of the situation and find some other source of energy.

Thus in this quest for energy it is but natural that man should turn to the elements or to sources he is familiar with. Therefore in practically every country, ways and means are being found to harness the unbridled energy of the oceans and in countries that are so blessed, to trap and enslave solar energy, to explore non-conventional energy sources such as biomass and geothermal resources etc. Of all the sources of energy, the most abundant source of all, is sunlight. It is not only inexhaustible but it is also one of the energy sources which is non-polluting.

Though man has used solar energy for a long time it was only recently that such equipment as boilers fitted with mirrors, steam engines, hot air engines and cookers came into being and it is only now that industrial nations too are launching intensive research programmes in the quest to harness solar energy. Thus even today some methods of utilising solar energy have reached a stage where they can compete economically with methods of using conventional energy sources.

On our own

However in countries like ours, which are blessed with perpetual sunlight, it is in our interests to develop the utilisation of solar energy on our own rather than waiting for this technology to be transferred to us. This energy could be converted effectively into mechanical, electrical, and chemical energy to be used in the production of electricity, desalination of water, irrigation, refrigeration, cooking, drying fishery products, fruits and vegetables etc.

At present a limited number of solar energy using products have been commercially manufactured but they are used only in industrialised countries because of the heavy expenditure involved. Thus there is a need for more information evaluation of performance especially on site, and investment promotion, if more developing countries are to use solar energy on a widespread scale.

However apart from lack of knowledge, there are other obstacles that face us primarily because the initial cost of solar equipment is high. Furthermore, although there are several bodies that are doing research on this, no intergrated effort has been made to co-relate the findings and to see the appropriateness of the methods used to apply the technology to the conditions prevailing in the country concerned.

In Sri Lanka, for example, much work is being carried on by various institutions such as CISIR, NERD and the IDB on the utilisation of solar energy but so far no concerted effort has been made to popularise this.

Know-how

However in a bid to provide technical know-how and to create an urgency for developing solar energy projects in the under developed countries, UNIDO (United Nations Industrial Development Organisation) in consultation with experts in this field, has identified these areas about which developing countries lack adequate information:

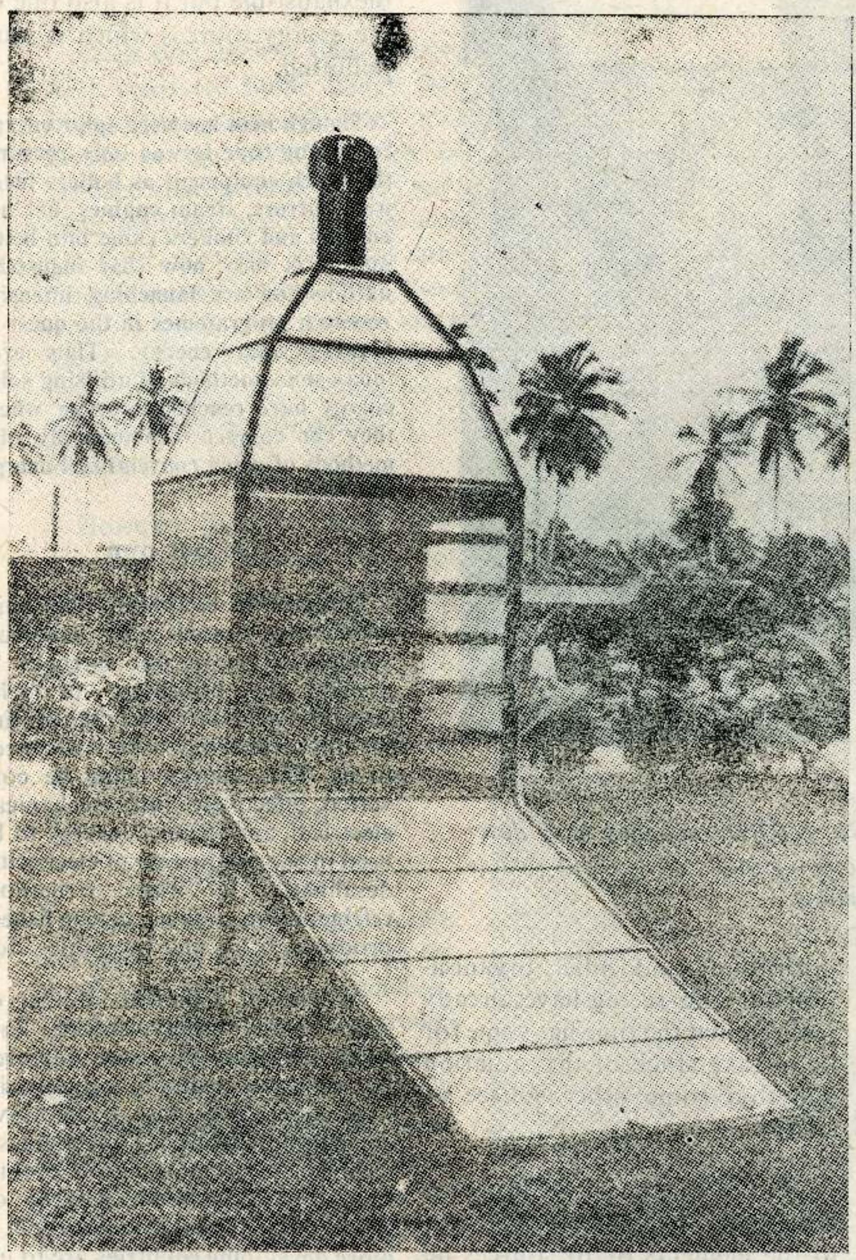
The criteria on which policy should be based, especially in regard to energy utilisation in rural areas;

The appropriate governmental structure and machinery for development planning with this regard;

Indigenous technology relating to the application of non-conventional energy sources;

Local potential for engineering development and manufacture of production equipment;

Appropriate institutional facilities.



A solar dryer that is on exhibition at the I.D.B. Head Office at Moratuwa

Important

There is no doubt that special equipment is needed to harness solar radiation and these have to be either obtained from abroad or produced locally. Therefore since eventual local production is the goal, then applied research and development are an important element where co-operation among other nations and technology transfer would play a vital role.

However, before any step in this direction could be taken three other vital steps must be taken viz:

A national energy policy must be formulated,

The role to be played by non-conventional energy sources must be evaluated and finally,

A realistic analysis of the contribution of solar energy to that role.

Furthermore, a national institution should either be set up or designated to carry out research and manufacturing promotion activities. Such a programme should not only evaluate imported technology and hardware products but also should concentrate on, the local development of domestic technology and products, on adaptation, prototype fabrication, testing, technical, and manpower development etc.

At present there has been a proliferation of commercial companies in the field of solar energy, but unfortunately some of them have asked extremely high prices for the transfer of solar technology that is of doubtful value to countries like ours.

Beneficial position

Apart from this, at present in Sri Lanka research in harnessing solar energy has not been carried out extensively, and what little has been done is still in the embryonic stage. Therefore we could find ourselves in a beneficial position if we decide to cooperate with other developing countries and study their achievements in this field. Most tropical countries like India, Bangladesh, Ghana, Madagascar etc. have already made considerable progress in harnessing solar energy, therefore if we take a leaf from them, we too, can benefit.

A luxury

As far as can be ascertained, several independent service and research organisations in Sri Lanka are today working in this field of utilising non-conventional sources of energy. However, though this is a very laudable situation because the problem is being tackled from varied approaches, still, this is a luxury which we cannot afford to indulge in because of our limited resources. For example, two of these research organisations have developed or modified solar cookers and driers, independently. Both the institutions have expressed satisfaction with their products. But, beyond the fanfare and the back-patting nothing more has been done. There aren't any attempts being made to popularise these or to work out a scheme whereby avenues of using these items on a commercial scale could be explored.

In India, especially in the southern regions, which are typically placed like us, much progress has been made in popularising the use of solar energy and especially other non-conventional sources of energy from as back as 1973 when the National Committee on Science and Technology went into the question comprehensively.

The Indian energy scene today, is characterised by low per capital energy consumption about 100 KWh per day, and as the country is primarily an agricultural one with population concentration being mainly in rural areas, their solar energy programme is heavily biased towards meeting the energy needs of this sector. The Energy Research Committee which monitors this programme consists of secretaries in the Government and is presided over by the Union Minister for Energy. Thus India has a well co-ordinated solar energy programme with targets to be achieved within certain periods.

Meanwhile in practically every developed country such as USA, Germany, Canada, France and the Netherlands giant strides have been taken and several energy research centres have already been commissioned and they have produced satisfactory results. Among these, the conversion of solar energy into mechanical energy has been very satisfactory and low temperature solar engines that are proving to be very versatile have been produced. The Societiete' Francaise D'Tudes Thermiques et'D Energic Solaire (SOFRETES) has already installed about 50 solar pumps which are at 1 KW.

Collaboration

Sofretes, in collaboration with the Mexican Government has also installed a 25-KW solar power plant in San Luis De La Paz. The installation has now been in operation for about one year and does not present serious technological problems though the control system is very sophisticated.

However though there are many possibilities for harnessing solar energy, there are only certain applications that are feasible for developing countries, They are:

Solar distillation of sea water and brackish water at low and medium fresh-water production rates,

Solar domestic water heating on an individual or collective basis. The technology of this application is easy and can be adopted to local conditions,

Solar drying. Upto now drying has been in the open air, but now, with a simple apparatus, it is possible to get better, quicker products.

Solar cookers. These are inexpensive and could be used alternatively with other fuel-consuming hearths.

High costs

In Sri Lanka due to high costs of conventional fuels, solar cookers could be used effectively. For this, solar cookers similar in capacity and size to classical cooking systems are needed. Therefore a solar cooker would have to have an energy delivery rate of roughly 1 KW to be comparable to existing systems. A solar collector area of about 2 M^2 would be necessary (at 50% collection efficiency) to give comparable normal cooking rates.

Several basic types of solar cookers have been developed already. In most developing countries including Sri Lanka, except for those interested in appropriate technological systems, most attention has been paid to small production units.

Three types

At present three types of solar collectors exist:

Solar hot box—An insulated solar cooker with double glazing in the form of a box set out in the sun and oriented manually. Reflectors are some times added to increase efficiency.

One of the inherent disadvantages of this type of cooker is that cooking has to be done in the open and this is not conducive to the cooker becoming popular.

Parabolic reflector solar cooker—Concentrates cooking rays on a focal point or an area on which a cooking pot or vessel could be placed.

Again this process requires cooking outside.

Detached solar collection and cooking chamber unit—In these units the heat transfer fluid, whether water converted to steam or heat transfer oil is heated in a separate collector.

This cooker can be used in the house.

However no comprehensive study of solar cooking technology has yet been made. Therefore it would be useful to collate all the existing information on this, and also to discuss the problems so that it may be possible to determine what role solar cooking can play in meeting the needs of fuel-scarce societies.

So many techniques have been developed not only in Sri Lanka, but also the world over, that they need to be put into a compendium that could assist those concerned to either make use of these technologies or to modify and adapt them to existing situations.

More Severe Fuel Saving Measures?

Minister of Industries and Scientific Affairs, Mr Cyril Mathew warned that the Government would be forced to take more severe measures than were currently in force, to curtail oil consumption if fuel oil prices escalated any further.

Warned

He warned that we were facing a major crisis as far as energy sources were concerned. He said that in view of the increasing price of crude oil, developing countries like ours were compelled to curtail oil consumption.

The Minister said this at the opening of the new laboratory at the Ceylon Institute of Scientific and Industrial Research (CISIR) recently.

"We must learn to walk and travel less by car or bus. Ride a bicycle if you can, but not if you are not accustomed to it", he said amidst laughter explaining how he came to be having his hand in a sling.

Stressed

However the Minister stressed the need for an integrated research activity, planning and management. He said that most tropical countries had already started using industrial alcohol to supplement their fuel consumption. The Minister said that this research should be coordinated. Sri Lanka had already begun work on finding new ways of using industrial alcohol. He said that institutions like the IDB, CISIR and NERD should make a coordinated effort to explore all possible avenues of harnessing alternate energy sources.

By P. L. Ramenaden

Keen to Invest

Several industrial tycoons and enterpreneurs in Hong Kong have evinced a keen interest in investing in Sri Lanka.

They have however stated that they required more information with regard to the conditions and regulations governing the foreign investor so that they could go ahead with their investment projects without delay.

These businessmen said that they were initially attracted to Sri Lanka because of the high incentives that have been offered to foreign investors by the Greater Colombo Economic Commission and also because of other incentives like duty free raw materials available and the comparatively cheap labour.

Aid to IDB to perfect cooker?

By Philip L. Ramenaden

The Special Energy Study Committee headed by Mr. James H. Lanerolle Secretary, Ministry of Power and Highways has recommended that the Industrial Development Board be given financial assistance to perfect the thermal efficient firewood cooker that had been developed by the IDB including identification of economic methods of mass production.

National Footing

This is one of the recommendation that has been made by the Committee on conservation of electrical and petroleum energy on a national emergency footing.

It has also recommended that top priority be given to oil and gas exploration and also made the following recommendations:

All possible measures be adopted to encourage the use of push cycles as a means of transport.

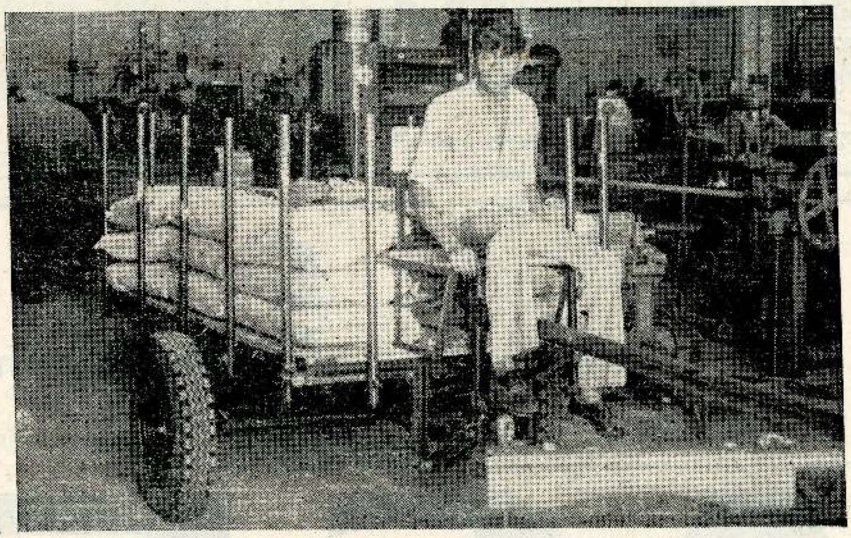
To grant a cash subsidy to persons who purchase new utility class cycles and that salary advances payable to employees both of the public and private sectors to purchase bicycles be increased to realistic levels.

Incandescent bulbs be replaced wherever possible with flourescent bulbs because fluorescent fittings conserve more than 75% of energy used by normal bulbs.

The Committee in its interim report has also suggested that customs duty on fluorescent, tubes, chokes, starters and holders be abolished inorder to make these cheaper.

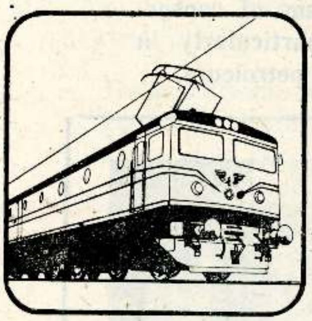
Meanwhile the Committee has also suggested that an extensive publicity campaign be launched to educate the public on means of conserving energy particularly in electricity and petroleum.

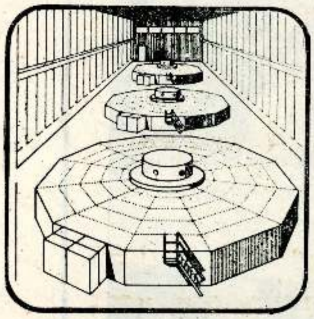
The Chairman of the IDB, Mr. Naufel Abdul Rahman addressing the inaugural session of the Industrial Extension Officers' training course held recently.

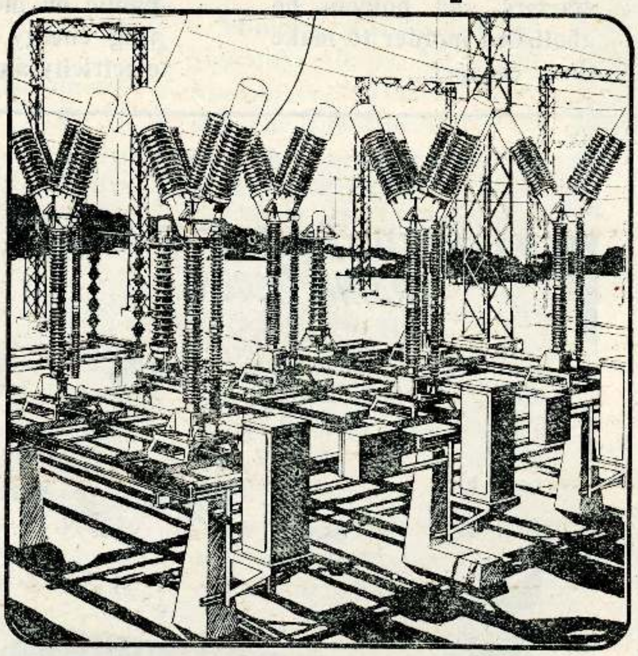


Tests are underway on a prototype of a new bullock cart that was developed by the IDB. Pictured here is the load-capacity test in progress.

ASEA in power in industry in transportation



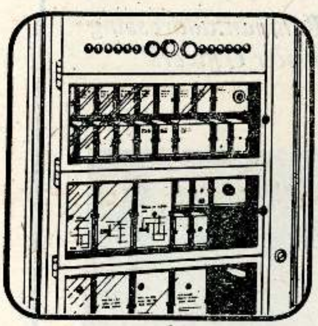


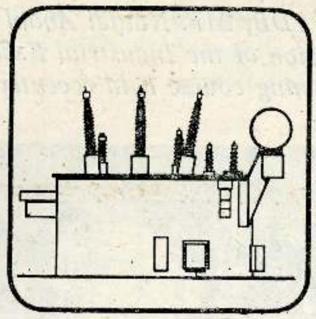


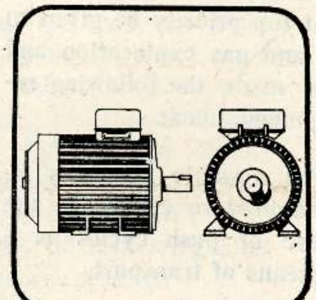
ASEA has a world-wide reputation as an international company with an extensive product range and considerable technical resources.

They have factories in ten countries and are represented in more than 80. In 1977 sales outside Sweden amounted to 52% of the total sales of US $2.085 million.

ASEA employs over 43,000 persons in its organisation. Their programme covers the entire field of electrical engineering-from standard products to complete plants and systems for power stations, industries and transport undertakings.







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WINDMILLS—ANOTHER ENERGY SOURCE

Harnessing wind energy for man's uses isn't a new concept. He has been using this energy to propel himself across the oceans and to drive mills and pumps etc. from very ancient times. In fact low-lying Holland has utilized it to such an extent that today it is known as the Land of the Windmills.

However, we, in Sri Lanka, though we have used it extensively for sailing, have not used it to drive our pumps or our mills. But today because of the energy crisis that is facing us, we are forced to make use of every energy source available.

Active efforts

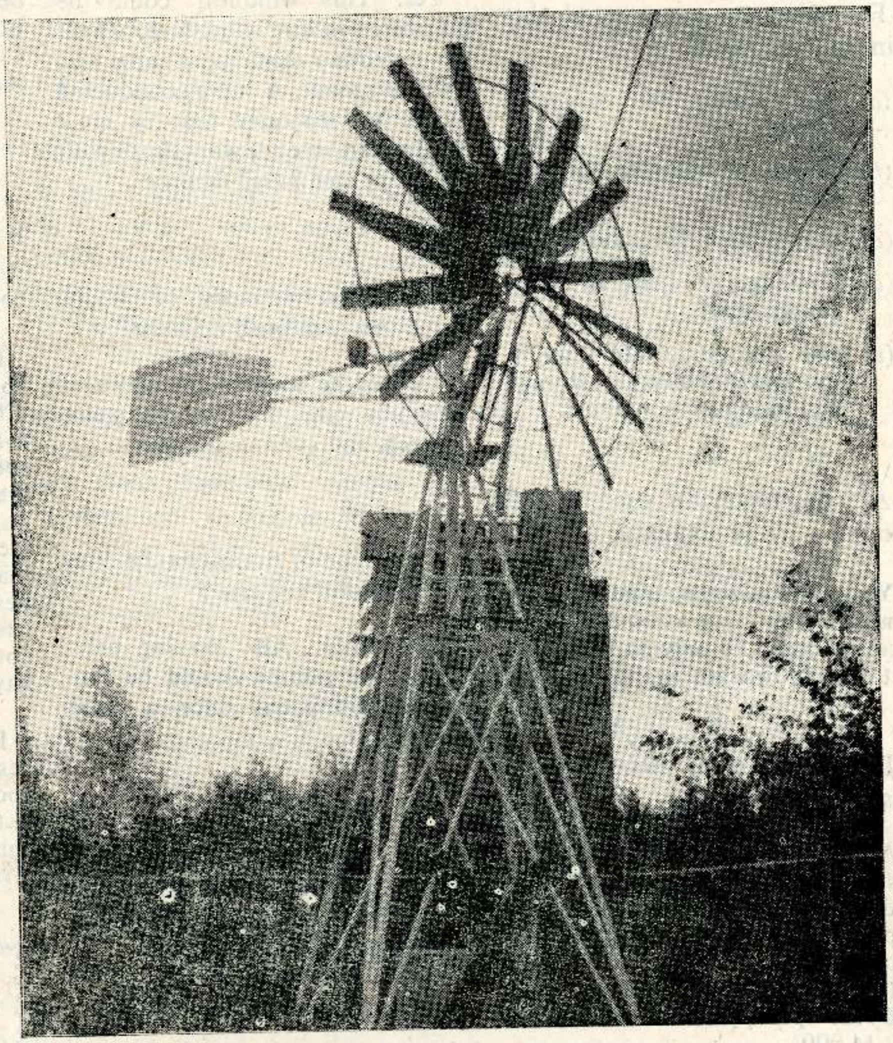
Therefore apart from the research into other energy sources, active efforts are being made to harness wind energy for as many purposes as possible. Though several institutions have done research on this, the Water Resources Board has come up with a workable model of a windmill.

In this article we have given in question and answer form practically all the information that our readers have wanted regarding a wind-operated water pump.

* * *

How does the Windmill work?

The pressure of the blowing wind applies force on the steel plates mounted on the wheel, causing it to rotate. Rotation of this wheel causes the up and down movement of the piston of a simple piston pump. The pump is submerged in water in the well, over which the windmill is mounted.



How much of water does it give and how high can water be pumped?

This depends entirely on the windspeed. For instance, at a daily average windspeed of 10 m.p.h. this windmill would pump 40,000 gallons of water per day, to a height of 20 feet. If the height is increased to 40 feet then the quantity of water available would be about 20,000 gallons a day.

* * *

At what windspeed would the windmill start pumping?

Windmill is designed to work at its best efficiency, at a daily average windspeed of 9 m.p.h. But, though slowly, it would still work at 7 m.p.h. which is the minimum windspeed at which it would work.

* * *

What is the maximum height to which water could be pumped?

A pump with a 6 inch diameter cylinder could be used to pump water to a maximum height of 40 feet, whereas a 4 inch diameter pump could be used for a pumping head from 40 feet to 80 ft. Obviously, at a pumping head of 80 ft., the quantity of water would be around 10,000 galls/day if the daily average wind-speed is 10 m.p.h.

* * *

For what purposes could this windmill be used?

(*a*) Small scale lift irrigation systems,

(*b*) Supply of water to livestock farms,

(*c*) Water supply for industries,

(*d*) Drainage of water in water clogged areas,

(*e*) For domestic water supply schemes with adequate storage and purification support.

* * *

Are the materials used in the windmill freely available?

Yes. All material used in this windmill are freely available in the local market, not only in Colombo but in any townshop in the country.

* * *

How much does this windmill cost?

At the present market prices, the cost of material is around Rs. 6,000/- and the fabrication cost of course depends entirely on the particular manufacturer. But it is safe to assume that the total cost of a windmill and the pump would be about Rs. 14,000/-.

* * *

Where should a windmill be located?

THIS SHOULD BE DONE WITH UTMOST CARE IN CONSULTATION WITH EXPERIENCED ENGINEERS TO AVOID DISAPPOINTMENT. A windmill should always be located on a landwhich is well exposed to wind and free from tall trees within a radius of at least 200 ft. Though a hill top would be the best location for a windmill, availability of water in sufficient quantities and at suitable depth in a well dug on a hill is doubtful.

Is it possible to fabricate this windmill in any ordinary workshop?

Yes. This windmill could be fabricated in any workshop, which has a drilling machine, a lathe and a welding plant. A survey conducted by us has indicated that in most rural areas there are workshops with the above mentioned facilities.

* * *

For what sources of water could this windmill be used?

It could be used to pump water from tube wells, ordinary dug wells, channels and streams or rivers.

* * *

What type of maintenance does this windmill require?

Very little. All moving parts (except the pump) should be thoroughly lubricated once a week without fail.

* * *

Does the Water Resources Board provide consultancy for those who are interested in using windmills?

Yes. It does.

When you request consultancy, please specify the particular purpose for which you intend to use the windmill, quantity of water you expect, source of water from where you intend to pump, whether the sources of water could provide your requirements, especially in the dry season when you most need it, description of the landscape in the area where the windmill would be installed, whether you use an engine pump at the moment or not and your general idea about the wind in the area. Also when you write to us, please indicate the district in addition to your postal address.

How do I obtain a set of drawings of the windmill?

A complete set of drawings could obtained from the Water Resources Board, 2A Gregory's Avenue, Colombo 7. Requests also could be made by post.

* * *

Does the Water Resources Board provide information on wind in a given area of the country?

There is general information available on the nature of wind in different parts of the country, but it is not adequate to predict the wind speeds of a particular location as these speeds are largely dependent on many other factors like landscape, local weather etc. Hence we presume that the local people would know best about the winds in a particular site. However, we shall try to help you with whatever information we have in this connection.

Please note that this windmill was designed and developed by us only about nine months ago is still being tested in the field and hence we are unable to specify the durability of certain moving parts.

Going Metric is vital to our industry

By W. N. B. Dabarera,

National Metrication Authority.

From earliest times even with pre-historic man, measurement has been a vital concept to estimate the time involved for the passage of the sun across the heavens, to gauge the distance of the hunting grounds from the caves, the burden of a slaughtered animal etc. and later to assess the quantity of grain harvested. Thus from the very dawn of the evolution of the Homo Sapien, a need to have some form of measurement had been in existence and many systems of measurement were developed.

Own System

Each civilization, country, and region developed its own system of measurement but with the development of commerce and trade, many problems arose due to the lack of an unified system or basis of measurement. Thus by the 17th Century when commerce was extensively being undertaken, the multiplicity of measuring systems was becoming a barrier not only to commerce but also to the flow of knowledge. Therefore in 1790, French statesman Talleyrand proposed the unifying of weights and measures urging a France-British collaboration. However, both Britain and USA declined co-operate.

The French, however, went ahead and decided to evolve a "natural universal" measure. The new system which finally evolved was to be based on the decimal system advocated by the Dutchman Simon Stevin and the base unit of length in this system came to be known as "a metre" and a unit of mass which was called a 'kilogramme' was defined as a "cubic decimetre of water at its maximum density". Thus two standards, one for length and another for units of mass came to be accepted and used by several countries including France alongside their traditional systems of measurement. In Britain, USA and the British colonies however, the British system of inches and ounces was exclusively used.

Recognition

The metric system gained international recognition only in 1875 with the signing of the Convention of the Metre and the establishment of the General Conference on Weights and Measures.

Base Units

The Convention envisaged only the establishment of two base units—for length and mass, but the need for the measurement of other physical quantities arose when the study of science expanded. Thus Gauss proposed the use of a system based on a millimetre, milligramme and the second. A little later, Weber introduced the classical system of units used in science which came to be known as the 'CGS electromagnetic system'. Apart from these, there were various other systems that were periodically introduced.

Therefore, once again there came to be a multiplicity of metric systems in use and in 1956, the Permanent Consultation Committee of the General Conference of Weights and Measures set up a commission which enabled the adoption in 1960 of the International system of units (SI) which had 6 base units, and in 1968, the seventh unit "mole" was added to the list.

Sri Lanka, which was under British domination had adopted the British system and it was only in 1974, with the enactment of the Weights and Measures (Amendment) law No. '24 that we recognised the International System of Units.

The Metric system that is in vogue today in Sri Lanka, is the SI which has seven different basic units to measure physical quantities.

The seven different basic units comprise:

Quantity	*Basic Unit*	*Symbol*
Length	**Metric**	**M**
Mass (weight)...	**kilogramme**	**Kg.**
Time	**Second**	**S**
Electric current	**Ampere**	**a**
Temperature	**Kelvin**	**K**
Intensity of light	**Candola**	**ect.**
Quality of material	**'Mo'**	**mil.**

The number of prefixes used to denote the size of these basic units are also included in this system. They are:

Prefix	*Symbol*	*Multiplication factor value*
Mega	M	1,000,000
Kilo	k	1,000
Hecta	h	100
Deca	da	10
Deci	d	0.1
Centi	c	0.01
Milli	m	0.001

There are many advantages in the Metric system with the main one being Product rationalization. By Product rationalization is meant, the use of a few types and sizes of an artical in place of a large number. For instance, in Sri Lanka, a variety of gauges such as B.S.W., B.S.F., U.S.C. UNF etc. are in use but if the Metric system, guage 150 is used, cost of production could be cut and at the same time, recording and stores procedure would be greatly simplified.

Successfully

Most of the manufacturing firms have adopted this system very successfully. In fact, one British firm engaged in the manufacture of nuts and bolts, has been able to reduce the variety of types and sizes from around 405 to about 200 without any adverse effect on production. Similarly, a company manufacturing ball bearings which produced around 250 types and sizes, was able to reduce the number to 30!

Furthermore, when production is on the metric system of measurement, sales promotion too is simplified especially if the product is meant for the international market because the demand for goods manufactured according to the Metric system is high as the majority of the countries in the world have gone Metric.

Other problems

Apart from this, most countries which have not gone metric are facing other problems. Since most developed countries, especially in the continent, use the metric system, they produce goods, machinery etc. using this measurement. Therefore if we buy their machinery, we would have to buy their spare parts as well. because since they have been manufactured according to metric measurements, only they would fit. Whereas if we maintained the British standard, we and just a handful would be using that measure, and this would mean that all non-metric models of machinery, equipment etc. would have to be purchased in a limited market, so would spares. This would result in a limited choice and extra expense. This problem has cropped up as far as Sri Lanka is concerned and our spares are costing us more.

Since we have got used to the British system by using it for so long, there is a certain amount of difficulty in affecting a conversion. Since most of the older generation have been taught in "inches and pounds", measuring in this system has become almost second nature to us. Therefore there is no accepted and cut and dry method by which the conversion could be achieved.

First step

However as an essential first step, a detailed study of the industrial sector and its uses of measurements must be made so that a phased conversion on a planned pattern could be made. Conversion to the metric system would prove invaluable to various other aspects of development as well.

Detailed study

Apart from this, a detailed study of all stages of industry beginning with the supply of raw materials, production and sales should be made so that the bottle necks and obstacles facing conversion could be unearthed. Once this data are gathered, a target date should be fixed and a definite plan of action must be launched to actively affect the conversion. This method, however would take time and cost money, but an entire way of life cannot be changed overnight nor could it be done by a mere stroke of the pen. Therefore the only way that we could go metric is by going about it with determination and in a systematic manner.

FUEL SAVING HEARTH

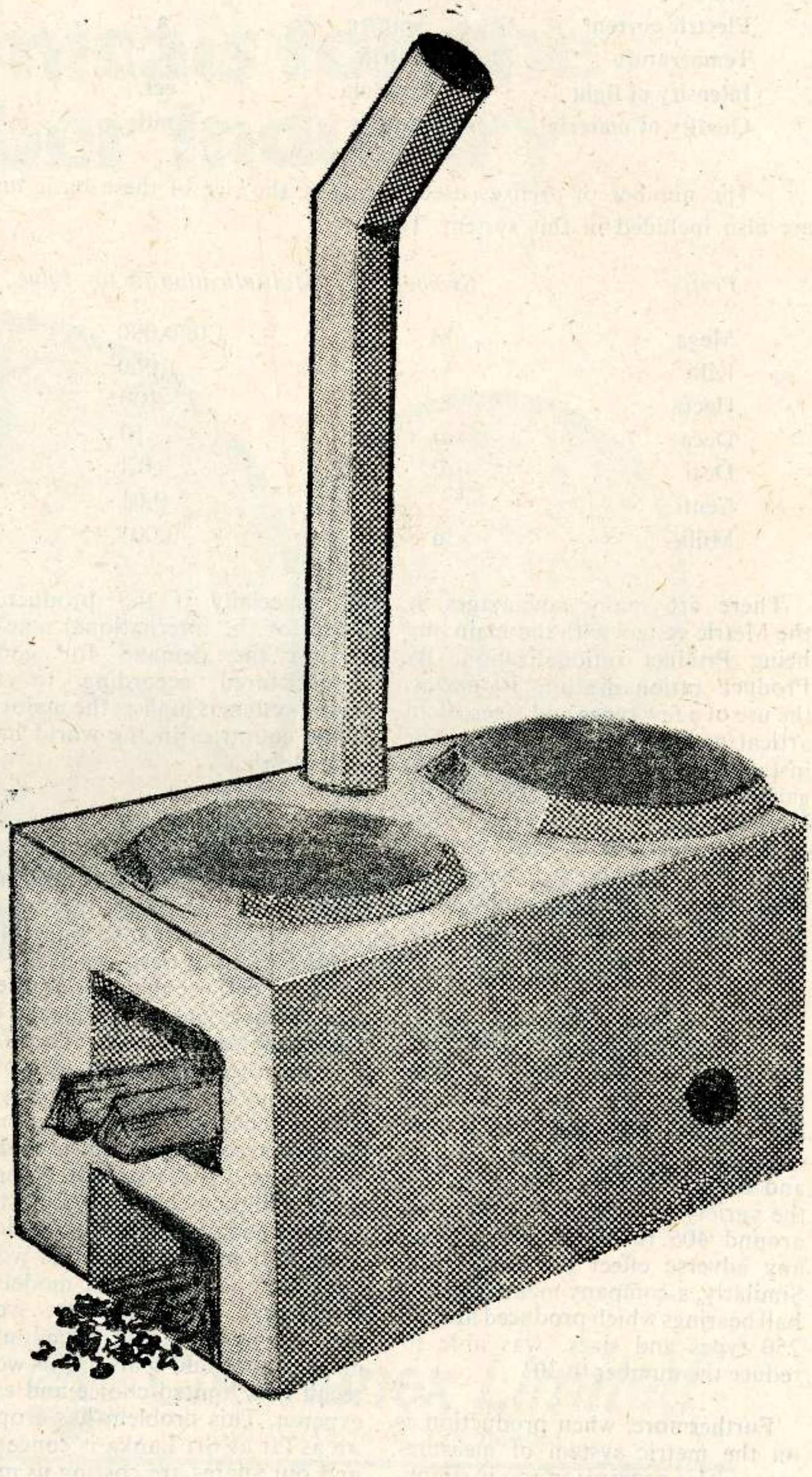
By T. Gunaratna

Extension Services Division

IT is estimated that nearly 98% of the households in the country use firewood as fuel for cooking. In urban areas where firewood which normally comes in the form of split rubber wood, has in the recent past risen in price to astronomical heights. The reason for this is undoubtedly that the supply cannot cope with an ever-increasing demand. The situation as a whole takes a very bleak outlook when viewed from a national point of view.

One has, first to consider where the firewood comes from. Firewood from rubber wood comes from unproductive trees felled in rubber growing areas. Rubber wood keeps flowing into towns and cities because among other reasons people in the outskirts have other sources of firewood. We all know of the high rate of population increase everywhere and the ensuring increase in demand for commodities. Firewood takes a prime place amongst commodities in our society. If no remedial measures are introduced now, there will be a time when even firewood becomes a scarce commodity in rural areas.

It is also worth mentioning here that rubber wood which is chemically treated is now growing in popularity as a wood for furniture making. Further, any discussion on the subject of firewood would be incomplete if no mention is made of weather patterns, climatic har-



Pictured above is the fuel saving hearth developed by the IDB

mony and ecological balance brought about by unsystematic and excessive deforestation, whether it be for timber or firewood.

All this indicates that we must strive hard to find means of economizing on the use of firewood. Nevertheless, since we cannot afford to do less cooking, our efforts must be aimed at getting maximum benefit from the available firewood.

Inefficient

Firewood hearths now being used in homes whether rural or urban, are very inefficient contraptions. By efficiency we normally mean, how close the output is to a given input. The input in this instance is firewood or rather the heat-content in the firewood. The output is the actual amount of heat absorbed by the material, that is being cooked, warmed or heated.

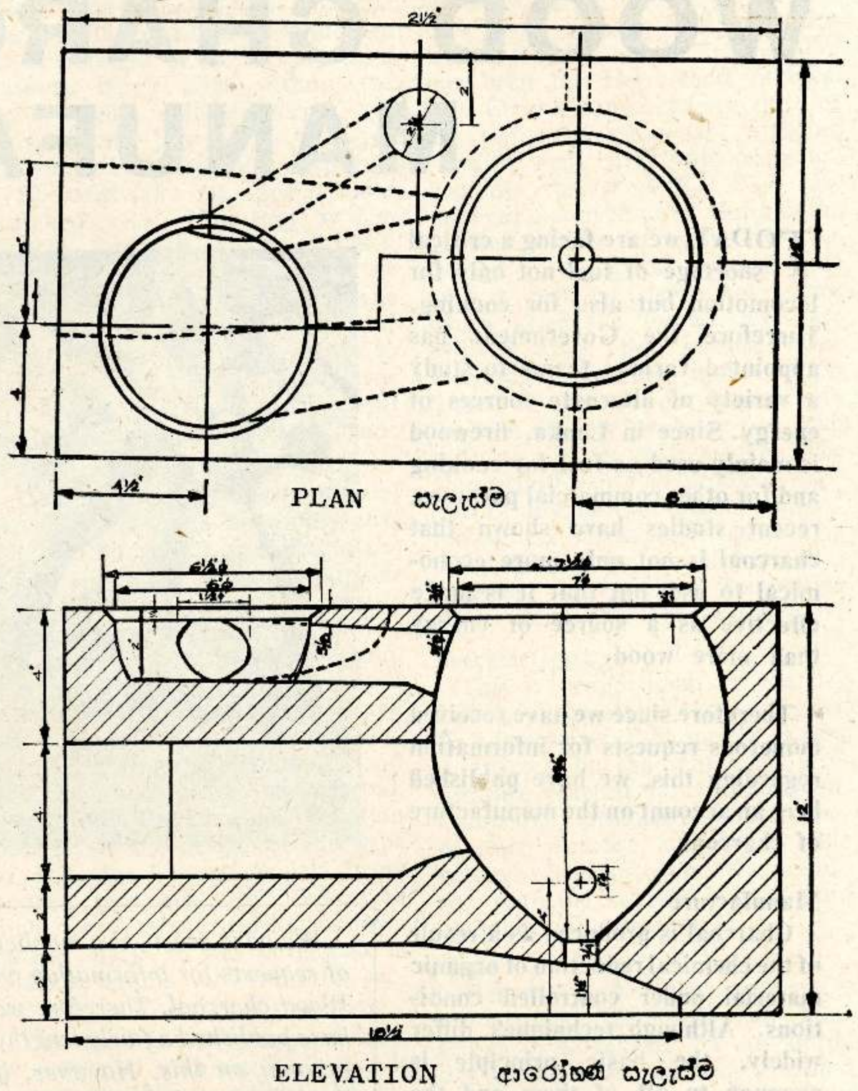
In the usual firewood hearths that we have in our households, this output is undeniably low. The loss in output is apparent to anyone as can be seen from the presence of soot in kitchens and the smoke emanating from chimneys, windows and other openings in the kitchens. Soot and smoke are carbon and other combustible materials which could be burnt to produce useful heat.

Besides, in the conventional firewood hearths, a good part of the heat in the flame is simply lost to the air as the flame is mostly in contact with air.

Reduce Waste

In the kitchen hearth developed by the Industrial Development Board, attempts have been made with success to reduce the drawbacks and shortcomings present in the ordinary firewood hearth.

Soot and smoke are avoided by providing a continuous and adequate supply of fresh air needed for combustion of all combustible materials. The chimney, well sealed at the base, provides an easy path out of the hearth for the heated flue gas which is lighter than air. This process thus provides a continuous supply of fresh air needed for burning of firewood through the air holes.



Further details of the construction could be obtained from the Public Relations Officer, IDB

Feature

An interesting feature in the kitchen hearth is that the remaining heat in the flue gas escaping from the main hearth is made to flow into the content in the pot on the secondary hearth before the flue gas finally enters the chimney.

The direct loss of heat from flame to air is not possible in the kitchen hearth as the whole combustion takes place inside an enclosed space in the main hearth.

The path of fresh air and flue gas is made clear in the diagrams.

Efficiency

Tests were carried to determine how efficient the Kitchen hearth was over the ordinary firewood hearth. In one test, equal weights of the same kind of firewood were burnt completely in the two hearths. This particular test repeated several times has shown that the kitchen hearth developed by the IDB is approximately 70% more efficient than the ordinary kitchen hearth. The same amount of cooking done with 100 lbs. of firewood in the ordinary firewood hearth can now be done by using only 30 lbs. of firewood in the kitchen hearth.

(*Continued on page* 25)

WOOD CHARCOAL MANUFACTURE

TODAY, we are facing a critical shortage of fuel not only for locomotion but also for cooking. Therefore the Government has appointed various teams to study a variety of alternate sources of energy. Since in Lanka, firewood is mainly used as fuel for cooking and for other commercial purposes, recent studies have shown that charcoal is not only more economical to use, but that it is more effective as a source of energy than mere wood.

Therefore since we have received numerous requests for information regarding this, we have published here an account on the manufacture of charcoal

Manufacture

Charcoal is produced as a result of the chemical reduction of organic material under controlled conditions. Although techniques differ widely, the basic principle is common to all of them and the types of appliance may be divided into:

1. **Kilns** in which the partial combustion of part of the charge is used to initiate carbonisation.
2. **Retorts** in which the charge is heated by means of an external source of heat applied to the outside of the container.
3. **Partial Retorts,** or continuous kilns, in which energy from an external source of fuel is passed into the charge for at least part of the carbonisation cycle.
4. **Furnaces** in which the wood charge is mechanically driven through a furnace under controlled conditions.

We have received a number of requests for information on Wood charcoal. Therefore we have published a fairly lengthy account on this. However, if further details are required please contact the Librarian, IDB.

The carbonisation process can be conveniently separated into four stages namely:

Stage A: Combustion (Kilns only)

It is necessary to ensure that enough dry kindling material is available to burn vigorously in the presence of ample oxygen so as to thoroughly heat up the charge before stages B & C can be sustained. The temperature rises rapidly during this period and, after an hour or when it reaches 600°C, the air supply is reduced and the temperature allowed to drop to 100-150°C.

Stage B: Dehydration

This stage varies in time from a matter of hours to several days depending on the moisture content of the wood and the type of kiln or retort used. The temperature rises to approximately 270° C before the exothermic carbonisation reaction begins.

Stage C: Exothermic

Once the free water has been driven off there is a rapid rise in temperature as decomposition of the wood commences and various substances, chiefly acetic acid, methyl alcohol and tar, are carried away in the smoke. Temperatures sometimes rise to 600-700°C before the distillation ceases, which is the stage at which kilns should be closed, and which is indicated by a reduction in quantity and change in colour of the smoke produced.

Stage D: Cooling

The rate at which the temperature drops depends upon the carbonisation technique used and the thickness and radiating capacity of the walls of the apparatus. In continuous retorts, the charcoal is discharged whilst still hot.

Kilns

The principle involved in all kilns is similar and depends on the combustion of part of a pile of wood until it is hot enough to carbonise. Simple ones are the earth covered kilns, and from these have evolved those built of brick, concrete and metal which give a better and clean product.

The methods of charcoal making adopted in more ancient times have their advantages but the charcoal is contaminated and the quality tends to be poor. The draught system is direct in the early type of kilns i.e. air enters at the bottom of the kiln and the hot gases emerge from the top. Most modern kilns embody the reversed draught principle as it gives better control and higher yields. The air enters at the base of the kiln and the gases leak from the chimneys connected with the bottom of the kiln.

Two classes

The two main classes of kilns are (*a*) fixed kilns (*b*) portable kilns.

Fixed Kilns consist of closed chambers with doors at one end for charging wood and discharging charcoal, and a series of air holes around the base which can be blocked as required. Usually there are chimneys at one end of a series of chimneys alternating with the air entrance holes. By making them as large as possible and by concentrating equipment and labour at one centre, economies of scale can be obtained.

A similar type is the Beehive kiln. The domed structure gives it great strength but does not lend itself to adaptation to mechanized methods of loading and unloading. A small version of this kiln has been developed in Brazil for labour intensive operations.

Best types

Although cheap and easy to construct, these kilns have not proved to be strong to withstand the high temperatures. One of the simplest and best types of fixed charcoal kilns which incorporates on the advantages of the beehive and masonry block kilns without the accompanying disadvantages is known as the 'Missouri'. Although measurements may vary, typically a 50 cord (180 m) capacity kiln is approximately 12 m long by 7 m wide by 4 m high. At one end is a door approximately 3 m wide by 2.5 m high. Along each side of the kiln are four chimneys and four inlet holes and, on the roof, six to eight holes with covers. The basic structure is usually of concrete but the roof section is sometimes made of metal sheeting.

Portable Kilns are usually made of metal and have the advantage that they can be carried or rolled to the wood supply. The most popular type of portable kiln today consists of two or more inter-locking cylinders surmounted by a conical roof section. Air vents and chimneys are arranged alternately around the base of the kiln. The kiln is built up and dismantled during the loading of wood and the discharge of the charcoal, respectively. There is a size limitation because of the design of this type of kiln, the largest models being about 3 m high by 2.5 m in diameter. A cylindrical kiln, known as the Mark V, was developed in Uganda and is now working successfully in at least six countries.

The chief disadvantage of kilns as compared with retorts is that it is not possible to collect the by-products. On the other hand, kilns have the advantage over retorts in that they are much cheaper to manufacture and they can also be made portable, which may give considerable economic advantages when dealing with dispersed raw material supplies in labour intensive economies.

Better control

Retorts are ovens in which the wood charge is heated until it is converted to charcoal. The advantages of retorts over kilns are that there is much better control of the process, which results in higher yields of charcoal. Retorting also produces gases known collectively as pyroligneous acid which when condensed, can be fractionated into commercial products such as methyl alcohol, acetic acid and pitch.

Furnaces

A most important development in the field of wood carbonisation has been the Herreschoff furance. This furnace can carbonise chips of any organic material, including sawdust and bark, with moisture contents below 45%. The raw material is moved down through the furnace spirally by means of arms carried on a vertical rotating shaft and is met by rising hot gases, which after the initial start, are evolved from the furnace. One Herreschoff furnace makes 7,250 tonnes of charcoal per annum with the aid of only two men on each shift of a three shift system. The Herreschoff can also produce charcoal of any desired volatile content, but unless charcoal is needed in powdered or very small sizes it is necessary to install a briquetting plant along side the furnace.

Specific Gravity

This is proportional to the dry density of the original raw material. To a lesser extent the specific gravity is affected by the maximum temperature reached in carbonisation. Charcoal is produced at high temperature because of the volatile matter which progressively diminishes with the increase in maximum carbonisation temperature.

Yield

Retorts yield higher percentage of charcoal (25-30%) than kilns (20-25%) calculated on an initial dry weight basis. In either method greater yields are obtained from dry than with (20-30%) moisture-content wood. However, the initial moisture content does not affect the product. Slow carbonisation at low temperature produces greater yields than fast carbonisation at high temperatures.

Moisture

After carbonisation charcoal absorbs about 5% moisture. Rubber wood is said to absorb about 14%. 4% for industrial uses is said to be desirable.

Raw Material

Soft wood produce lighter charcoal. In the tropics Eucalyptus is a widely used wood. Hardwoods are dense and yield a hard charcoal. The IDB has experimented with 'Kadol' a mangrove plant which has yielded good quality charcoal.

PLASTICS FOR ALL MAN'S NEEDS

By C. R. Jayawardana

PLASTICS have become part and parcel of our lives today. We cannot imagine what life would be without this willing slave. Whether it be at home or in office, we have come to depend on this material for a host of our needs.

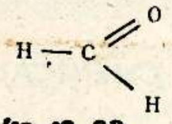
Plastics are defined as materials that could be moulded by the application of heat or pressure or both. Certain plastics which soften and become plaint on being heated, change in shape and become solidified on cooling again. These are known as "thermoplastics".

Another variety

There is another variety which could be moulded only once, after it is softened with heat. These plastics which do not respond to repeated heating or do not become soft with reheating. turn into solid heat-resistant substances known as 'Thermoset' plastics.

On this basis, polythene, Polypropylene, P.V.C. Nylon, terylene, etc. are "thermoplastics" and are liner polymers. Therefore they become soft and pliant on application of heat. The action of heat facilitates the movement of one long chain molecule in relation to another and this causes the plastic to soften.

In the case of thermosets, since their structure often consists of cross linkages and branch chains, they are formed in a three dimentional arrangement. Further, since cross linkages are also strong bonds, they are much stronger than the thermo plastics. They do not split even on application of heat, because their molecules do not 'slide' in relation to one another and therefore, are heat



ෆෝමැල්ඩිහයිඩ්

Formaldehyde

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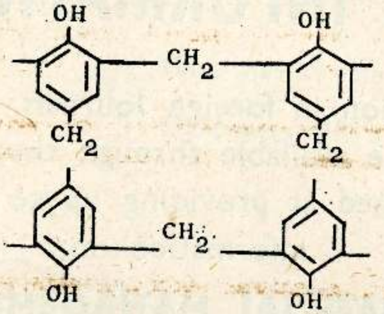
Phenol



Bakeiite plastic with cross linkages

resistant. Bakelite which is used as an electrical insulating material, is an example of this type of plastic.

Bakelite is a thermoset-plastic obtained by the reaction of the monomers, formaldehyde and phenol with one another.

This material turns into a durable one on heat being applied, causing the reaction of cross-linkages within the polymer itself.

Therefore it is evident that the properties of most plastics are governed and determined by the molecular nature of the monomers which constitute them. Thus the characteristics of certain plastics could be improved by adding various other substances, for example, polyesters with a low molecular weight are added to P.V.C. plastics inorder to improve their physical characteristics.

Elastomers

Elastomers are plastics having elasticity. They could be drawn by applying mechanical force and once the force is withdrawn, they retract.

Polymers with extensive cross-linkages cannot be drawn out in this manner because of the strength of the cross linkages. Therefore such plastics have no elasticity. Linear molecules such as polythene can be drawn out by mechanical force, but they do not return to their original form.

These can be drawn out because their structural molecules are twisted and entangled with each other and when force is applied, these twisted molecules stretch out but they don't return to their oiiginal form once the pressure is removed. Therefore polythene does not return to its original form if it is pulled out.

[*Diagram on next page*]

Rubber

Natural rubber is an Elastomer having a linear chain structure. According to evidence obtained from experiments, it has been observed that this polymer is formed by the polymerization of the monomer Isoprene, which has 5 carbon atoms and 2 double bonds. Natural rubber has a few cross linkages. The elasticity of rubber could be reduced and it could be made into a strong polymer by vulcanizing i.e. by heating natural rubber with sulphur.

Synthetic rubber, that is artificial rubber, having the qualities of the natural variety have been produced by man. Once such 'rubber' is poly-butadine.

Poly Butadine

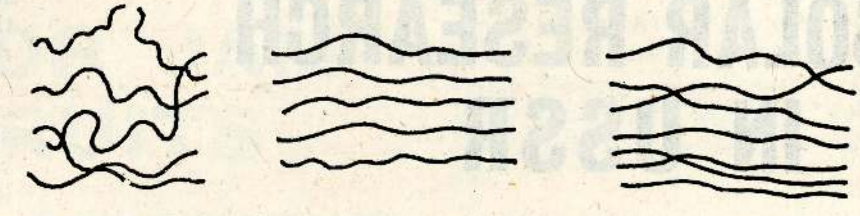
Poly-butadine which is very strong, is largely used in the manufacture of tyres and footwear. This synthetic rubber is formed due to cross linkages being formed across chain molecules. Inorder to do this, the molecule styrene is used with Butadine to form the cross linkages between the long chains.

Organic

All the polymers discussed so far are known as 'organic polymers', with their basic structure being of carbon atoms. However apart from the organic polymers, there are also two other groups known as 'inorganic' polymers and 'organic-metalic polymers.

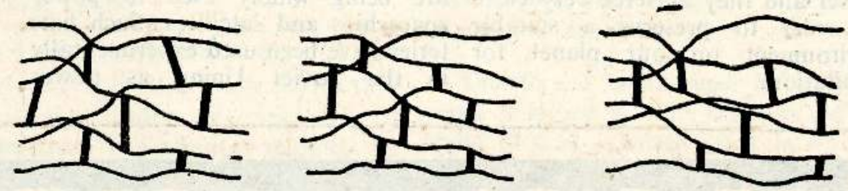
In the chains in the inorganic polymers there are no carbon bonds, but they have inorganic atoms such as silicon, phospherous and Boron. Since these inorganic polymers are capable of withstanding excessive heat they are ideal for use in high heat-resistant gear.

Organic-metalic polymers are a combination of organic and inorganic polymers. The best example of the type of polymer is silicone. There are many products that have been manufactured using this. Silicone oil and Silicone lubricants are some of them.



Before drawing **On being drawn** **After drawing**

Thermo plastic polythene



These plastics return to their original—

Elastomers with a few cross linkages

Shapes once the pressure is withdrawn.

Natural rubber is one such elastomer.

The main draw-back or weakness about man-made polymers is that they tend to deteriorate in strength and rigidity with time. They also tend to get discoloured. They also react with radiation, environmental polutants and gases. Thus since they change with time, they are not durable, even though they are not perishable even when cast aside. Thus these polymers are useful only for a certain variety of uses. For example plastic bottles, ball-point pen cases etc. long out last their productivity but they cannot be destroyed; in fact they become environmental polutants. Whereas certain other polymers like polythene etc. become discoloured and lose their rigidity with age.

However today, polymer chemistry has developed to such an extent that man is able to design a varied range of polymers with various properties which satisfy a multitude of specific technical needs.

The heat resistant suits that the Astronauts used to journey to the moon and even the shoes that they used on that historic occasion when man first trod on the moon, were made of man-made polymers. Thus it will not be a surprise if plastic cylinders replace metal ones in internal combustion engines. At present tests and experiments are underway to develop a plastic which can be dissociated by bio-degradation when cast away. Therefore it would not be wrong for us to call this, the age of man-made polymers.

SOLAR RESEARCH IN USSR

THE future of energetics lies in the search for and tapping of new kinds of energy, since the epoch of fuel energy is already near its end. These new sources must satisfy at least two main requirements: they must be sufficiently large to meet mankind's future requirements of power and they must be very clean in order to preserve a suitable environment on our planet for habitation.

RESEARCH AND DEVELOPMENT

Solar radiation stands out among the power sources for its exceptional "purity" and vastness of quantity.

In the Soviet Union, solar energy research is being conducted in several directions. There are works connected with the development of systems of solar, thermal and cold water supply to buiidings and structures: Nearly 20 dwelling and public buildings employing solar cooling systems are to be erected in the Soviet Union in the current five-year plan period (1976-1980). Several units, mainly with solar hot water supply systems are already in action.

A plant has been put up on a stream in Uzbekistan that will manufacture solar collector heaters for solar heating and hot water supply systems. These installations have been operating successfully.

In the field of conversion of solar energy into electricity, the research is along two lines; the development of generators of relatively small capacity for individual consumers, and the development of large power stations. The development of small units to provide isolated consumers in remote regions with electricity will be of great economic and social importance. Researchers in this field work mainly on photocell and thermo cell units.

Silicon photo-cells-sun batteries are being widely used to power spaceships and satellites. Such batteries have been used experimentally in the Soviet Union as power sources for sea and river navigation marks, water pumps, communications apparatus, etc. To-day nearly 60 photo-cell power sources ranging from 10 to 250W are being operated experimentally. These units are simple in operation and reliable but are still rather costly. Therefore, the main problem here is to cut down their cost drastically—a problem researchers are tackling to-day.

The designing of solar power stations of large capacity, say, of scores and hundreds of megawatts, is based on photo-cell as well as on themmodynamic methods of converting solar energy. In the first case, the cost of the photo-cell has to be reduced considerably (by 100 times) The second method, based on the "traditional, steam turbine cycle—boiler-turbine generator"—as applied to a solar power station is distinguished from the conventional one only by the system of solar heating of the steam boiler.

Some of the common problems in the field relate to converting solar energy into electrical and mechanical energy, the use of solar energy in agriculture for desalination of water, drying products, pumping water and obtaining artificial cold.

(Courtesy of the *Hindu*)

MONEY FOR JAM FROM FRUITS

by Mrs. Wyomi Perera

Food Group, IDB.

IN a country like ours which is abounding in all varieties of delicious fruits the year round, there is always an excess production. While some of it could be consumed locally and abroad in the fresh state, it is not always possible to utilize the entire produce in this manner since all fruits do not have 'keeping' qualities. Therefore it is possible to set up a viable cottage scale industry to make jams and preserves without much expense and difficulty.

Not difficult

Furthermore, jam making is not difficult. It has been carried out by practically every housewife in Sri Lanka on a domestic basis. Therefore since there is no dearth of the basic raw materials, an enterprising entrepreneur would not find it difficult to set up a viable industry in this field. Apart from this, the equipment needed, isn't expensive.

Equipment

No sophisticated machinery or equipment is needed to start an industry of this nature. The basic materials needed are as follows:

1. Scales—to weigh fruits and ingredients,
2. A long handled spoon—wooden or metal,
3. Boiling pan—stainless steel, aluminium or copper,
4. Thermometer—to detect setting point.
5. Jug, and a strainer (Muslin too could be used)
6. Jam jars, lids and labels.

Care Taken

In selecting fruits, care should be taken to use fresh fruits that are not under or over ripe or mushy. The fruits should be carefully inspected to weed out spoilt or damaged ones.

Before cutting or peeling, the fruits should be washed thoroughly in clean, fresh running water and dried well with either an absorbant paper or a cloth. When peeling or cutting the fruits, any diseased or spoilt fruits should be discarded. A stainless steel knife should be used to cut or peel the fruits.

Acid in the form of lemon juice, citric or tartaric acid may have to be added to some fruits that are low in acid content before they are cooked. This is done to extract pectin. Generally, the ratio of addition is about two table spoons of lemon juice or ½ (half teaspoon) of citric or tartaric acid to four pounds of fruit.

It is important that pectin be present in the jam because it's setting property depends on the pectin content. Therefore if sufficient pectin is not present, artificial pectin could be introduced in the ratio of 2 to 4 fluid ounces of pectin to every pound of fruit. The quantity of pectin to be added depends on the grade of pectin. This pectin could be obtained from the open market. Papaw, wood apple, damson, plum, pears and tomatoes have sufficient pectin and therefore it is not necessary to add any.

Preservative

Apart from it being added to give sweetness, sugar is the best preservative for jam. It is best that before the sugar is added to the mixture, it be warmed because it dissolves more quickly then. However brown sugar alone should not be added as it gives a peculiar flavour.

Therefore if brown sugar is to be used, it is best if white sugar in the ratio of 4 : 1 is added (that is one pound of white sugar be added to every four pounds of brown sugar). This would ensure purity of flavour.

Preparation and process

Care must be taken to see that once the fruits are cut or peeled, that they are used immediately. If the cut or peeled fruits are allowed to stand, the chances are that they would be spoilt. Therefore they must be cleaned, cut or peeled just prior to being used. Further more it is essential that they be cooked slowly under a low fire so as to extract the maximum amount of pectin. After the sugar is added, it must be stirred briskly.

Constant care should be taken to ensure that when the required constancy is reached, the pan is taken off the fire because if the pan is not checked to find out the setting point the mixture would solidify. Apart from this, once the sugar is added, if the mixture is not stirred thoroughly, there is a tendency for it to stick to the pan.

Therefore to avoid both these mishaps, it is best to keep a close watch on the pan to check when the setting point is reached.

The setting point could be checked in two ways either through the temperature test or by the plate test. The first method is by using a thermometer—that is, if the temperature of the mixture reaches 219°F to 224°F.

The second method is to place some of the mixture on a plate and test the constancy in the good old way any housewife would adapt. However, details of this could be obtained from any good cookery book.

When bottling, the jar should be tapped to get all the air bubbles to the top. It is best if a waxed disc is placed over the top to prevent air and dust getting into the jam before it is sealed with the lid. The filled bottles should be stored in a cool, dry place for the jam to settle. If bottles are used, 350 p. pm. of Sodium could be used as a preservative.

Billin Jam

Raw materials

1. 1 lb. Billin,
2. 1½ lb. Sugar,
3. A piece of cinnamon

Process

Clean and wash the fruits thoroughly. Slice and dip them in water for a few hours. Squeeze out the water and weigh the fruit. Add sugar according to ratio 1½ lbs. to 1 lb. Add the cinnamon and boil until the fruit is well boiled.

Mango Jam

Raw Materials

1. 1 lb. mango—(seedless),
2. 1 lb. sugar,
3. 1 piece of cinnamon
   * Lemon juice if needed.

Process

Cut the mangoes into small pieces. Weigh the fruit and add sugar according to the 1:1 ratio. Boil the mango and sugar until the mango is well boiled stirring constantly. Add cinnamon and about 2 tablespoons of lemon juice if desired.

Pour into jars and allow to cool.

Therefore it is evident that the initial capital outlay required for setting up an industry in this field is not heavy. If a quality product could be manufactured, there wouldn't be any difficulty in finding a market for it either here or abroad. However if further details are required, please contact the Food Group of the IDB.

To Our Readers

If you like our journal, we'd appreciate your telling us so; and if you don't, let us know what you would like us to write about.

Or better still, send us a nice article of about 1000 words.

Editor

LOANS FOR SMALL INDUSTRIALISTS

The Bank of Ceylon will set up a new unit to assist small and medium scale industrialists.

This unit which would be set up to help servicing loans to small and medium scale entrepreneurs, would handle all aspects of financing loans. It would also evaluate, and assess the viability of projects, study feasibility and advice on projects.

This unit would also help entrepreneurs to obtain foreign exchange through the International Credit Institute, an affliate of the World Bank.

The loans to entrepreneurs would be granted on a priority basis. The units that would be set up in the areas that are less developed, those that would utilize local raw materials and are labour intensive would get priority.

It is hoped that as a result of this, more investors would move into the less developed areas of the island and that they would be utilizing more and more raw materials that are indigenous. At the same time, the Government hopes that this move would help to provide more employment in the rural areas.

EXPORT OPPORTUNITIES

	Products	Country
1.	Betel Nuts	Pakistan
2.	Batik	Australia, Fiji & France
3.	Bamboo (Veneer)	Sweden
4.	Cardamom	U.S.A., Pakistan
5.	Coffee	U.S.A.
6.	Cashew Nuts	Sweden
7.	Fresh cut flowers & Plants	France
8.	Furniture (knock-down)	Australia, Federal Republic of Germany
9.	Gift articles	Kuwait, Fiji
10.	Ginger	Pakistan
11.	Herbs	U.S.A.
12.	Horticultural products	Holland
13.	Handicrafts	Australia, Fiji, France
14.	Jewellery (Imitation)	Kuwait
15.	Kapok	Fiji
16.	Novelties	Kuwait, Fiji
17.	Office equipment	F.R. Germany, Kuwait
18.	Pepper	Egypt
19.	Papain	U.S.A.
20.	Passion fruit juice	Australia
21.	Readymade garments	Fiji, Sweden
22.	Tropical fresh fruits	France
23.	Tea	U.S.A.
24.	Toys	Kuwait

Fuel Saving Hearth....

(*Continued from page* 15)

It is particularly essential to point out here that the temperature of water placed in the pot on the secondary hearth is an average of 82°C which is 18°C below the boiling point of water. The secondary hearth can therefore be used to warm food while the main hearth is being used to cook (or boil) food.

The process of cooking can be speeded up by placing two pots on the two hearths at the same time and transferring the pot on the secondary hearth to the main hearth when the food on the main hearth is ready for the table.

It is well to remember that at no time should any hearth be left 'open' while the hearth is being used.

Construction

The Kitchen hearth can be made from a mixture of cement, sand and metal, pottery clay and bricks or artificial clay and bricks. The chimney must be at least 4½ ft. in height. When the hearth is being used, hair line cracks may appear on the surface. This, however will not develop into any appreciable degree of disintegration of the kitchen hearth.

COMPRESSED AIR AS POWER STORAGE MEDIUM

IN most countries electricity generating authorities are faced with the same problems; how to supply all the demands of their consumers and how to make the best use of their generating equipment.

Every authority also faces the fact that the main demand comes in the working day, when equipment runs flat out to meet the need. The load is only slightly relieved as darkness falls because the domestic consumer then starts to make big demands on the supply. But late at night the demand from all users drops markedly and the pressure on turbines and generators is at last reduced.

One could be forgiven for thinking that the ease-up is no bad thing. But any machinery that is subject to peaks and troughs in usage becomes more and more susceptible to wear and, subsequently, more likely to break down. In the power generating field, the cruise condition is highly desirable for it would allow turbines to be run at a steady rate through the 24 hours. Peak demands would have to be met by stored energy, and it is the storage problem that prevents the best use of power output potential.

The storage available to electrical authorities is hydrostorage, in which excess output is made to pump water up into a convenient reservoir. Then, when peak-period power is needed, the water is released to run down through channels to drive turbines. But not all countries are blessed with the geological formations that lend themselves to dams and reservoirs, and in some countries, water itself may be scarce.

So what is the answer ? The battery system to store vast amounts of power for domestic and industrial use has yet to be invented but there is hope from another source, and that is to store the surplus power below ground.

In Salt Caverns

At Huntorf, in Federal Germany a unique power storage system is now in use. Though the principle has been discussed for some years, this system employs the first commercial prototype generating unit using compressed air as a storage medium. During the off-peak period the turbines in the power station drive a compressor unit and compressed air is channelled into nearby salt caverns. Then, when demand reaches its peak, the stored air is released under careful control to drive a turbo generator, which adds its weight to the station's output, but unfortunately the heat generated by the compression process has long since been dissipated. To develop enough expansion to drive the turbine efficiently fuel has to be added to the air and the fixture ignited.

If the storage were not the ideal salt caverns, with their guaranteed sealing qualities, but rock caverns or caverns with water all round them the heat would create even greater problems. It would make 'dry' rock even more dry, giving rise to crumbling and subsequent leaks, and if a seal were provided by placing the compressed air inside an undergroundwater 'bubble' quite clearly the water would soon be driven off by the high temperature involved, It is this problem that has attracted the attention of a young engineer with Britain's Central Electricity Board.

At their Marchwood research station, near Southampton, Ian Glendenning has been working for some time on ways to make use of the heat generated in the compression stage of storage. In May 1978 he put his ideas before a conference on storage, in California.

Removal of Heat

What he proposes is that once the turbines are switched to the compression stage, instead of the air being directed straight to the storage cavern it should be passed through heat-retaining units. These would be giant 'silos' containing heat-retaining materials such as dense fire clay pebbles. The air subsequently in store would be cool, so it would not cause the storage chamber to deteriorate. But that is only a relatively small advantage.

Glendenning proposes that when the trapped air is released to drive a power turbine at peak periods, it should pass back through the silos, where it would pick up enough heat to start the turbine without having to add fuel. In effect you would have a turbine that did not burn any fuel at all. Ambitious this may well be, but small-scale tests have shown it to be feasible and many American authorities are looking at the 'no-fuel' method very seriously indeed.

In the opinion of all concerned salt caverns form the best store, not only because of their sealing qualities but because they can be easily created. All that is needed is to tap a hole into the ground in a known salt area and then pump water into it at high pressure. Unwanted deposits are washed out by a pumping system. Glendenning is quite convinced that natural rock caverns could be utilised, too, with perhaps a seal and applied to the rock face. And the idea of storage in a bubble becomes feasilbe if the compressed air has been cooled.

(*Courtesy Spectrum*)

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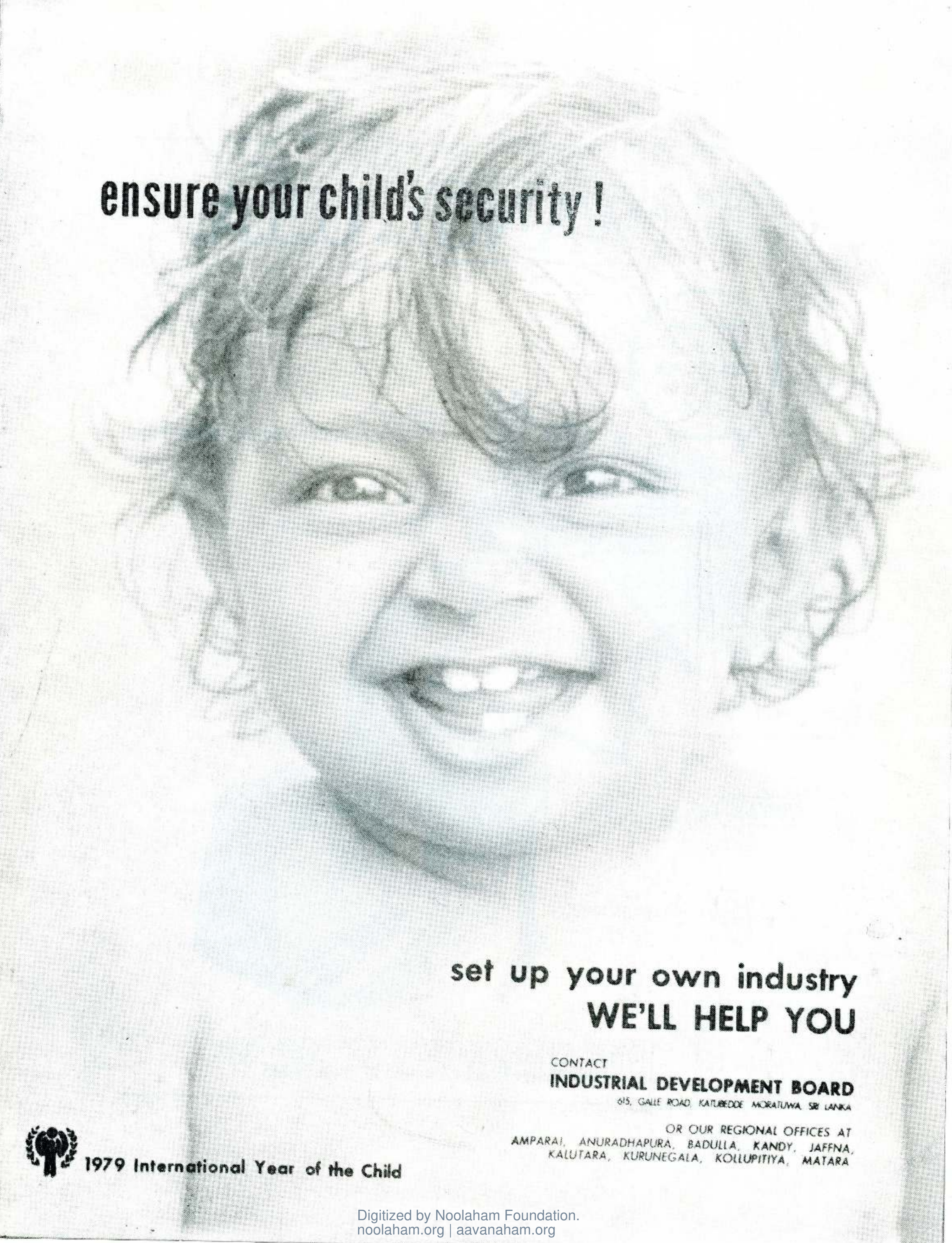
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