A WINDOW OPEN ON THE WORLD

The UNESCO Courier

SOLAR ENERGY TODAY AND TOMORROW

Messages from space with solar batteries

SEPTEMBER
1958
(11th year)
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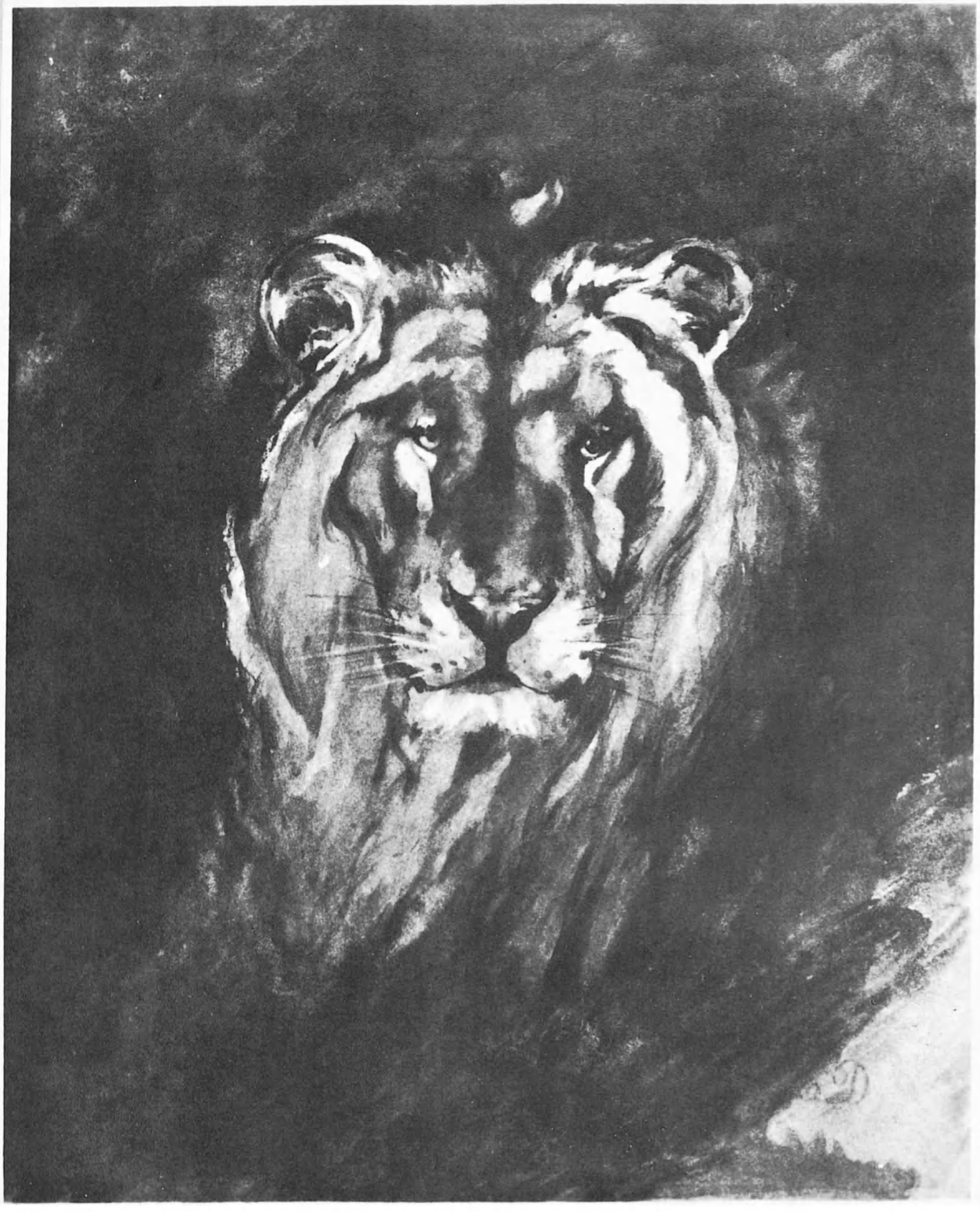

SEVENTY-TWO WATER COLOURS from the brushes of some of the world's greatest artists will shortly leave on a round-the-globe tour. They are the high-quality reproductions which make up the latest UNESCO travelling art exhibition. Previous exhibitions have already toured over three-score countries. Water colour shown here is "Head of a Lion" by the 19th century French historical painter and illustrator, Eugene Delacroix (Colour reproduction by Editions Euros, Paris). See page 26.

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11TH YEAR

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COVER PHOTO

Radio transmitters in most recent Soviet and U.S. earth satellites are powered by solar batteries which pick up energy from the sun's rays as the miniature moons hurtle through space. Here second U.S. satellite (6.4 inches diameter ; 3 1/4 lbs) undergoes special tests prior to launching last March. The rectangular objects which are seen on its surface are the solar batteries. (See p. 17)
USIS

THE history of man's quest for energy resources is practically that of human progress and civilization. We are now beginning to realize how rapidly the world assets of coal and oil are dwindling. And although the atomic age has begun we are still far from the widespread harnessing of atomic energy for industrial and other useful purposes.

Scientists have therefore turned to other more readily available sources of energy such as the greater utilization of direct solar radiation and the energy of the winds, and even the energy of sea waves for industrial, domestic and agricultural purposes.

UNESCO has given serious attention to the possibilities of using the unconventional energy sources particularly in the world's arid or semi-arid regions. As part of its regular scientific activities and particularly in its Major Project on Scientific Research on Arid Lands, it has undertaken a broad review of current research in different countries. In 1954, UNESCO organized an international symposium in India on wind and solar energy at the invitation of the Indian Government (see *Wind and Solar Energy*, published by UNESCO in 1956). In 1955, UNESCO gave financial support to a World Symposium on Applied Solar Energy held in Arizona, U.S.A., and assisted the Department of Economic and Social Affairs of the U.N. in preparing an important study, *New Sources of Energy and Economic Development*, published last year (1).

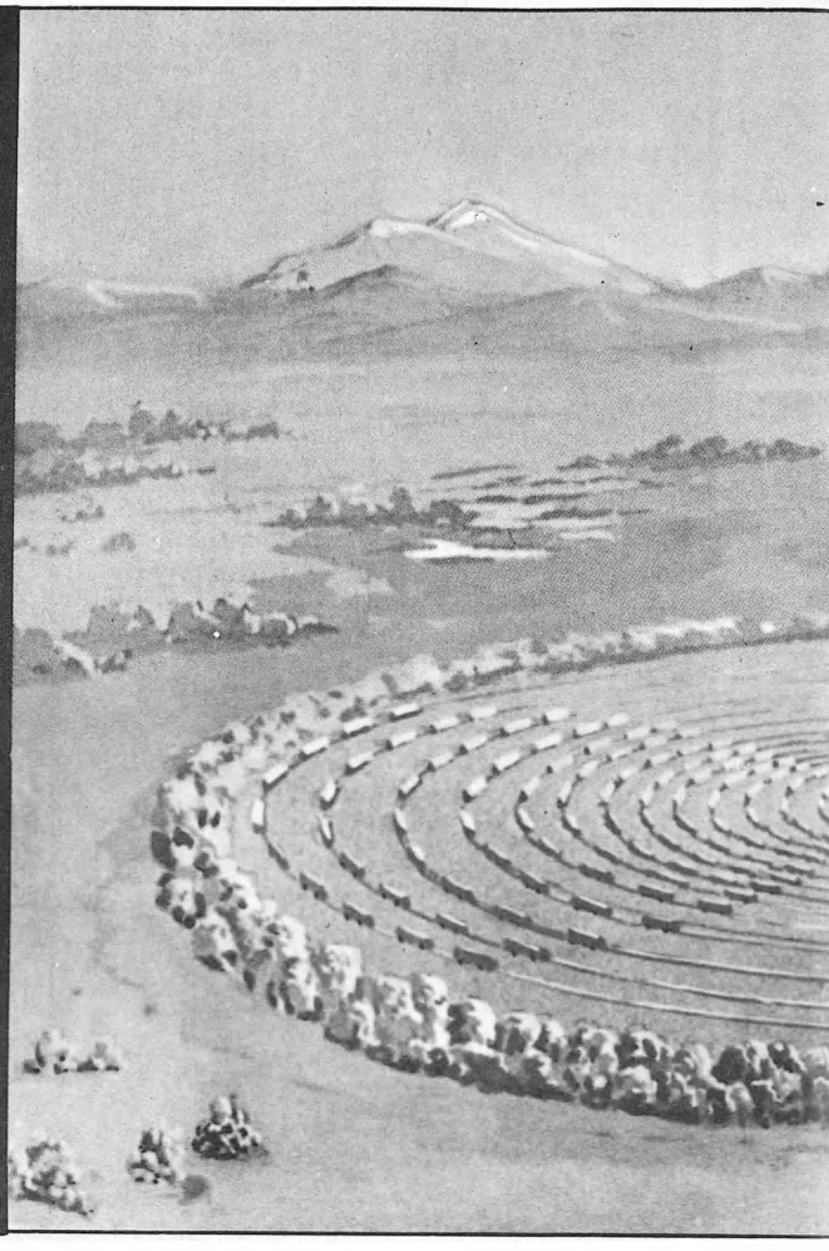
UNESCO has only limited funds to support research projects as such. One of these has been under way in the past year at the Beersheba Institute in Israel under the direction of Dr. H. Tabor of the National Physical Laboratory, Jerusalem (see page 11). In the next two years, UNESCO and the World Meteorological Organization will undertake the first world survey of solar radiation distribution, by mapping its daily and annual variations and its dependence on altitude and other factors. The study will be carried out in co-operation with a specialized observatory and will make use of the data gathered during the International Geophysical Year. At present there is no cheap and simple instrument for measuring solar radiation and thus capable of determining the most suitable sites for solar energy development. UNESCO will provide funds to develop such an instrument as well as for testing other solar energy equipment.

In the pages that follow THE UNESCO COURIER describes a few recent experiments in the direct utilization of solar energy. A word of caution however is perhaps appropriate. There is no sudden era of solar prosperity just around the corner. As the Unesco Advisory Committee on Arid Zone Research recently reported: "Utilization of solar energy holds great promise for the arid zones of the world, but an immense amount of patient and diligent research is still needed."

(1) *In 1955 The Unesco Courier published a special 68-page issue, (No 8-9), entirely devoted to "The Conquest of the Desert" (Now out of print).*

SOLAR ENERGY TODAY & TOMORROW

by Prof. V.A. Baum
Head of the Solar Energy Laboratory, G.M. Krzhizhanovsky Power Institute, U.S.S.R. Academy of Sciences



POWER STATION IN THE DESERT—Soviet scientists believe that solar power stations can be used to create oases in the desert. They plan to install one in a valley near Erivan, capital of Armenia (drawing, right). It consists of a boiler on top of a 130-foot tower heated by the sun's rays focussed on-to it by 1,300 mirrors on concentric railway lines at the base of the tower. These five acres of mirrors will generate 2,500,000 kilowatt hours of electricity annually. Power will be used to drain valley's swamps, to irrigate its desert area and to supply electric current for the use of local farmers. (See article, page 10.)

U.S.S.R. Official

THE great problem of transforming the energy of the sun's rays into other forms of energy for practical use has interested humanity for a long time.

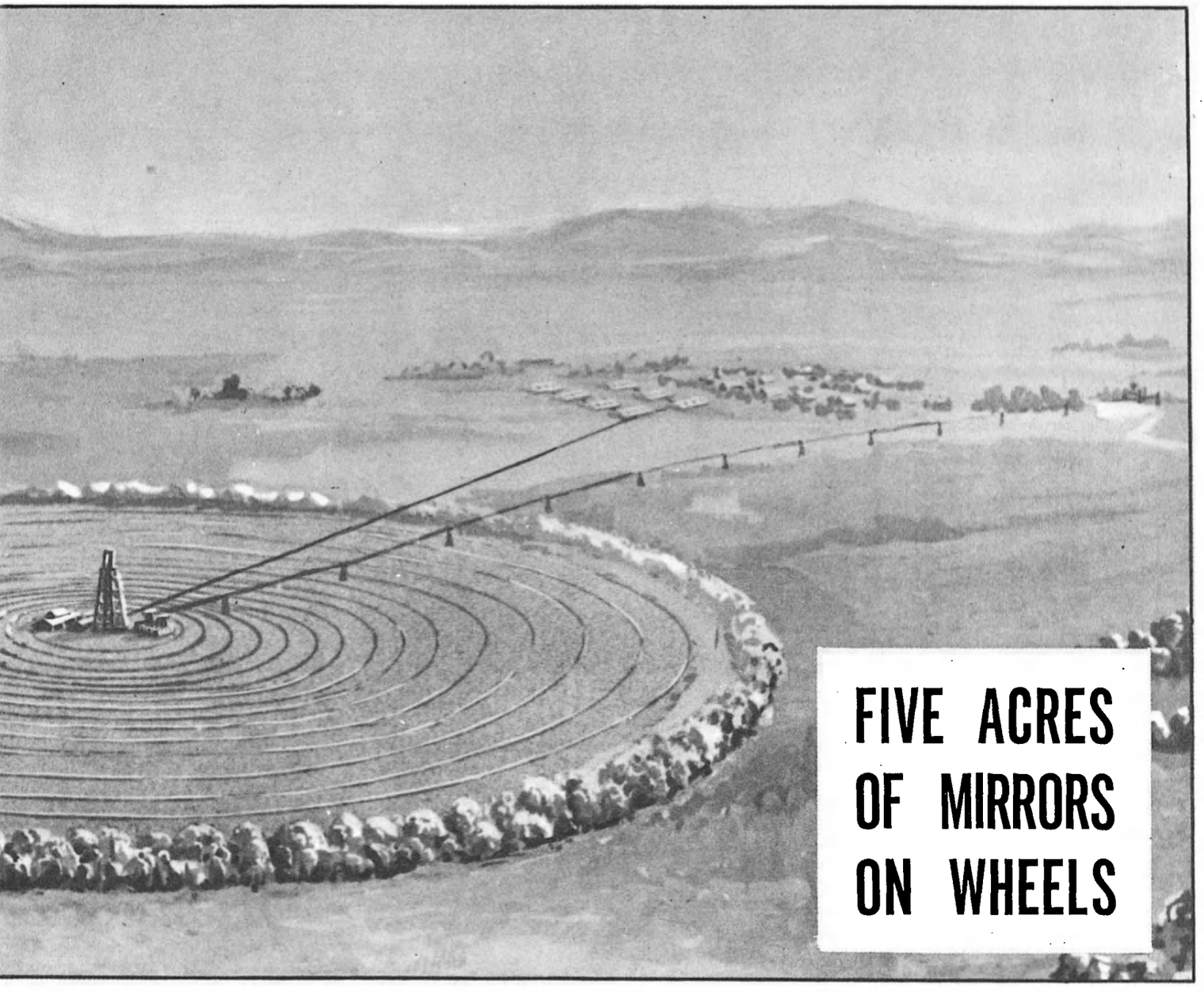
Scientists have calculated that the world's resources of fossil fuels would be exhausted within one or two hundred years if they were to remain the basic power source. However, if the growing demand for energy could be supplied from new, additional sources, first of all, solar radiation, they could last several thousand years. At first, solar radiation could serve as an auxiliary source of energy in districts with a large number of sunny days per year, and then, given certain conditions, it could become the main source.

The problem must be tackled by seeking ways of exploiting this eternal, inexhaustible source of energy, tens of thousands of times more abundant than current demands. In ten days, for instance, the earth receives as much warmth from the sun as we could get by burning all the known reserves of organic fuel within the earth! However, this enormous energy has not been exploited directly until now. Due to uncontrolled natural processes, it is transformed into low-potential warmth difficult to employ technically, and is lost in space without working for us. Only a comparatively insignificant portion of the stream of radial energy is transformed into the energy of falling water, wind, or chemical plant energy. It can be said that so far man only uses these secondary resources, while direct radiation is only used in cultivating plants.

This radiation is of very high quality due to the great temperature of its source, and it can be transformed to advantage into other forms of energy, such as mechanical, electrical and chemical. Besides, scientists, engineers and inventors in several countries have built many experimental solar appliances which have been tested in operation. Some of them are already profitable and are being used.

In the past, attempts to use the energy of solar radiation were made by individual enthusiasts, but in the last two decades, planned work has been conducted by large groups of specialists and even by entire laboratories. Leading scientists have joined this work, the grandiose prospects of which are so fascinating. Results are discussed at regional and international conferences, and exhibitions of operating solar appliances are arranged.

There have been five national heliotechnical conferences in the U.S.S.R. since 1939. Heliotechnical conferences have been held annually in the United States since 1950; some of them were international in scope. In 1954, there was an international conference in India, sponsored by the Indian Government and UNESCO. It discussed the use of wind and solar energy for arid and semi-arid zones. In this article it is impossible even to list the countries where such investigations are taking place. It is indicative of the interest in the problem that more than one thousand



FIVE ACRES OF MIRRORS ON WHEELS

people from 37 countries took part in a conference in Arizona, U.S.A., in 1955.

The most recent international conference was held in June of this year in Mont Louis, France. (See page 7.)

Technically, radiation transforms most simply into warmth, so that various thermal solar appliances were the first to appear, such as water distillers, water heaters, refrigerators, pumps, steam boilers, kitchen heaters, fruit driers, and high temperature furnaces.

Their operation is based on the well-known fact that when the sun's rays fall on a object with a blackened surface they are almost entirely absorbed, and their energy is transformed into warmth which is used for the desired purpose either directly or through a series of supplementary energy transformations. The amount of warmth depends on the amount of radial energy absorbed in the appliance. If high temperatures are desired, the sun's rays are preliminarily concentrated by mirrors or lenses. This makes it possible to achieve a temperature of 3,600° C.

In recent years, physicists have demonstrated the practical application of several wonderful properties of certain semi-conducting materials to transform radial energy and warmth into electricity. This made it possible to construct simple appliances without moving parts, photocells and thermo-elements, which transform solar radiation into electricity with a high efficiency.

Of course, only the economically profitable solar appliances will become widespread. Some of them can already be recommended for districts where there are at least 170 to 200 sunny days per year and where there is a shortage of fuel. Some need improvement and a reduction in cost. The cost could be lowered by producing them and the special materials for them industrially.

One of the chief difficulties in using the energy of solar radiation is its inconstancy. At the present stage, accumulation of energy is technically and economically practical only in certain cases. It is therefore difficult at present to use solar appliances in locations requiring a constant supply of energy. In such cases, solar radiation can be used in combination with other sources of energy. The development of cheap ways of accumulating energy for different purposes is a very important task, and its achievement could widely extend the field of application of solar appliances.

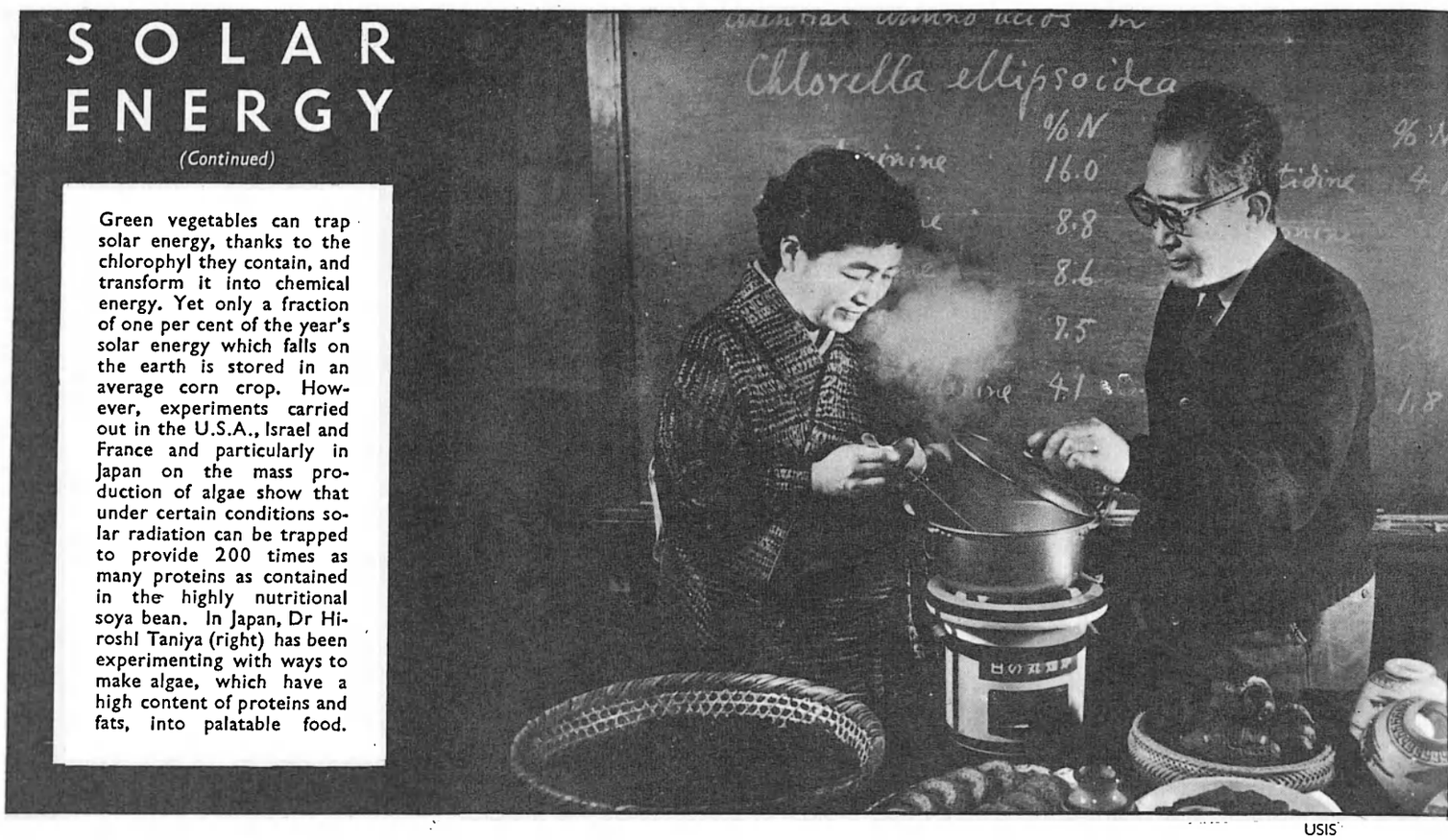
In this respect, photo-chemical methods of transforming the energy of solar radiation should also be mentioned. In this case, the radial energy spent on the chemical processes in the irradiated system of matter can perform in the reverse course of the process either as heat or as electricity.

Cont'd on next page

SOLAR ENERGY

(Continued)

Green vegetables can trap solar energy, thanks to the chlorophyl they contain, and transform it into chemical energy. Yet only a fraction of one per cent of the year's solar energy which falls on the earth is stored in an average corn crop. However, experiments carried out in the U.S.A., Israel and France and particularly in Japan on the mass production of algae show that under certain conditions solar radiation can be trapped to provide 200 times as many proteins as contained in the highly nutritional soya bean. In Japan, Dr Hiroshi Taniya (right) has been experimenting with ways to make algae, which have a high content of proteins and fats, into palatable food.



USIS

An example of a photochemical process is natural photosynthesis, a process of green plant growth, which from the energetic point of view consists of a transformation of solar radial energy into the potential chemical energy of plant matter. By arranging optimal conditions for plant growth, the harvest can be greatly increased. There have been interesting experiments in the United States, Japan, Italy, and other countries in artificially breeding a mono-cellular alga, Chlorella, with very high yields, constituting a prospective source of food, and perhaps of energy fuel.

So far, matter or systems of matter with sufficiently high energy efficiency of photochemical processes have not been formed artificially. Their efficiency is incomparably less than what could be achieved from plants. If work in this sphere succeeds, it will solve the problem of accumulating energy.

Boons to power-poor areas with a surplus of sunshine

What are the prospects of using solar radiation, and what part will it play in the near and the distant future among other sources of energy? It is difficult to answer. In a rationally organized economy, each source will be applied in the sphere most convenient and profitable, since each has its advantages and shortcomings. It can only be said with certainty that in the near future solar radiation will satisfy most demands for energy in the home as well as for small motors and possibly lighting in rural communities—sparsely inhabited districts where there are small-scale consumers.

The amount of energy consumed by the population of the world is enormous. However, it is chiefly expended in the large cities and industrial settlements, while the rural population often does not have the possibility of satisfying its most elementary energy requirements.

The shortage of energy is felt especially in arid and semi-arid areas, though they have a surplus of solar energy. Conditions in these areas could be improved immensely right now by supplying them with such solar appliances as kitchens, boilers, distillers, and driers. A solar kitchen, for instance, with a light metal mirror about one square metre in size, is equal to a 600 watt electric heater. Food and boiled water could be kept warm for many hours in thermos vessels. These areas also need refrigerators operating on solar energy, but available models must be simplified and lowered in cost.

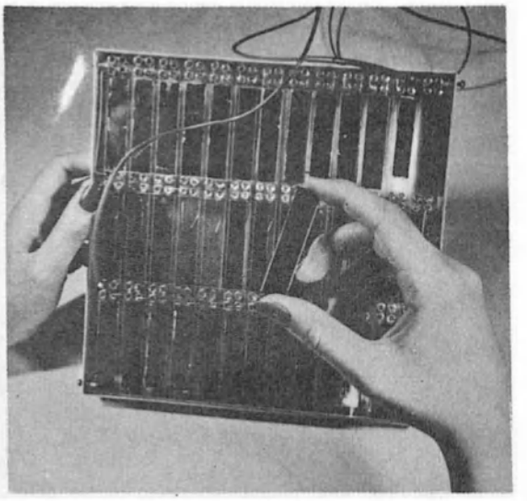
It might prove expedient in supplying energy to large oases in desert districts to build large solar heat and power stations like the one designed at the Helio-laboratory of the G.M. Krzhizhanovsky Power Institute under the direction of the U.S.S.R. Academy of Sciences.

The solar photocells now manufactured in the U.S.S.R., the United States, the Federal Republic of Germany, Japan, and other countries are still expensive, and can only be employed when there are no other means of getting electricity, and if their cost is no concern. Still, they are very promising. If their price could be lowered sufficiently, that would solve the problem of lighting for most of the districts of the globe. Photocells on 5% to 10% of the surface of a rural roof would light up the house for an average of six hours daily. This is possible with the photocell efficiency already achieved.

In the very near future, one-kilowatt solar thermoelectric generators will be more profitable than steam power-and-heating appliances of the same capacity. They would be of tremendous importance for water pumps in arid and semi-arid zones. They would release many people from exhausting, monotonous, and inefficient irrigation labour.

Throughout history, people have been working to transform nature and improve their conditions. Transformations are becoming more and more tremendous. Man advances from small problems of separate enterprises on a small scale to larger, multi-purpose tasks of greater and general interest. Doubtless, some time will be necessary to solve such problems on a cosmic scale. This will require enormous amounts of power, which cannot be supplied by any known energy source but that of the sun.

THE SUN AT WORK ROUND THE WORLD



by Daniel Behrman

USIS photos

In 1954 the United States produced a tiny solar battery which could operate a pocket-size transmitter containing transistors. Here an engineer (with solar battery in hand) demonstrates that his voice can be clearly heard at a receiver some distance away. Top photo shows details of a larger solar battery. (See p. 17 for facts about the use of these batteries in artificial satellites.)

In lands scattered around the world, solar energy is coming out of research laboratories and into daily life at a price which the average man or his national economy can afford to pay.

Today in Africa, Europe or the United States, you can buy a solar-operated apparatus to heat the water in your home. In France and in other countries, solar furnaces are opening up new fields in metallurgical research and in the production of refractory materials capable of standing the increasingly high temperatures demanded by modern metallurgy. In the Soviet Union, costs of operating a sun-powered refrigerator have been brought down to the point of competing with classical methods of refrigeration. In Israel, the world's first factory making use of "solar steam" to produce chemical products is under construction in the Negev.

These are only a few of the highlights of the applications of solar energy in the modern world which were revealed at a recent symposium conducted by the French National Centre of Scientific Research. The symposium drew more than fifty scientists and engineers to Mont-Louis, a citadel built in the 17th century under Louis XIV in the eastern Pyrenees and now the home of the world's biggest solar furnace, designed and operated by Prof. Felix Trombe and a team of French research workers.

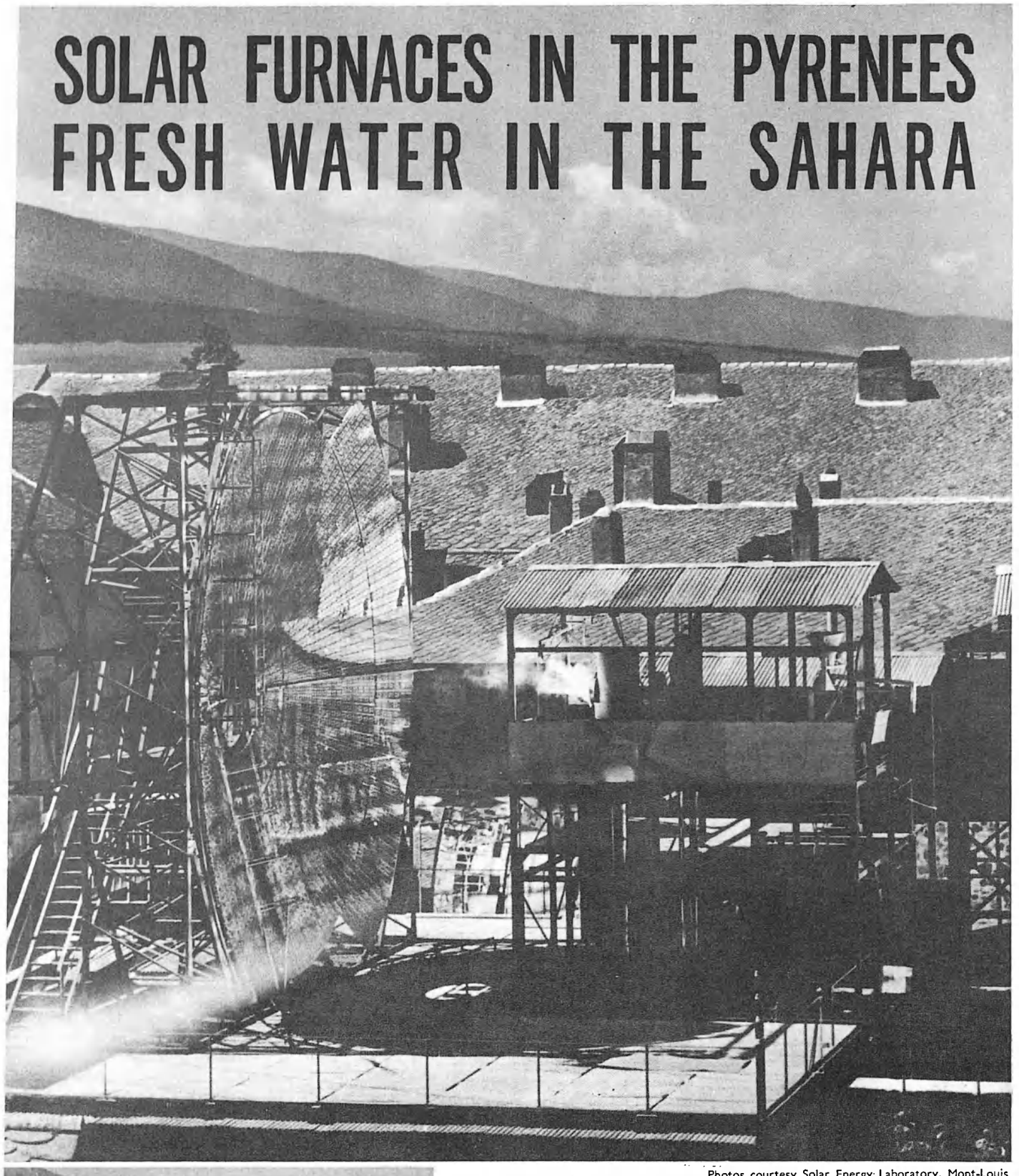
By the end of the week-long symposium, a clear picture had been drawn of the applications of solar energy in France, Great Britain, the Federal Republic of Germany, Spain, the United States, Israel, the Soviet Union and Yugoslavia. As is often the case in such international meetings, it served to pull loose threads together and to bring into focus the status of a vital field of scientific research.

Both during and in between the meetings of the symposium, it was possible to take a trip around the world of solar energy. The results of this trip show a tremendous range in the use now being made of the sun: it runs from cookers which can fry an egg or grill a steak to laboratory research aimed at improving turbo-reactors and space-conquering rockets. Most important of all, this progress offers new hope to those regions which are the richest in sunshine and, through some quirk of nature, usually the poorest in other power resources: the countries in the arid lands covering one-third of the earth's surface.

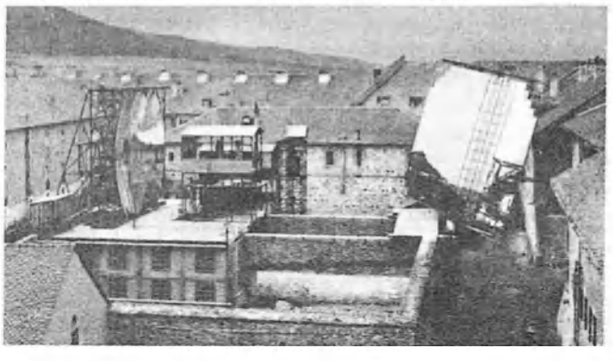
Here is what this trip around the world has shown.

THE UNESCO COURIER *last month sent its special correspondent, Daniel Behrman, to the international symposium on solar energy held at Mont-Louis, in the French Pyrenees. There he interviewed some of the world's leading scientists now engaged in solar energy research. His reports on the work now going on in this field in several countries are published on pages* 9, 10, 11 *and* 16.

SOLAR FURNACES IN THE PYRENEES FRESH WATER IN THE SAHARA



Photos courtesy Solar Energy Laboratory, Mont-Louis



STUDY OF METALS capable of resisting working temperatures of today's jet engines, rocket motors or nuclear reactors calls for furnaces lined with special heat-resisting materials. One of these materials, zirconium, is produced on a commercial scale in the world's biggest solar furnace (above) at Mont-Louis in the French Pyrenees. Photo shows parabolic mirror (left) which concentrates sun's rays into orifice of solar furnace (centre), creating temperatures of 3,000° C. Photo, left, shows sun-catcher mirror (40 feet across; 520 individual mirrors) which pivots automatically, when sun acts on photo-electric cells, to pick up sun at any angle and then reflects rays to parabolic mirror.

FRANCE

Slowly, almost imperceptibly, the platform bearing a handful of white powder rose until it reached the focal point of the parabolic mirror overhead. Then, before the eyes of scientists and engineers at the recent Mont-Louis solar energy symposium, the powder suddenly burst into white heat brighter than any diamond.

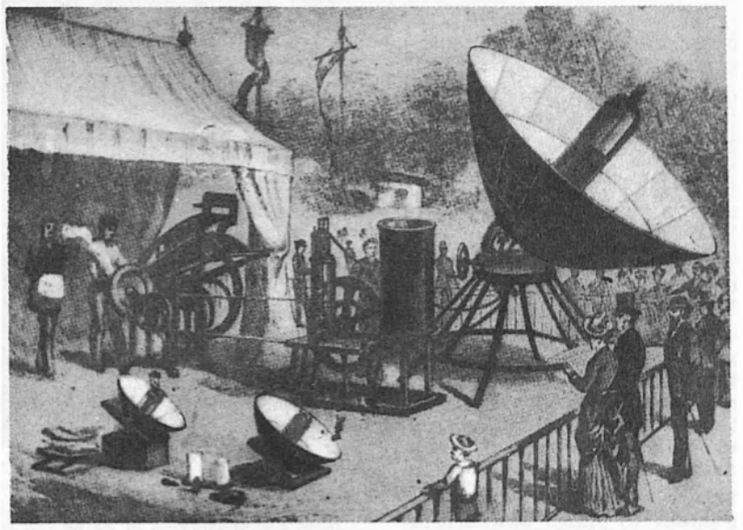
The powder was zirconium oxide with a melting point of 2,700 degrees Centigrade, and it could not stand up to the 3,000 degree heat of concentrated sunshine focussed on it. Nor could the naked eye witness its smelting ; the onlookers had to use special plates of black glass. Through these plates, the small heap of powder looked like a young volcano from another geological era.

"I remember a conference of industrial ceramics manufacturers in France about ten years ago," said one of the onlookers, a French manufacturer, as the platform moved away again to allow the powder to cool. "When Felix Trombe told that conference he could use solar energy to produce refractory materials for furnaces, those present treated it as a joke."

Today, no one is laughing. There is a steady demand for "solar zircon" produced by the Mont-Louis Solar Energy Laboratory founded by Prof. Trombe and his assistant director, Marc Foex. The mirror used in the demonstration was one of a battery of small solar furnaces flanking a huge parabolic mirror 30 feet in diameter and generating the equivalent of 75 kilowatts.

One firm in Paris has already purchased several tons of zirconia for use in manufacturing furnaces in which special metals are treated. With this product of solar energy, one member of the firm explained, operating temperatures of electric furnaces can now be safely raised from 2,000 to 2,300 degrees Centigrade.

But this is only one aspect of the applications of the Mont-Louis furnace, which can create a temperature of 3,000 degrees within a split second. It is now being used to penetrate unexplored realms of metallurgical research.



SOLAR PRINTING PRESS: In 1884 a paraboloid mirror (above) was used in Paris to print a newspaper by means of solar energy alone. About 1670, a French scientist, François Bernière, built a solar furnace using huge lenses mounted on a carriage. Lavoisier later used this same machine to obtain a temperature capable of melting platinum. For a time in 1913, a 20-horsepower "sun engine" was used in Egypt to pump water from the River Nile.

In the words of General Paul Bergeron, former director of the French National Defense Scientific Activities' Committee and one of the founding fathers of the laboratory, "the solar furnace is invaluable in any field where purity of materials and resistance to heat is an important factor." One example is the study of metals capable of resisting the tremendous working temperatures of jet engines, rocket motors or nuclear reactors.

Mirror eleven storeys high

FANTASTIC though it seems set within the walls of a 17th century citadel built 5,000 feet high in the Pyrenees, the Mont-Louis furnace is only a beginning. This autumn, work will start on a new furnace six miles away at Odeillo.

Here, solar energy will enter a new phase. The Odeillo furnace will be operated by a mirror measuring 115 ft. by 165 ft. thus having an area of 1,793 square yards. Its size can be visualized more clearly with the help of another fact: it will form one side of the solar energy laboratory's new buildings standing *eleven* stories high.

With this mirror, production of zirconia will go up from 60 kilogrammes a day at Mont-Louis to 2,400 kilogrammes. Odeillo will be able to produce from ten to twenty tons of steel daily for it will turn solar heat into the equivalent of 1,000 kilowatts of electrical energy.

Prof. Trombe, who gave these facts in an interview, is a tall, lean man in his forties and far more at home tinkering with a parabolic mirror than presiding over an international symposium. This probably explained the success of the symposium—where tea was brewed in laboratory beakers and the future of solar energy discussed in a handsome 17th century room heated by the crackling logs of a huge fireplace.

Hot water costing nothing

FELIX TROMBE is interested in the sun as a way of developing arid lands from every angle, human as well as economic. Mineral deposits in the Sahara, for example, could be treated on the spot in solar furnaces. Workers at these plants would live in houses air-conditioned by the sun and would raise their own food in greenhouses. Even lettuce can be grown in the Sahara in greenhouses, explained Prof. Trombe, because it requires only one quarter of the water used in normal cultivation.

The solar furnaces in the Pyrenees are only one aspect of how the French are harnessing the sun. Solar-operated hot-water heaters are a common sight both in North Africa and on the Mediterranean coast of France. One French firm manufacturing heaters in Beziers uses as its advertising slogan: "Hot water for nothing." It produces units which provide hot water for homes, hotels, laundries and even shower-rooms in factories.

One Paris firm now has even more ambitious plans. After installing individual hot-water heaters in France, Africa, Australia, the West Indies and various other parts of the globe, it has begun to work on large-scale installations. It has already installed a 1,500-litre (327 gallon) heater in the Moroccan national tobacco factory at Casablanca.

It is now working on plans for a huge solar energy unit designed to supply hot water to 205 apartments in a new housing development at Koubra, near Algiers. With solar energy collectors set on the roof and tanks in the basement, this plant will have a capacity of 50,000 litres (11,000 gallons) if present plans are adopted. On sunless winter days additional hot water will be provided by normal central heating systems.

Finally, the French are looking into the problem of distilling saline water for drinking and other purposes (truck drivers in the Sahara often pay $.25 a quart for distilled water for their radiators because ordinary Sahara water contains too many minerals).

What are probably the world's first solar stills manufactured on a commercial basis have been developed by a firm in Algiérs and tested by a French engineer, Cyril Gomella. One hundred and fifty of these stills, made of asbestos concrete to stand up to Saharan conditions, are now in service, producing a total of 1,000 litres (220 gallons) daily. They have brought the price of distilled water in the Sahara down to one franc per litre—a figure which Mr. Gomella emphasizes is "honest" because it included the high cost of transporting the prefabricated elements of the still out into the desert.

From the solar furnaces in the Pyrenees smelting the metals of the future to a life-giving fresh water supply at "Bidon V" in the Sahara, the French are making solar energy an economic reality.

1,300 MIRRORS TO OPERATE POWER PLANT

U.S.S.R.

The sun is being put to work in the Soviet Union to do everything from producing ice by the hundredweight to the generation of electric power both on a scale suitable for the isolated farmer and for a major attack against the problems facing dry regions.

This was disclosed by Professor Valentin Baum, director of the Heliotechnical Department of the Power Institute of the Soviet Academy of Sciences, during an interview at Mont-Louis.

Here are some of the latest results described by Professor Baum :

—Production of 350 kilogrammes (771 pounds) of ice daily by a solar refrigerator operating at a cost "comparable to that of other methods."

—Widespread use of solar cooking stoves—an estimated 600 are now in service—which produce the equivalent in energy of a 600-watt electric hot-plate. A collapsible solar cooker, used to free scientific expeditions from dependence upon fuel, has also been developed.

—Experimentation and planning for a gigantic 1,200-kilowatt solar energy plant for use in irrigation and electric power production.

—Development of a new method for converting the sun's heat directly into electrical energy by eliminating the inefficient steam boiler and engine.

In an interview, Professor Baum pointed out that research in the Soviet Union has paid particular attention to the need for putting dry regions to work. The so-called arid zones would no longer be arid if we could bring up fresh water from the soil—and this could be done with the help of solar energy, he said.

There are two sides to the problem. The first is symbolized by the farmer who needs power to pump water from his well and into the irrigation canals of his fields.

Here, Professor Baum's laboratory at Tashkent has developed the technique of the "thermo-electric generator." The principle of the thermo-couple is well-known—when two different metals are heated, an electric current is produced—and it is widely-used in measuring high temperatures.

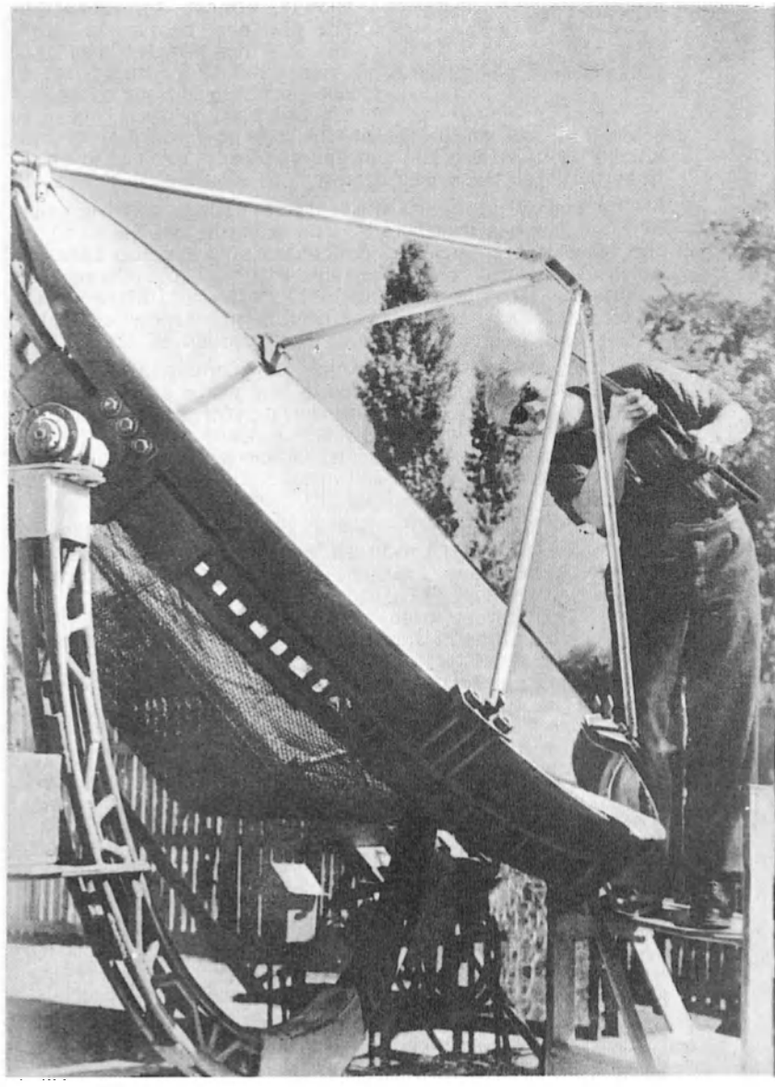
Soviet scientists took a parabolic mirror measuring two metres (6½ ft.) in diameter and heated a specially-designed thermo-couple. Despite the relatively small area of the mirror, it produced 40 watts in electric energy.

"Our experiments have shown that, with the use of semi-conductors, we can create a one-horsepower thermo-electric generator," said Professor Baum. "This would be much more efficient than a steam engine of the same power operating on solar energy."

On a far greater scale are the solar power stations which Professor Baum believes could be used feasibly to create oases in the desert. One such power station has been planned at Tashkent and its components have already been tested.

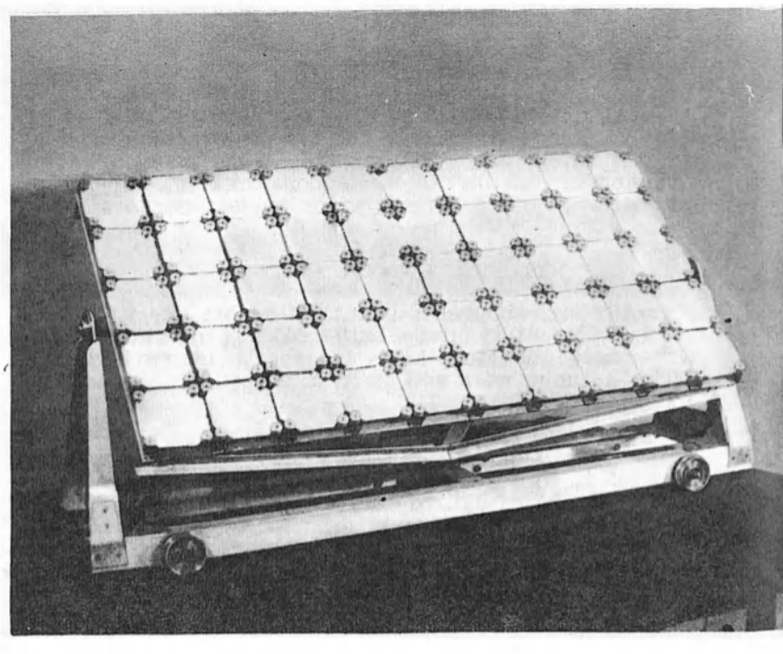
It consists of a boiler on top of a tower 40 metres (131 feet) high and heated by the sun's rays focussed on-to it by 1,300 mirrors on concentric railway tracks at the base of the tower. The mirrors with a total of 19,500 square metres (five acres) would generate 1,200 kilowatts of high pressure steam.

Prof. Baum designed this plant for use in a valley near Erivan, the capital of Armenia, where it could be put to work with extreme efficiency. One-third of the valley is swamp, one-third is dry and, finally, one-third consists of farms requiring power. The solar power station could be used to drain the swamps, irrigate the dry land and feed power to the rest of the valley.



Official Soviet photos

SOVIET SCIENTISTS are putting the sun to work in dozens of ways from the production of ice by the hundredweight to the generation of electric power in installations designed for individual consumption and larger ones for public use. Above, bar held at focal point of a Soviet solar parabolic reflector melts away in the intense heat. Below, experimental model of mobile reflector. When batteries of these are used, sufficient concentrated heat is generated to produce high pressure steam.



THE WORLD'S FIRST SUN-OPERATED INDUSTRIAL PLANT

ISRAEL

The world's first industrial plant operating on solar energy is now under construction in Israel at ancient Beersheba, the home of the Negev Institute for Arid Zone Research.

This is one of the applications of the solar energy programme which Israel is now carrying out on a broad front described by Dr. Harry Tabor, director of the National Physical Laboratory in Jerusalem and one of the fifty scientists and engineers who participated in the Mont-Louis Solar Energy Symposium.

A lean, alert man who obviously has little use for the "science fiction" approach to solar energy, Dr. Tabor methodically traced, in an interview, the practical steps which his sun-baked country is taking to put the sun to work.

"We are trying to answer four questions at the Negev Institute", he stated, and then he ticked them off :

— Can we use solar energy to cool houses ?

— Can we use solar energy to generate steam for a factory ?

— Can we use it to run a small power unit for farmers ?

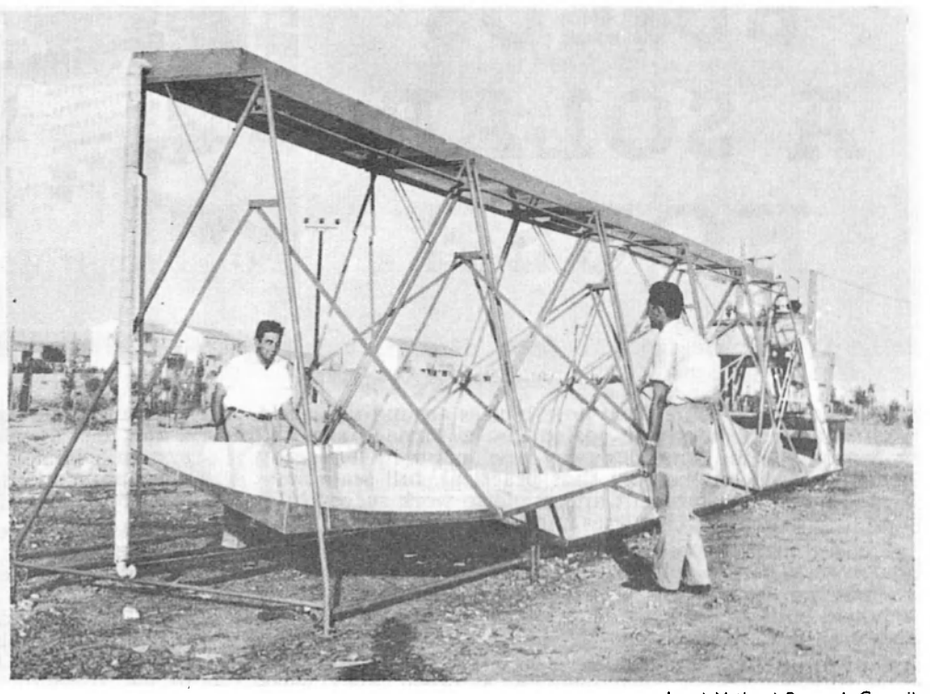
— What are the long-term prospects of building a solar power station ?

These immediate economic concerns have led Israeli scientists to concentrate on the most efficient ways of collecting the sun. In this respect, other participants at the Mont-Louis symposium agreed, they are among the world's pioneers, while Dr. Tabor himself is one of the men responsible for developing a new type of collector which doubles the solar energy collected for a given surface.

Here, a word of explanation is needed. The world's solar energy specialists can be divided into two groups : men working in high temperatures who use parabolic mirrors to focus the sun in the same way as a burning glass, and scientists interested in using the sun's heat for low-temperature applications—such as the heating of water. In this second category, the "powerhouse" is a collector and consists basically of a black plate which absorbs the sun's rays and pipes which carry away water heated beneath the plate.

What Dr. Tabor has done is to develop a plate which is both "black and white". That is, it absorbs the sun's heat as effectively as an ordinary black plate, but its wasteful emission of energy is almost as low as if it had been a perfect reflector.

This new type of collector is capable of producing low-pressure steam without the use of mirrors. It is to be used in a chemical factory now under construction at Beersheba which will produce fertilizer and insecticides with the help of steam provided by 300 square metres of roof collectors.



Israel National Research Council

FUEL-POOR BUT SUN-RICH, Israel has embarked on a broad programme of solar energy research including the development of steam for industries and the production of small power units. At the Negev Research Institute, Israeli scientists have built the new type of solar energy collector unit shown above. This consists of simple curved mirrors which reflect heat upwards to collectors fixed overhead. Use of black surfaces cuts heat losses by about four fifths, enabling unit to compete with more expensive systems. Five hundred units will save about 500 tons of fuel oil a year.

Refrigeration and air-conditioning are other tempting goals for the scientists working in solar energy. They do not offer the same problem presented by solar heating, which is that the least amount of sun is available when you need it most.

Packaged power for the farmer

HERE, stated Dr. Tabor, the Negev Institute has managed to bring the price of solar cooling down to the point where it is only twice as expensive as electric refrigeration. The "running costs" of a solar refrigerator or heater consists of paying off its original price—and that is why the scientist in this field is forced to think as a businessman. In 1959, he said, Israel hopes to test more economical systems of running a solar cooler.

One of the most tempting prospects of all in the uses of solar energy is the small power plant which could bring the machine age to the aid of farmers living in regions where the cost of fuel has kept machine power away. Unfortunately, the problem is not as simple as it sounds.

There are two stumbling blocks. The first one is the tremendous loss of efficiency which always occurs when you convert heat into mechanical energy with a steam engine. The second is the problem of moving the collector so that it can track the sun all day long. This involves either a photo-electric device known as a "heliostat", or constant supervision—and both are expensive.

A new mirror-type collector developed at Beersheba is so efficient that it has to be moved only once a week to catch the sun properly. Thus, one stumbling block has been removed.

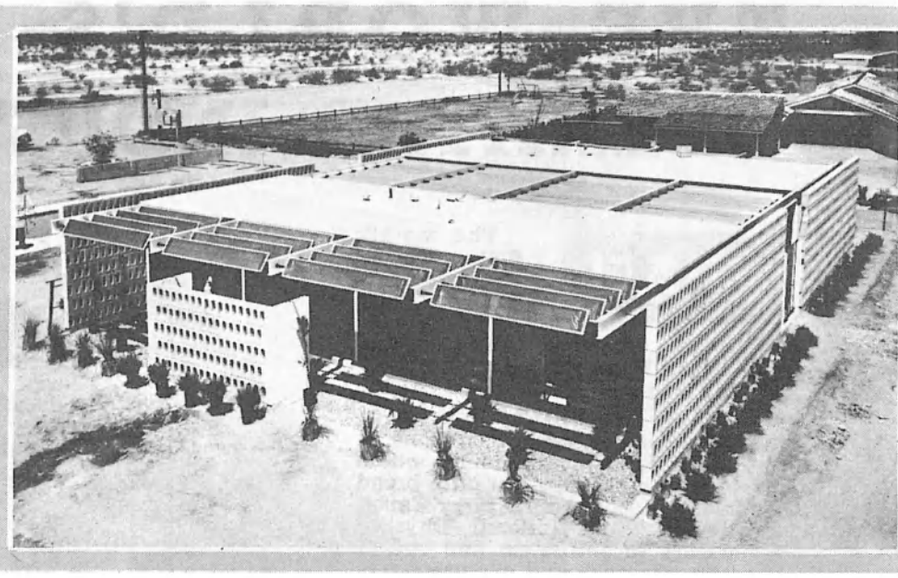
"What we are looking into now is a small turbine operating at 150 degrees centigrade and using not steam but a heavy fluid of high molecular weight", Dr. Tabor added.

The Negev Institute is now aiming at a 10-H. P. solar "power package" which Dr. Tabor believes may be able to compete with Diesel plants—particularly in maintenance costs.

Regarding the prospects of large-scale power installations, Dr. Tabor's attitude is one of "reserved optimism".

"Any large solar power installation means an extensive site", he explained, "but we have huge chunks of the Negev which are not good for anything else."

ARIZONA BUILDS A SOLAR HOUSE



Not so many years from now, houses around the world may be heated (or cooled) by a furnace situated some 93 million miles away. Scientists have already demonstrated convincingly that practical, full-scale sun-heated houses can be built and made to work successfully both in hot-weather countries and chillier northern climes.

For example, a pre-view of the comfortable existence that awaits people when central heating will come by courtesy of the sun has been provided since last April at a house built in Phoenix, capital of the sunny state of Arizona, in the U.S.A.

Outwardly the house doesn't look too different from ultra-modern styled dwellings (in a fairly high price range) that are being built in many parts of the U.S.A. today. But there are plenty of new notes and new ideas in the internal construction.

Its completion this year climaxed a project which began when the Association for Applied Solar Energy and the Phoenix Association of Home Builders planned an architectural competition for the design of a new and unique solar house which was to provide three things: architectural distinction, a solar energy collection area sufficient to meet all the heat requirements of the house and its swimming pool throughout the year, in the kind of weather normally experienced in Phoenix and, finally, sunshine control to reduce the amount of energy needed to cool the house in the summertime.

In this competition, architects and designers throughout the world (126 entrants from 13 nations finally competed) set to work to solve the problems of "living with the sun", including summer cooling as well as winter heating. Winner of the competition was an architecture student at the University of Minnesota, Peter R. Lee. The entire project, from the mailing of the competition programme to some 1,600 architects in 42 countries to the opening of the completed house, built to Lee's designs, was carried out in only eleven months.

Solar heated houses have been built in various places since about 1939, but their designers have been beset by two problems: How to compete economically with conventional heating systems, at least in installation costs; and how to provide heat when the sun doesn't shine.

Methods used in the past to provide solar house-heating have ranged from the simple installation of a large window wall facing south (to give supplementary heat) to installing large collectors on the roof for heating water in a conventional central heating system with circulation through pipes and radiators. The storage of collected heat has also been accomplished with pebble beds or by the use of certain chemical salts that absorb heat when changing from a crystal to a liquid state.

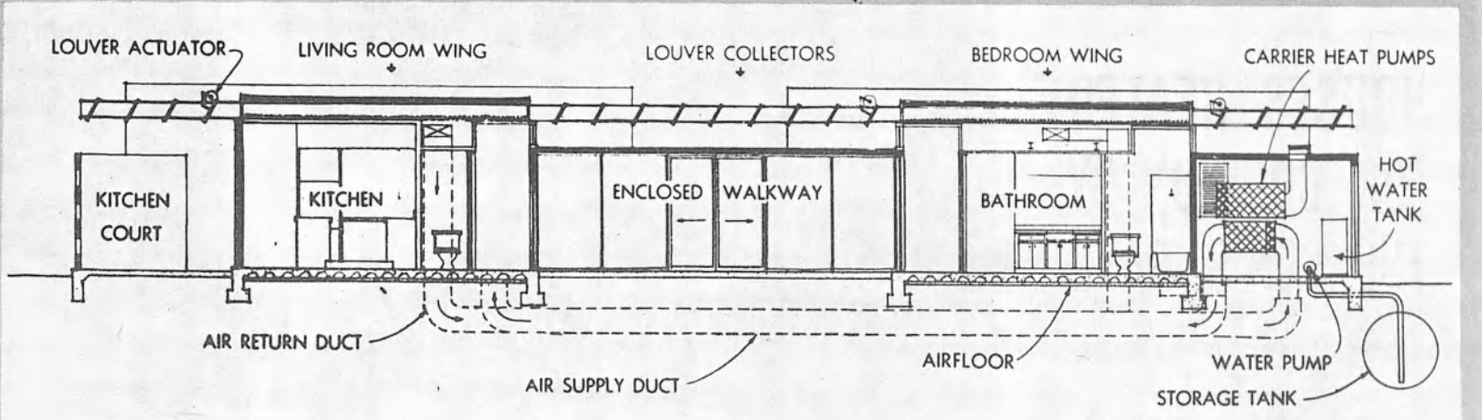
The Phoenix house shows a new trend and a new idea in solar heating. The trend is to use water both to transfer the collected heat to a storage tank and also as the medium to retain the heat. Water is the lightest of the heat storage materials so far employed. Its heat storage capacity ranks between rocks or pebbles—which are the lowest—and salts, which hold the most British thermal units per cubic foot.

An outstanding architectural feature of the house—and a new idea in solar heating design—is its energy collection system. This is composed of a series of 68 louvers, or aluminium shells, mounted in 17 parallel rows between the steel roof beams.

Resembling the wings or control surfaces of an aircraft, these aluminium shells are covered with fibre for insulation. Blackened copper tubes set in a blackened copper sheet are placed over the fibre. The copper absorbs heat from the sun and transfers it to water which circulates through the tubes. Transparent sheets of plastic are placed over the copper and these allow the sun's energy to get through, but prevent the long heat waves from radiating back out to be lost. This is the same principle on which a greenhouse operates.

All the heat collectors are arranged louver style over the house's patio and central court. They are rotated by a clock-operated motor to face south during daylight hours in the heating season (in Phoenix, October to mid-April) and can be adjusted so that they are always nearly perpendicular to the sun's rays. During the summer, the collectors are flipped over so the aluminium shells reflect

SUN SAND AND SKY set the decor for the Solar House built at Phoenix, Arizona. Nearly 600 yards of material were used to curtain the extensive glass areas (as in living-room, above, left) which form two



CROSS-SECTION THROUGH THE SOLAR HOUSE

USIS photos

heat away from the house and provide shade below.

Fifteen of the seventeen rows of collectors are used to provide heat for the house and swimming pool while two rows are reserved to heat the domestic water supply, which is stored in a 50 gallon tank apart from the house heating system.

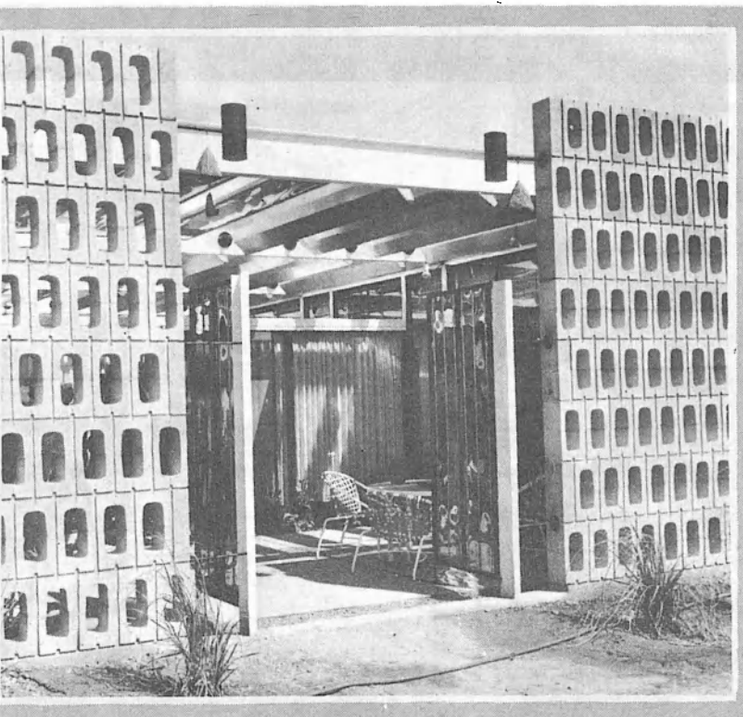
Water, warmed in the copper pipes concealed in the roof heat collectors, is carried to a 2,000 gallon storage tank. When this water is needed it circulates through the coils of a forced-air system, warming the air in the house. The system in the Phoenix House does not make use of an auxiliary furnace to provide heat when the sun does not shine. Instead, it makes use of a heat pump—an air-conditioning device—which can extract heat from the outside air when there is not enough solar heat.

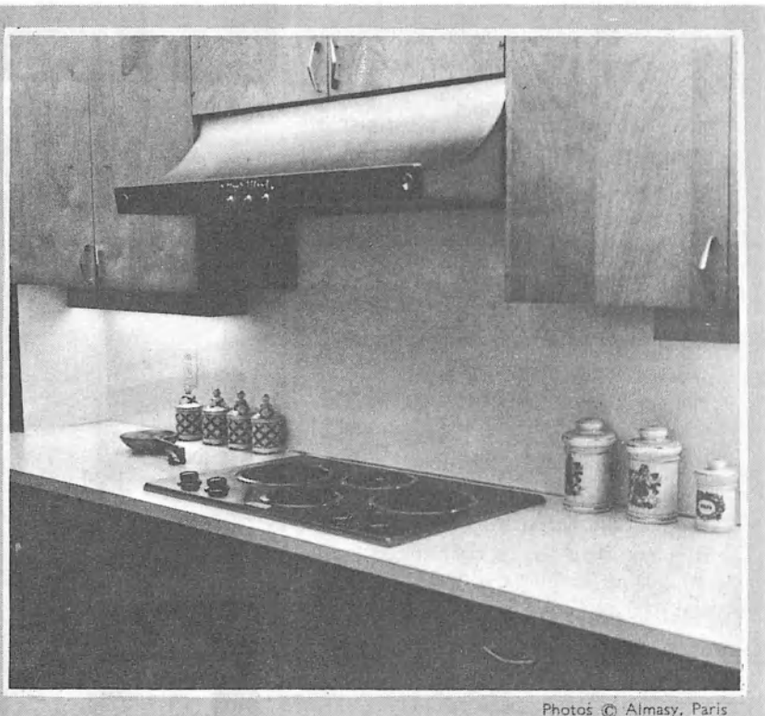
Thus, if the water in the storage tank cools after several sunless days, the heat pump comes into action to warm the house air. The residual warmth of tank water is used to pre-heat air round the heat pump's external coil. In other words, these pumps need electricity to operate, but obtain their heat from the warmth remaining in the storage tank and the swimming pool. When cooling in summertime, the heat pump reverses itself and acts like a conventional air-conditioner. This time, water from the storage tank, cooled by the aerated swimming pool, is used to precool air round the pump's external coil.

Cost of the Phoenix solar heating equipment is estimated to be about $4,000 more than conventional heating equipment would have cost. However, the cost of heating and cooling the house (close to 2,000 square feet) is placed at $450 a year, compared with $1,000 when using conventional equipment.

The purpose of the Phoenix Solar House is to stimulate public interest in the use of the sun's energy for man's benefit in his living conditions. The lessons learned from its operation will be useful in designing houses of every price level and for more northerly areas, where the sun can supply only a part of winter heat requirements.

Proof that such systems of solar house heating are practicable in cooler climates than that of Arizona has been given by a series of experimental houses erected by the Massachusetts Institute of Technology. The latest of these was completed at Lexington in March. (See following pages.)





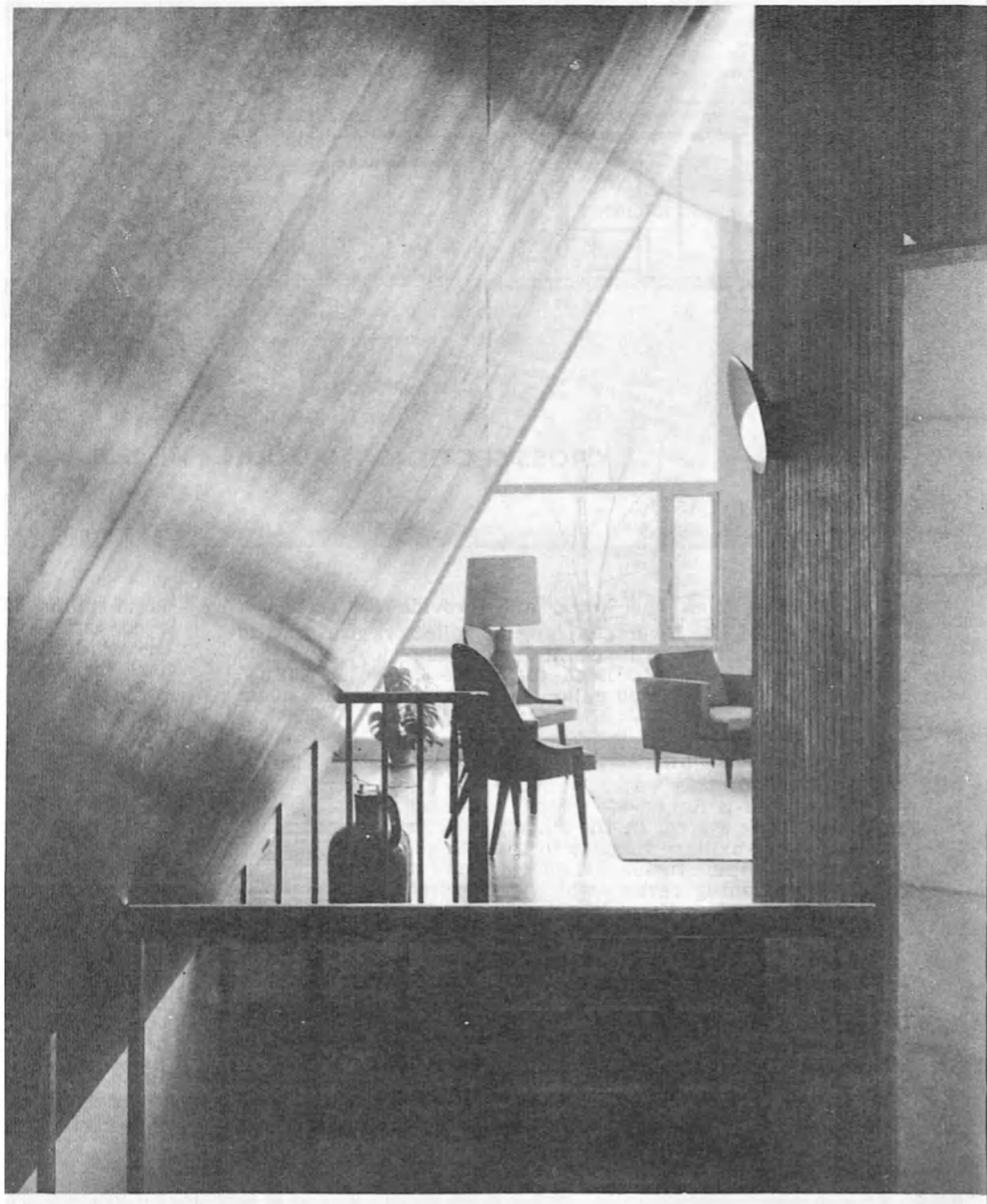
Photos © Almasy, Paris

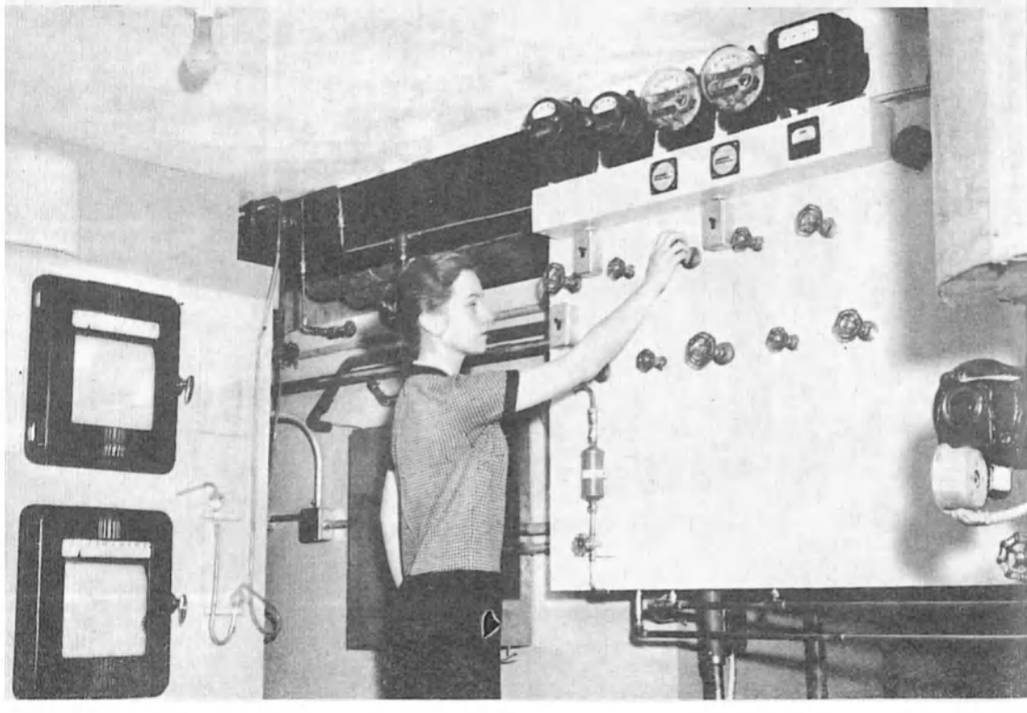
sides of virtually every room. Concrete masonry screen walls to shade the sides of the house from the sun are seen (centre photo) flanking one of the two patio "outdoor living rooms". Ultramodern kitchen has an "island" containing sink and dishwasher (located to command a view of the nearby mountains) and its equipment includes an electronic oven, a built-in refrigerator and electric cooking range (above, right).

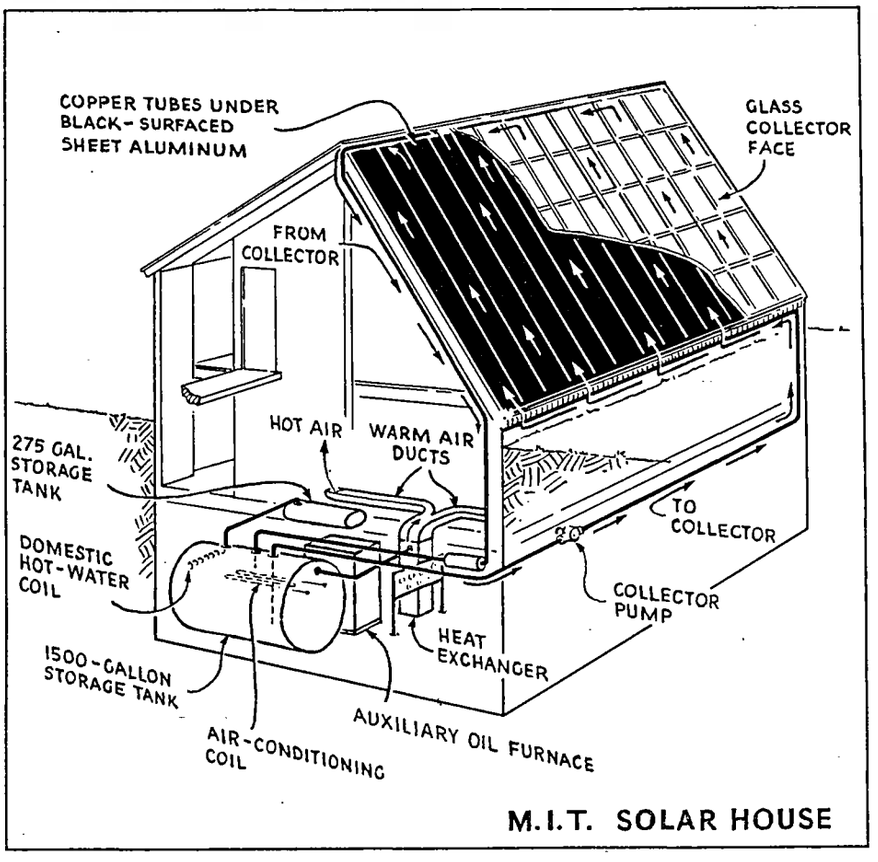
HOUSES HEATED (OR COOLED) BY THE SUN'S RAYS

Earlier this year a team of architects and engineers from the Massachusetts Institute of Technology, in the United States, put the finishing touches to a unique full-scale sun-heated house at Lexington, near Boston. This sleek, two-storey, three-bedroom house is officially called "M.I.T. Solar House IV" for it is the fourth in a series that M.I.T. has built over the past 20 years to study ways of obtaining practical house-heating from solar energy. Using the results of this research, M.I.T. built the latest house to demonstrate that enough facts and equipment are now available to combine a reliably engineered solar heating system with a house designed for comfortable suburban living in a northern clime. The entire solar heating system is thermostatically controlled and completely automatic in operation. The house owner simply has to visit the basement instruments room (right) twice in the year (in the spring and autumn) and turn the valves (at right) either to provide cold air during the summer or to obtain warm air in the winter. (Instruments on left are solely for engineers who will take data from the house). Professor Anderson, chairman of the committee under whose auspices the house was built, calls it "the wedding of the special engineering requirements of a reliable solar heating system with the architectural demands of modern living". Top photo, corner of the living room in "Solar House IV". Behind sloping wall at left is 640 square-foot solar heat collector.

Photos : Office of Public Relations, Massachusetts Institute of Technology.







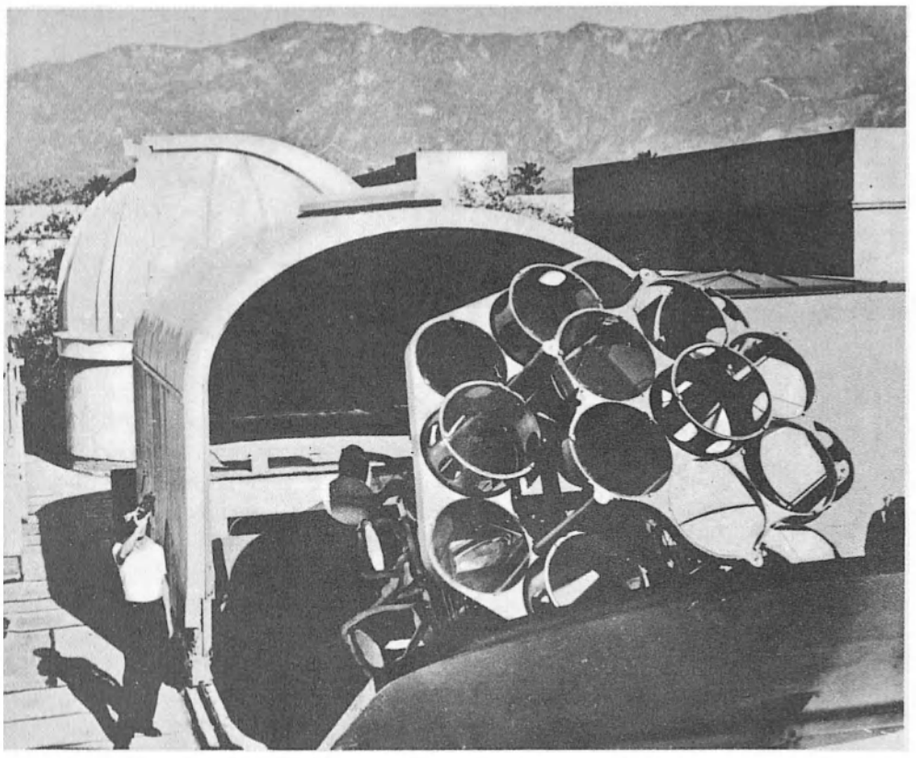
M.I.T. SOLAR HOUSE

SNOW-COVERED ROOF SUN-WARMED PARLOUR

Most striking feature of the M.I.T. Solar House in Lexington is the solar collector with which the sun's energy is trapped for heating use. Photo, above, shows this collector, a sloping roof wall consisting of 640 square feet of glass, two layers thick, over a similar area of thin aluminium sheet, painted a heat-absorbing-black. While the aluminium sheet absorbs the solar energy, the glass works as it does in a greenhouse—it lets in the sunshine, but keeps the longer waves of heat energy from escaping again. To store this energy for use, water is circulated through copper tubes attached to the aluminium sheet and is thus heated. This hot water is stored, in turn, in a 1,500 gallon basement tank. To heat the house, water from this tank is pumped through a heat exchanger, which functions like an automobile radiator, to transfer heat from the water to a stream of air. This warm air is then forced through ducts to heat the living spaces. (See diagram, left). A small auxiliary oil furnace is used for heating if a series of sunless days occurs. In summer, water in the basement storage tank is refrigerated so that forced-air system can be used to cool the house.

Photos Office of Public Relations, Massachusetts Institute of Technology.

POWER FROM SOLAR BATTERIES — PROSPECTS AND DRAWBACKS



USIS photos

MULTIPLE LENSES (left) concentrate sunlight to "feed" a solar furnace at the California Institute of Technology. Furnace is used for high temperature tests of Jet Age materials, those, for example, required for rockets and earth satellites. Right, forty-eight cells on the lid provide current for world's first sun-powered radio-phonograph which was demonstrated in New York last year. The 48-cell solar battery for this portable transistor unit will operate on artificial light when the sun is not shining. Standby batteries provide current when no light is available.

U.S.A.

Only a few years ago, solar energy was the pampered, spoon-fed darling of scientists working in laboratories behind closed doors closed not so much for the sake of secrecy but for protection against the usual form of humour reserved for research off the beaten track. Today, it is a healthy child doing very well in the hard-headed world of industry in the United States.

This was brought out by American participants at the Mont-Louis symposium. Dr. Frank Edlin, a consulting engineer in the engineering department of Du Pont de Nemours at Wilmington, Delaware, reported, in an interview, on the results of a Du Pont survey of the uses of solar energy in the United States. No less than 5,000 solar hot-water heaters have been sold in the United States, mainly in Florida, Texas, Arizona and California.

An even more spectacular illustration of the market for solar energy is the "silicon photovoltaic cell" developed by the Bell Telephone Company several years ago. At present, thousands of cells a *month* are being produced in the United States. Their two main uses are in powering transistor radio sets and in lighting beacons, buoys and other aids to navigation. In some cases, up to 3,600 cells are used.

They are popularly known as "solar batteries". Each cell consists of a slice of single crystal of silicon. When the sun shines, it converts from 8 to 14 per cent of the sun's energy into electricity—a much higher efficiency rate than in other methods. This electricity is fed into an ordinary storage battery to run the beacon or the radio at night.

The solar-powered silicon cell has one main advantage: it requires very little maintenance. No one knows as yet how long it will last—but the estimate is "dozens of years." Its main disadvantage—high cost—is disappearing rapidly. At present, the price of a cell measuring one square inch has been brought down to $ 3.

Why is Du Pont interested in hot water heaters and silicon cells to the point of carrying out a survey of the use of solar energy in the United States ?

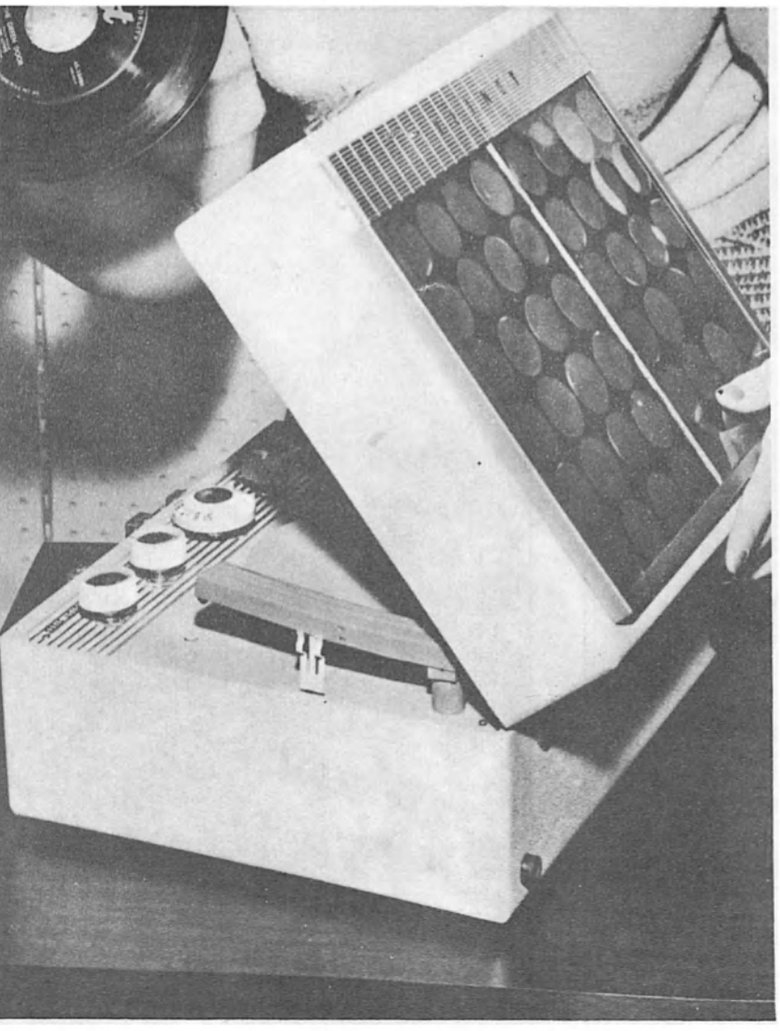
"We don't sell solar energy appliances, but we are interested as suppliers of material," explained Dr. Edlin. "It's the same with nylons—we manufacture the yarn and we've made thousands of experimental stockings but we've never sold a pair."

Plastic panes for the greenhouse

Du Pont is almost synonymous with plastics and plastics have a tremendous future in solar energy, Dr. Edlin pointed out. One of the biggest economic question marks in the use of solar energy is the cost of the glass in an appliance's collector. Plastics, Dr. Edlin explained, have several advantages: they are cheaper, they can be more easily shaped for special requirements (such as parabolic mirrors) and they are less fragile.

Du Pont is now manufacturing one weather-resistant clear plastic—known as mylar—and is experimenting with another. This material is already used for greenhouses, but it will open up new vistas in solar energy—and that is why Du Pont sent Dr. Edlin and its chief consulting engineer, Mr. R.C. Ficke, to Mont-Louis.

The use of the sun to "weather-condition" homes has been developed to such a point that, today at Lexington in the U.S.A. there is a solar house for sale. The house was developed by Prof. H.C. Hottel of the Massachusetts Institute of Technology at Cambridge. It is a two-story home with one-half of its roof—the south side—covered with solar-energy collectors which take care of its heating



and hot water requirements. It has an auxiliary oil furnace for emergencies. (See page 14).

Dr. Thomas A. Unfer, a young scientist who has been working with Prof. Hottel, told the symposium at Mont-Louis of research in "selective surfaces" for solar energy collectors. By coating an aluminium plate with copper oxide, losses from emission are reduced from 95 % to 10 % —and twice as much water can be heated with the same collector surface.

Another centre of solar energy research in the United States is the University of Wisconsin at Madison, represented at Mont-Louis by Prof. Farrington Daniels and Prof. John A. Duffie. Prof. Duffie has been working on solar refrigeration and air-conditioning and, he declared in an interview, it appears "reasonably attractive" when combined with a space heating system (in order to amortize the original investment in collectors as much as possible).

Prof. Daniels has been working for the past decade to bring the costs of a solar power unit down to the point where it can be used to help non-industrial countries. His research, financed with a grant from the Rockefeller Foundation, has led him to look into all low-cost possibilities—and plastics are one of them.

Prof. Daniels, who has worked extensively in India, does not think in terms of bath heaters or refrigerators—but of bullocks. "I've seen bullocks raising water to irrigate land—and then eating up most of the crops they had irrigated," he pointed out. He has conducted extensive experiments with small steam engines and, he admitted frankly, he is still looking for one efficient and simple enough to meet his requirements.

Prof. Daniels is basically a chemist, and is also conducting research on chemical ways of storing the energy of sunlight—which would not be limited by the laws of thermodynamics governing steam engines. "Nature does it with plant synthesis," he said, "so we know that it can be done."

MESSAGES FROM SPACE WITH SOLAR BATTERIES

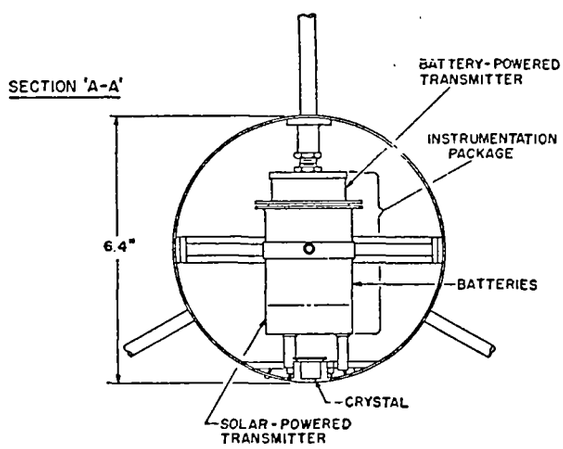
SOVIET Sputniks and American satellites are transmitting important data on conditions in space as well as in the upper reaches of the earth's atmosphere thanks to power picked up directly from the sun. Unlike the earlier artificial satellites, the latest ones launched during the International Geophysical Year are now equipped with solar batteries—which means that scientists now have an efficient means of receiving information from the satellites for years to come. Though the life of these solar batteries has not yet been determined, some scientists believe that they will last about ten years, others hint that they may be charged indefinitely by the sun.

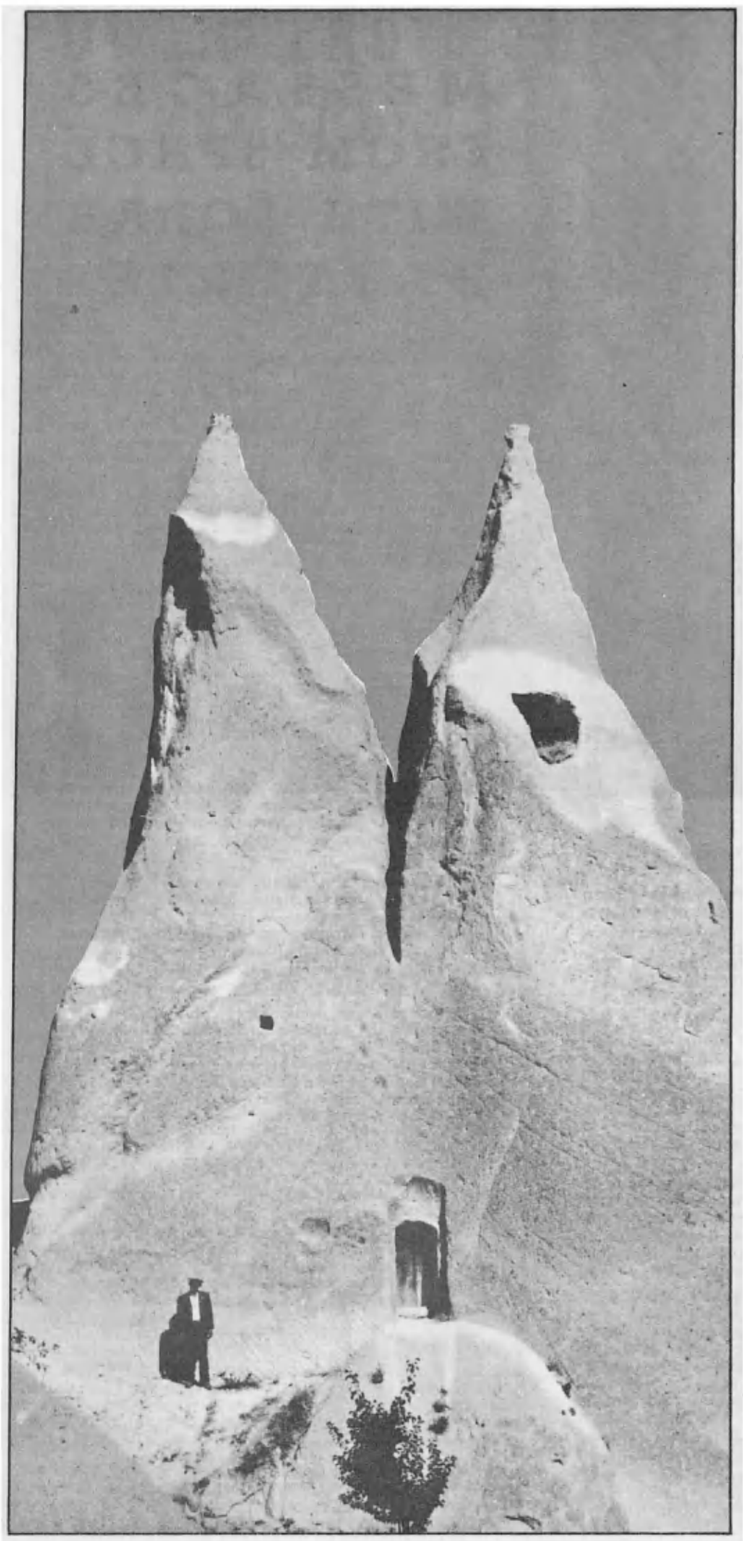
The first Soviet and American Sputniks were equipped with standard, though specially sensitive batteries (working on a mercury principle) to supply the needed electricity for their transmitters. But after several weeks their power was exhausted and they ceased operating. Thus one transmitter of the second U.S. satellite faded out in less than three weeks.

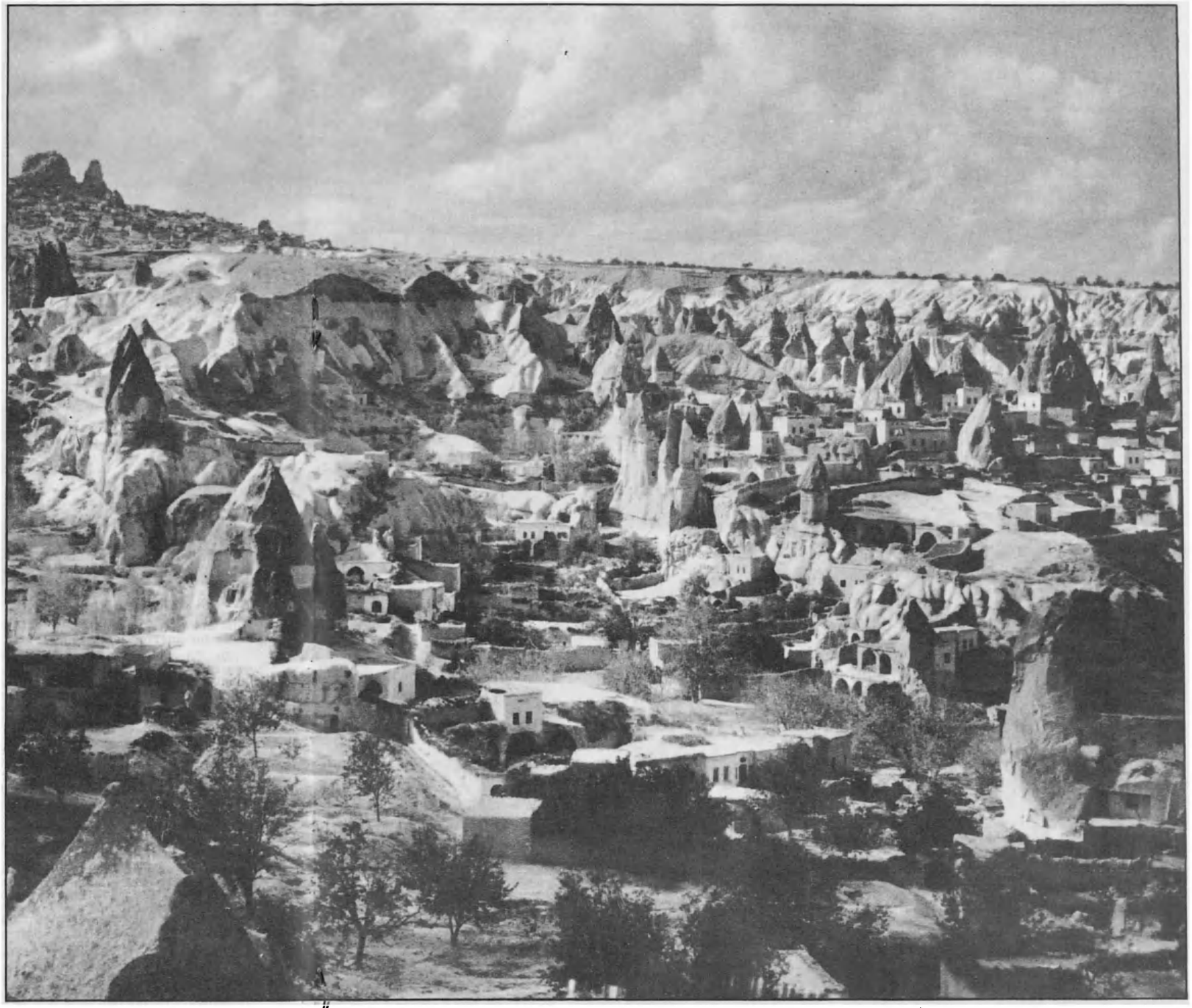
Both the American and Soviet solar batteries now hurtling through space consist of wafer-thin silicon cells smaller than the size of common razor blades. (The cells in American batteries are 1/400th of an inch thick). Each cell contains two layers of silicon of different electrical properties so that when sunlight strikes a cell, electrons move from the first layer (positive) to the second (negative), creating an electric current.

The second U.S. satellite, launched on March 17, 1958, has six solar batteries spaced on its surface (diagram below) so that at least one of them is in direct sunlight except when the satellite finds itself in the earth's shadow. (Because of its distance from the earth, it is estimated that it will not be in the shadow period 85% of the time).

The third Soviet satellite, sent up on May 18, 1958 (it carried a ton of scientific equipment and measuring instruments) has nine solar battery sections Four are installed on the front end plate, four on the side surface and one on the back end plate. This arrangement ensures normal working irrespective of the Sputnik's orientation in relation to the sun.







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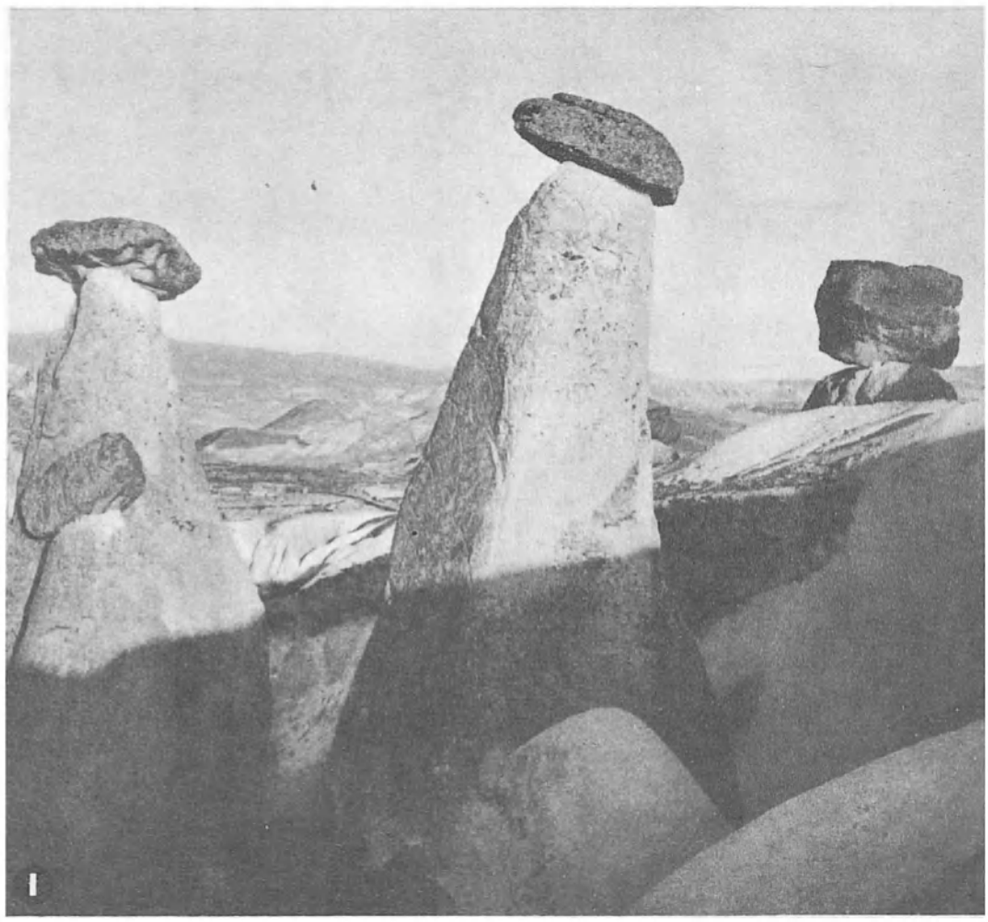
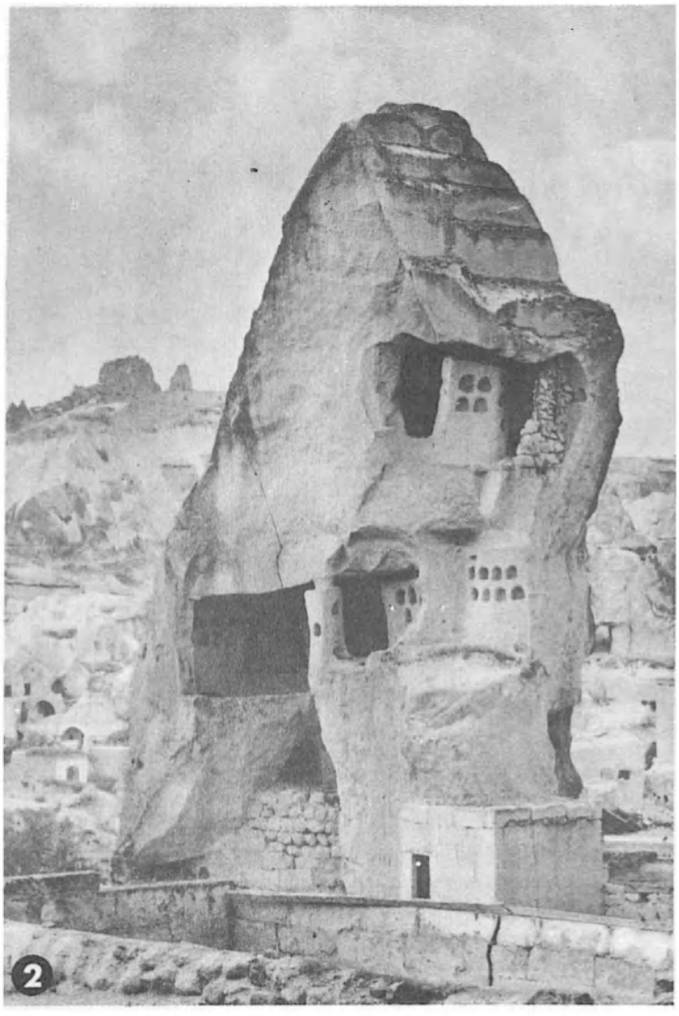
LUNAR LANDSCAPE OF PINNACLES & TOWERS

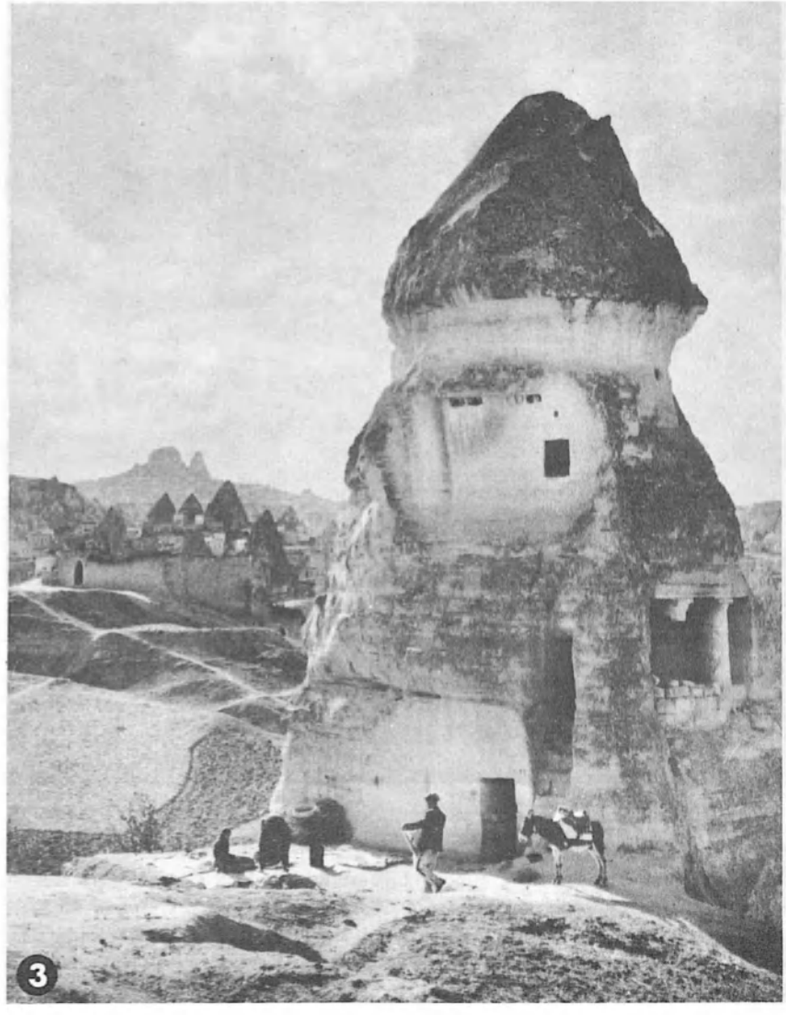
Strangely-shaped rock towers and pinnacles stud countryside around Mount Argaeus, Asia Minor's highest peak, which rises 12,848 feet on the Cappadocian Plateau of Central Turkey. In prehistoric times the mountain erupted, spewing ash and lava hundreds of feet deep across the land. Rains and melting snows created valleys and riverbeds, and wind and water slowly carved the volcanic debris into thousands of pyramids and cones. For thousands of years men have made their homes in these rock shapes. Maçan (above) is one of half-a-dozen villages half-hidden in this lunar landscape. First cone dwellers hacked out homes from the soft rock. Many carved entrances high above ground to protect themselves from attack. Double towered cone (opposite page), no longer inhabited, has many rooms on different levels.

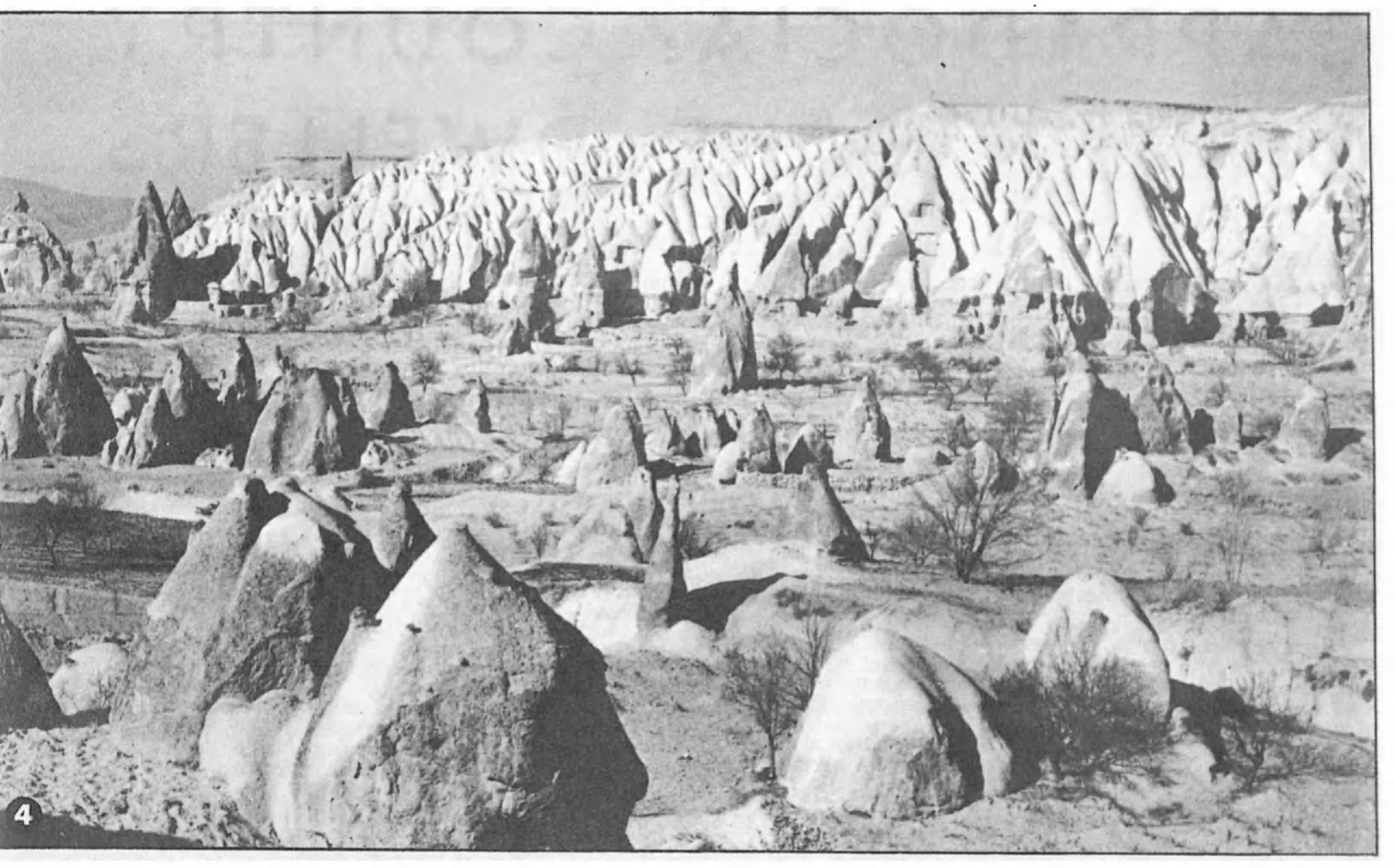
STONE CAPS WORN AT RAKISH ANGLES

The whims of nature have rarely produced stranger sights than those in the cone-land of Cappadocia. As wind and water have carved out valleys and river beds, they have also left cones and pyramids standing in space, sometimes with stone caps of a different, more resistant material. (1) Rock hats on these cones, already at a rakish angle, will one day tumble off and the unprotected cone will crumble away. (2) A two-storey dwelling, now uninhabited, whose weather-worn walls have opened up like a honeycomb. (3) A cloistered community grew up in Cappadocia between the fifth and twelfth centuries. Holy men excavated tombs, shrine and even large churches out of rock. Farming family now lives in this mushroom-shaped cone which Christians of medieval times used as a chapel. Columned room (on right of dwelling) is thought to have been carved as a tomb. (4) Rock pyramids in the Goreme Valley stand in serried ranks like some army poised to strike. (5) Towering spires dwarf a farmer's wife and her donkeys near one of the oasis-like cultivated patches which dot the floor of the valley near Urgup.









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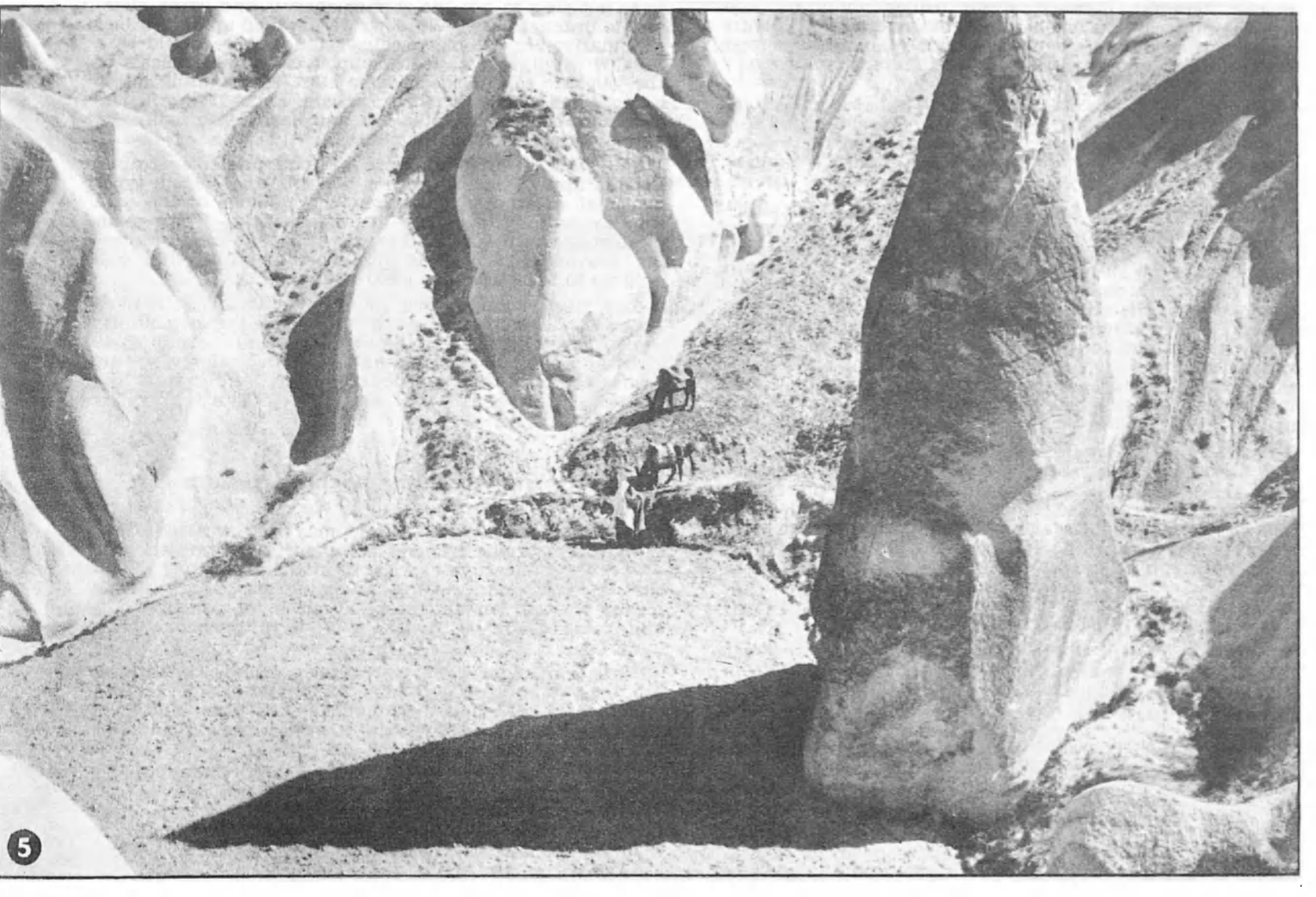

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CAPPADOCIA: COUNTRY OF THE CONE DWELLERS

"TAKE the first turning on the left, pass two minarets and a tower, go round the pyramid on the right and make straight for the cone with the stone cap leaning to the left." This is the type of street direction a visitor would need to find his way around Ürgüp, a Turkish village set in one of the strangest landscapes this side of the moon.

For Ürgüp is in the heart of a country of volcanic towers, a fabulous land of some two or three hundred thousand stone cones, in the centre of the Cappadocian Plateau of Turkey. Kayseri—formerly Caesarea, a commercial centre from Roman times—is the nearest town. Ankara is some 200 miles to the northwest. Here nature has taken a fling at proving that anything is possible and man has countered by demonstrating that no matter what nature contrives, and however improbable, he can make some use of it.

This is the situation today. But the beginning of the story of Ürgüp is in prehistoric times when Mount Argaeus (Erciyas Dagi), the biggest mountain peak in Asia Minor exploded violently covering a forty-mile area around its base with ash and lava hundreds of feet deep. At first the triangular volcanic plateau was a smooth molten mass but as the lava cooled, large cracks, fissures and ravines appeared, and the process of erosion began.

Melting snows, rains and wind then took a part in sculpting the weirdest landscape the human eye has ever seen outside of the lens of a telescope focussed on the moon. Pyramids, towers, spires, cones, minarets and needles of rock in a brilliant phantasmagoria of colours ranging from blinding white to bright yellows and softest rose were left jutting skywards in haphazard confusion.

Handiwork of a drunken architect

SOME towers, polished smooth by grit-laden winds, stand so high that they have as many as ten floors; others are man-size. Some have comical caps of rock substance, more resistant to the weather than the main cone, which sit coquettishly on top. Others have been worn down to the shape of a Cleopatra needle. And lest, if even in this, there might be some semblance of symmetry, the hand of some drunken architect seems to have pushed this one slightly left, that one over to the right, placed these cones leaning towards each other like people in deep conversation and set these others standing stiffly apart.

If the first tribes wandering across the desert land saw this strange incomprehensible rockland as a challenge they also seized on it as an opportunity. For more centuries than are recorded in history, men have made their homes in this woodless land by digging into the rock shapes and enjoying the safety offered by dwellings with a life span beyond human reckoning. Yet even the rocks do not last forever because once the caps fall off, the shape of the cone starts changing, giving a constant impermanency to the bizarre skyline.

What is known of Ürgüp has been compiled from what the previous generations have left behind them. Some time about the 4th century A.D., a community of Cenobite monks discovered the advantages offered by this rock land for the preservation of the seclusion demanded by their order. Side by side with the humble farmers who tilled the valleys, they established themselves in the cone village of Goreme a few miles from Ürgüp.

With considerable ingenuity they dug out living quarters, sometimes at ten different levels in the same cone, reaching the entrances by rope ladder or by a central inside chimney niched to provide hand and footholds. Ground level doorways they sealed with large stone wheels which rolled on carefully cut grooves.

These monks left a rich heritage for the archaeologist. They built dozens of small chapels in the cones, mainly following the Byzantine form of architectural construction and covered the walls and ceilings with brilliant paintings depicting the iconography of the Christ, Mary and the Saints. In the earlier chapels probably built about 400 A.D. the paintings were done in simple wash on the stone face.

Kilroy was here—in 1650

MORE elaborate work was done from the 8th to 11th centuries when artists had learned the art of using tempera which is more resistant to the ravages of time, though not, unfortunately, to the vandalism of sightseers. Thus many of the paintings have been mutilated almost beyond recognition by visitors who, wishing to leave their mark on time, have scribbled their autographs on the walls. One autograph defacing a well-nigh priceless fresco has been identified as dating back to 1650.

The departure of the monks, following the decline in the Christian monastic communities in the 14th century, brought another era to the rock country. The villagers were not slow to put the former chapels and living quarters to practical use. Windows were walled up and former sanctuaries became pigeoncotes so that there would be a reliable supply of guano to supplement the chemicals of the volcanic soil. Cells became store-rooms, and, not to be outdone by the monks in artistic effort, the villagers decorated the outside of crofts and barns with figures of animals and geometric patterns.

Blessed with an abundance of food products—grapes, melons, apricots, pears, apples, walnuts and certain types of cereal all grow in profusion—the villagers of the cone country have little reason to go far afield. Their main product is a sweet wine absorbed easily by the surrounding provinces, though Ürgüp itself has vats that can hold up to 3,000,000 litres (790,000 gallons).

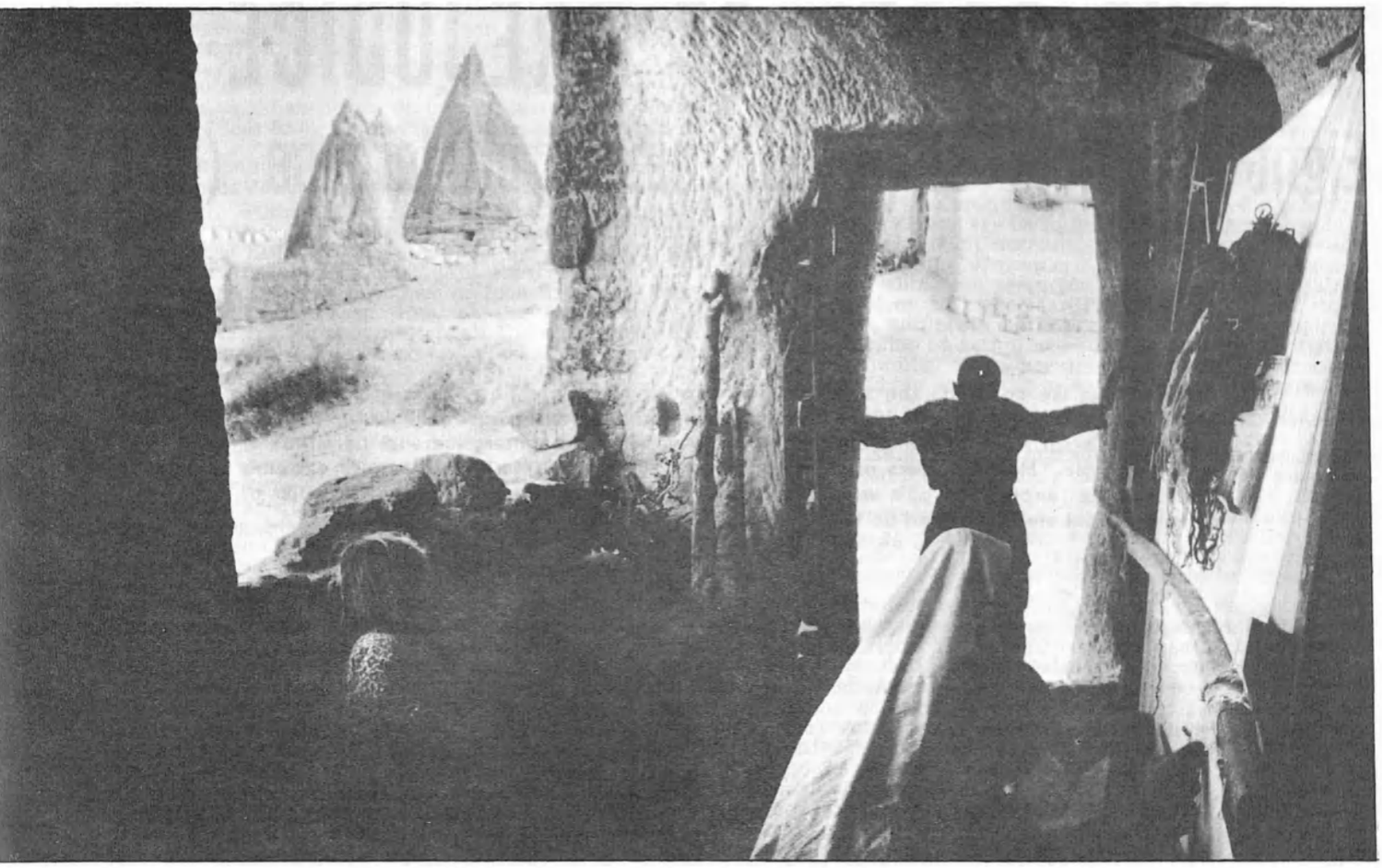
As a result, changes have come slowly to this outlandish place. Though the richer members of the community sometimes build housefronts and install wooden doors to give the appearance of ordinary dwellings, they show no desire to alter their cave houses behind, and a step over the threshold is a step back across the centuries.

Spring-cleaning with hammers

WHILE the people of Ürgüp may now wear Western dress in their homes—probably the same shelters their ancestors carved out of the untouched rock—the stairways, floors, ceilings and walls are of stone. The divans they sit on and probably sleep on, are of stone, and the fireplace—without a flue—is of the same basic material.

When spring-cleaning time comes round, the women use hammers to chip off the accumulation of grime—incidentally enlarging the chamber each time—and then complete the annual renovation with whitewash applied with a twig brush.

Should the family needs change and living space become cramped, one can always cut out another room—and if the cone is not large enough to allow this, then there is always another round the corner. And who could wish for more than a home that is cool in summer, warm in winter, rent-free and well-nigh indestructible.



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TROGLODYTE HOMES OF THE 20TH CENTURY

In cave houses of Cappadocian villages like Uchisar (below) stairways, floors and even divans are of stone, but one advantage of these modern troglodyte dwellings is that they are cool in summer and warm in winter. Smoke from their flueless chimneys blackens the rooms, so once a year the people chip away the begrimed layer on ceiling and walls—thus enlarging the room each time. A coat of whitewash then completes the "spring cleaning." Below, left, a young woman, balancing atop a woven basket, uses a bundle of twigs to whitewash the ceiling. Above, view through window space shows thickness of cave house walls. Women are busy at their looms weaving carpets. Some carpets take as much as two years to complete.

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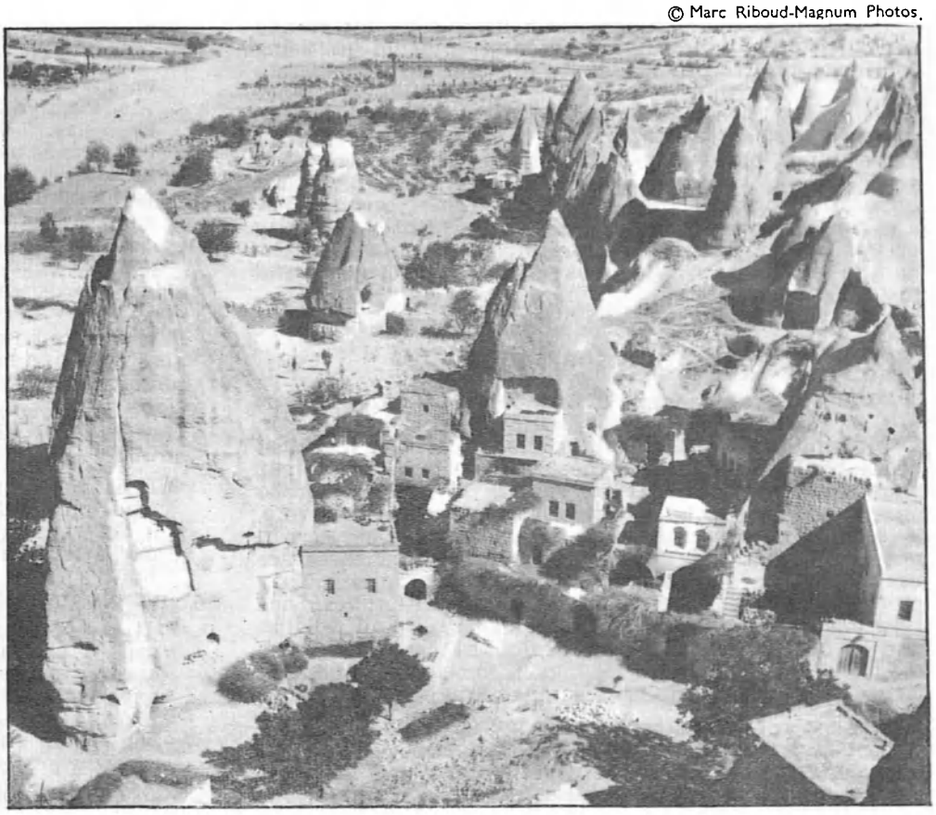


THE ROOTS OF PREJUDICE

Eight practical steps to reduce intolerance (bias)

by Arnold M. Rose

(4)

In this issue we conclude the serialization begun in June of "The Roots of Prejudice", published by Unesco in its series "The Race Question in Modern Science." In the present article Professor Rose explains how prejudice arises from imaginary fears in the minds of certain people. He then goes on to examine prejudice particularly in its more extreme forms as the "expression of a warped personality." The author concludes with a list of eight practical steps that can be taken to help reduce prejudice.

FRUSTRATION explains the force behind prejudice. But it does not explain why certain minority groups are chosen as scapegoats. To explain this, psychologists help us out with another theory—the "symbolic" theory. This theory is based on the important fact that one thing can stand for something else in the unconscious mind. People often find themselves liking something, certain foods or some scenery, for example, without knowing why. If such feelings could be traced back to their origin, it would be found that these new foods or new scenery "remind" people of some pleasant experience in their past. There need not be any real connexion at all. The unconscious mind is always making connexions so that one thing will substitute for another.

There can also be substitutes, or "symbols" as the psychologists call them, for things disliked. Probably everyone has had the experience of disliking something at first sight, without any reason for doing so. The unconscious mind made a symbolic connexion there, too.

Now, the question is: why are certain minority groups disliked by so many people? Obviously, they must be symbolically connected with something very important to many people. Such things would include an interesting life with new opportunities, money, a belief in being kind and just to others, family life and sexual satisfaction, good health, and so on. Toward all these things most people have mixed attitudes; we like them, but we also dislike them. We may be a little afraid of some of these things, or we may wish to rebel against them. But we cannot say so: it is not proper to dislike these important things. So the dislike becomes unconscious, and can be expressed only through a substitute. Minority groups become substitutes for important things in the culture with which they have deep psychological and historical connexions.

What man fears he hates

LET us take an example of how this works for one type of case. All of us have had the experience once in a while of disliking a thing that is good for us. Most of us have kicked up our heels at our parents, at our church, at practices that are said to be healthy and so on. That seems to be a natural human way of behaving, if it happens only once in a while. But some people will not admit that they would like to rebel, and these are usually the ones who would most like to do so. They pretend that they adore their parents at all times, that they always have "pure" feelings about sex and religion and so on. Since this is not *really* the case, they have to give vent to their rebel feelings in some way. And they do so by having prejudices against minority groups.

It is not only a matter of disliking the objects of prejudice; it is also a matter of fear. When people hate something strongly, they are usually also afraid of it. It is of course sensible to hate and fear certain things, but when the danger is imaginary there is something wrong with the person who hates and fears. That is the situation when there is prejudice against minority groups. Most of the fears connected with prejudice are imaginary, even though they seem real enough to those who have them.

- Take, for example, the fear of large numbers. Many people who are prejudiced against Negroes, or any other minority group, say that there are *so many* Negroes. They are afraid they are going to be "overwhelmed" or "dominated" by Negroes. If these people are asked: "What percentage of the people in this town are Negroes?" they usually give a falsely high number. The real facts are available to them if they wished to know them. But prejudiced people seem to wish to hold on to fears about the large numbers of Negroes.
- Another fear is that minority groups have too much power. Prejudiced people say that Jews own the big banks and run the government. Even a little investigation will indicate that this is not so. As a matter of fact, in some countries Jews are kept out of the banking business and out of many government posts because of prejudice. There are no Jews in many of the biggest and most powerful industries.
- There is the fear that members of the minority many be spying for foreign governments. For years before the World War II many Americans were afraid of Japanese spies. When the war came, hundreds of Japanese-Americans were arrested because they were suspected of spying. There were many rumours of various kinds of secret work for the Japanese Government. But when it was all investigated, *not a single* Japanese-American was discovered to have been helping the enemy. The Japanese Government knew about Americans' prejudice and hired only white Americans as spies.

It is wise to be afraid of some things. But the fear that goes with prejudice is always harmful, because it is a fear of something imaginary.

We can now bring together the ideas dealt with in this section: Why do people learn prejudice and hold it so strongly that they do not wish to give it up?

- It is *not* because people naturally dislike any person who looks different, behaves differently, or speaks in a different manner from themselves. In fact, people pay attention to differences only when they have prejudices first. Then they hold themselves apart and despise or hate the differences of the other people.
- It is *not* because prejudiced people have had unpleasant experiences with minority groups. Some have, and some have not. Those who have had unpleasant experiences with minority groups have also had unpleasant experiences with other people. They remember some unpleasant experiences because they are *already* prejudiced.
- In part, people have prejudice because they are frus-

trated and unhappy in a general way. Depression, unemployment, and low wages are among the main causes of frustration for a country as a whole, but there may be other causes. There are many things which cause fear and anxiety among large numbers of the people. When people do not understand the cause of their frustration, or feel that there is nothing they can do to stop it, they look for a scapegoat. Certain kinds of politicians gain popularity by naming the Negroes, the Jews or some other group as the scapegoat.

- People are willing to use these groups as *scapegoats* because the groups have become *symbols* of other things they dislike. They cannot openly show their dislike of these other important things, since they would regard that as improper or foolish. Also, they like or admire the other thing at the same time as they dislike it. So they switch all the dislike over to the symbol—the minority group.
- Fear of imaginary dangers is an important part of prejudice. One of the reasons why prejudiced people dislike or hate minority groups is that they imagine all kinds of fearful things about them.

A number of students have sought to explain prejudice as a type of mental disease. Some mental disorders can be traced to inadequacies in personality development, and prejudice is regarded under this theory as resulting from a particular kind of mis-development. Prejudice arising from this source is quite non-deliberate and cannot be eliminated by rational appeal or the application of laws. Most studies of this aspect of prejudice take the form of a comparison between groups of prejudiced and unprejudiced persons, based on a number of questions about personality characteristics and personality development. The items where significant differences appear are then integrated into a clinical picture of the "prejudiced personality".

One study, by Frenkel-Brunswik, Sanford, and others, at the University of California, is based on a detailed comparison between the personality traits of known anti-Semites and the personality traits of known non-anti-Semites. By comparison, the typical anti-Semite was found to be a compulsive conformist, exhibiting anxiety at the appearance of any social deviation. He appears to be a person with little insight into himself, who projects his own undesired traits on to other people, so that he blames people against whom he is prejudiced for traits which are characteristic of himself. He has a tendency toward stereotyped thinking and is unimaginative. He tends to have unconscious inferiority feelings centering mainly in a feeling of sexual inadequacy. He expresses strong filial and religious devotion, but unconsciously manifests hatred of parents and indifference to moral values. He exhibits an aversion for emotionality but unconsciously has a feeling of inferiority toward it. He is prone to aggressive fantasies.

Anxiety, insecurity breed anti-Semitism

ANOTHER study was conducted in New York City by Jahoda and Ackerman. They secured detailed reports on 50 patients who had expressed anti-Semitism while undergoing psychoanalytic treatment, and tried to determine what role, if any, anti-Semitism played in their unstable mental make-up. It appeared that anti-Semitism resulted from some distortion in personality structure and fulfilled certain needs. Anxiety and lack of security in group membership are among the principal traits of anti-Semites. Fearing attacks on their integrity as individuals, these persons counter-attack against Jews, the handiest object. The anti-Semitic personality type in this study, too, has an overwhelming desire to conform, to appear "respectable" and to attach itself to dominant organizations, and is characterized by outward submissiveness and inward aggressiveness.

Hartley made a study among college students of the personality traits of the prejudiced person. His summary of the characteristics of the intolerant personality follows: "unwillingness to accept responsibility; acceptance of conventional *mores;* a rejection of serious groups; rejection of political interests; a desire for groups formed for purely social purposes and absorption with pleasure activities; a conscious conflict between play and work; emotionality rather than rationality; extreme egotism; compulsive interest in physical activity, the body and health. He was likely to dislike agitators, radicals, and pessimists. He was relatively uncreative, apparently unable to deal with anxieties except by fleeing them."

These studies of prejudice as the expression of a warped personality have certain weaknesses when considered by themselves. But when taken in connexion with other factors underlying prejudice, they add much to our understanding. They probably are most useful in explaining extreme case of prejudice.

Shatter stereotypes with facts

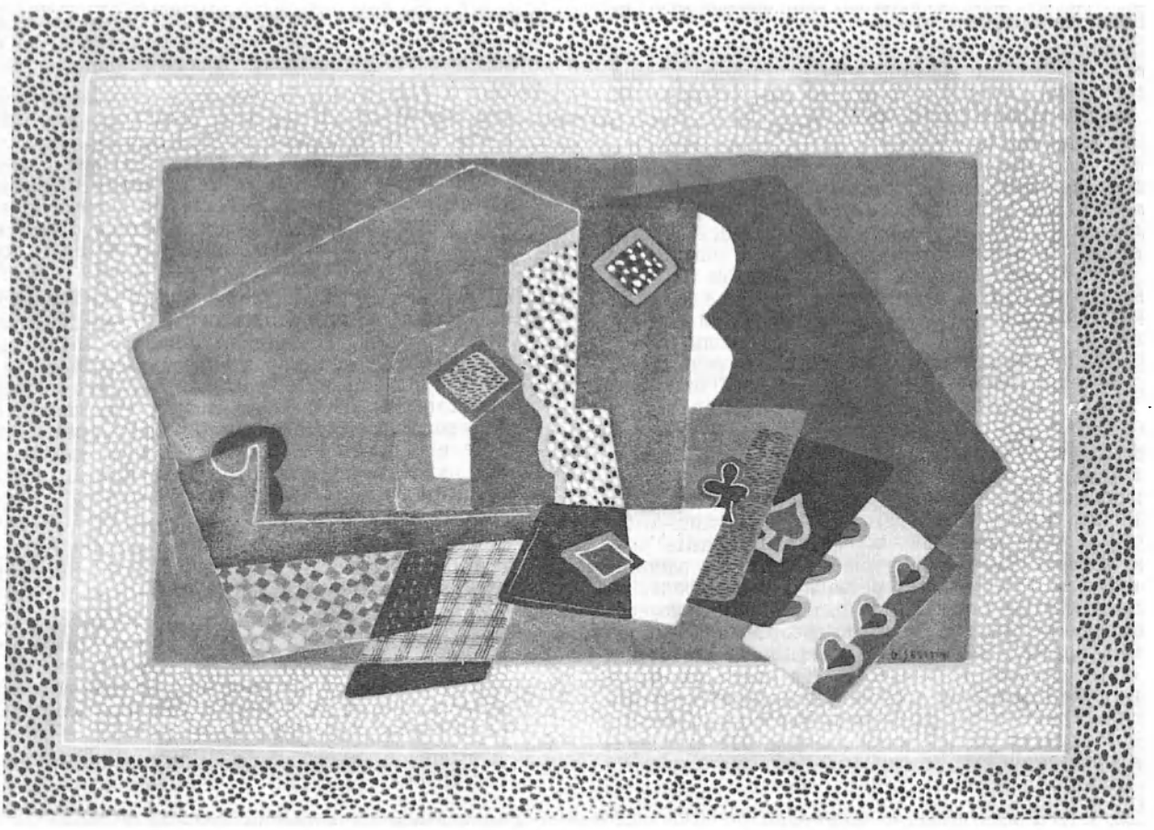
WE have thus seen that prejudice is indeed a complex thing. There are background factors and immediate factors which account for its presence in any individual or group of people. This complexity makes it difficult to eliminate prejudice, as action taken against one root does not necessarily affect the other roots. Perhaps we can best summarize our findings by suggesting what kinds of action will contribute toward a reduction of prejudice. These are *not* listed in order of importance but simply according to convenience of presentation.

1. One thing would be an intellectual appreciation by prejudiced people of the fact that prejudice harms them, financially and psychologically. Involved in this is a recognition that the gains that seem to come from prejudice are to some extent temporary and illusory. These gains, which can be classified as economic, political, sexual and prestige, sometimes divert the prejudiced person from more satisfactory and more permanent gains. Prejudiced people need to be shown how they are exploited because of their prejudice.
2. A second activity helpful in diminishing prejudice would be the provision of accurate information about the minority groups against which there is prejudice. This should include facts which break stereotypes, and explanations of the causes that give rise to differences between minority and dominant groups. Facts of this type are learned not only through books, newspapers and speeches, but through personal contact on a friendly and equal basis.
3. One of the most important traditions to combat is that of racism. This can be attacked not only when it is applied to minority groups, but also whenever biological explanations are applied to *any* social phenomenon.
4. Legislation which penalizes discrimination reduces the occasions on which prejudice is made to seem proper and respectable, as well as eliminating some of the worst effects of prejudice. Legislation against discrimination is thus one of the most important means of breaking traditions of prejudice.
5. A tradition on which prejudice is based can be maintained only by being transmitted to children. If the transmission of prejudice through the home and play group can be counteracted by the school and church while the child's mind is still flexible, prejudice cannot long survive. Also, if the public can be led to consider that manifestations of prejudice are shameful, many parents will refrain from displaying their prejudice in front of their children. Where this happens, children are less likely to acquire prejudice.
6. Direct efforts to solve major social problems will not only divert people from prejudice, but will remove some of the frustrations that create a psychological tendency towards prejudice. The most important single step of this type is the provision of economic security.
7. Demonstration that many of the fears about minority groups are imaginary might help to dispel those fears. There is probably a need to inculcate a more thorough understanding of the fact that fear or hatred of a minority group is a mere substitute for real or hatred of some other object, towards which people are unwilling to express their true attitude. A general programme of mental hygiene needs to be developed to get people to be honest with themselves.
8. Any effort to develop healthier and saner personalities will diminish prejudice. Such efforts usually require the guidance of psychiatrists.

A concerted programme which included all these activities would, in a generation or two, at least greatly reduce prejudice. But many of these activities are difficult to put into practice. Further scientific research is needed to indicate just how important each of these factors is, and how they can be manipulated most easily. Both research and action aimed at diminishing prejudice are under way in several countries. The future is hopeful if even a small group of people in each country is organized to eradicate this most serious blight on all civilization.

WATER COLOURS ON A GRAND TOUR

by Herbert Read



STILL LIFE WITH PIPE, by the Italian painter, Gino Severini (born 1883). New York Graphic Society.

GREAT works of art are notoriously bad travellers. Not so their sturdy stand-ins, the high quality reproductions that make up the UNESCO Travelling Art Exhibitions. These intrepid voyagers pass happily from continent to continent, from hot climate to cold, from green lands to desert, giving the great masterpieces of the world a previously inconceivable mobility and universality.

The first exhibition was assembled in 1949 from fifty quality reproductions of the work of artists from 1860 to the present time. Five sets were made and the object was to send them to stimulate interest in world art in countries that have little economic possibility of obtaining significant collections of their own. Brazil was host to the first display. After an astounding success in Rio de Janeiro, the exhibition toured the smaller towns. It was then scheduled to go to adjacent lands in Latin America, but the Government of Brazil set a precedent, and thereby started an unthought on sideline, the selling of exhibitions, by asking UNESCO for permission to keep the collection. The same fate awaited many of the others, which have found permanent homes in countries, not necessarily culturally impoverished, who have realised that the exhibitions fill a gap in their artistic life.

Since these early days five further exhibitions have gone on their way and been enjoyed by some 74 countries. The themes dealt with are: Paintings Prior to 1860, The Works of Leonardo da Vinci, Japanese Woodcuts, Two Thousand Years of Chinese Painting and Persian Miniatures.

A seventh Exhibition is now ready. It consists of 20 identical sets of 72 framed reproductions of water colours dating from the 4th century onwards. It already has world-wide bookings. On the following pages we publish an article on the water colours specially written for the exhibition by the noted British art critic, Sir Herbert Read.

IN a general sense, water-colour is one of the most ancient methods of painting—it was used in Egypt in remote times for the decoration of papyrus rolls, and in a similar way the sacred books of the Middle Ages in Europe were illuminated with pigments mixed with water and gum. Such early forms of the art, however, have very little in common with water-colour painting as it has developed in Europe since the eighteenth century. More comparable, from a technical and aesthetic point of view (the aesthetics of the art, as we shall see, are inseparable from the technique), is the early development of the art in the Far East. The art cannot, of course, be older than the invention not only of paper, but of the soft-hair brush (camel hair or hare's fur) and tradition attributes this invention to Mêng T'ien, who died about 210 B.C. Paper was not invented until about three centuries later. A scroll in the British Museum, *The admonitions of the instructress,* bears the signature of Ku K'ai Chih (*circa* A.D. 344-406) and may be a Chin dynasty copy of an earlier painting. One scene from this scroll illustrates a hunter in a landscape and this particular painting may be regarded as the prototype of the art as it was to develop in Europe many centuries later.

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CHINESE water-coulours always remained strictly subordinate to calligraphy—even Confucius lays down a law on this point ('Applying colours comes after the groundwork'). In Western terminology most Chinese paintings on paper should be classified as tinted drawings rather than as water-colour paintings. But the modern European tradition developed from the tinted drawing—it was the practice of painters from the fourteenth century onwards to make preliminary sketches in ink, reinforced by washes (usually of the same colour). An early example is a wash drawing in the Louvre by Taddeo Gaddi (*circa* 1300-1366) which is a preliminary study for the fresco of *The presentation of the virgin* in the Baroncelli Chapel, Santa Croce, Florence, For the next four centuries the technique remained ancillary to the arts of tempera and oil painting, and though such artists as Rembrandt and Rubens produced water-colour drawings of great beauty, it was only Dürer who used the medium as an end in itself—his landscapes in tinted water-colour anticipate the fully developed art of the eighteenth century.

The art of water-colour as we know it had an independent origin, as a miniature art within the capacity of travellers, topographers and illustrators of books on natural history. Pisanello's studies of birds (second quarter of the fifteenth century) may be taken as an early prototype and these are scientific records rather than works of art. Then in the sixteenth century the medium began to be used to record the discoveries of the early explorers—John White, who sailed with Raleigh, drew Indians in their various occupations, birds, plants and fishes. There were other topographical artists of this period in France (Jacques Le Moyne, for example) and in the Netherlands. An artist of this kind, Wenzel Hollar, came from Bohemia to England in 1635 and began to make tinted drawings of scenes in London and its neighbourhood. Hollar inspired Francis Place, a native of York, to make similar drawings of his city and its surroundings, and from that moment we can trace the continuous development of the English water-colour school—a tradition of landscape based on topography, from Hollar and Place through Samuel Scott and the Sandbys, Rooker, Hearne and Dayes, to Girtin and Turner.

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THE medium was also used skilfully by the Tudor and Stuart miniature portrait painters, notably by Nicholas Hilliard (1537-1619) and Samuel Cooper (1609-1672). But here again the European artists had been anticipated by the Chinese artists as we may see in the portraits by Yen Li Pen and Liang K'ai included in the exhibition.

From the middle of the eighteenth century water-colour painting became the most characteristic art of England, and even this country's greatest oil painters, Gainsborough, Constable and Turner, found in it an essential medium of expression. This efflorescence of the art lasted barely a century, but in that relatively short period artists like J. R. Cozens, Francis Towne, Thomas Girtin, J. S. Cotman, Peter de Wint and David Cox gave to the art, not only its highest perfection, but also a distinct aesthetic.

Cont'd on next page

GENTIL BERNARD and **ROUSSALKA,** by French painter Georges Rouault (1871-1958). Guy Spitzer, Paris.

WATER COLOURS ON TOUR (Continued)

PORTRAIT, a work by the French painter Jacques Villon (born 1875). Daniel Jacomet et Cie, Paris.

KINGDOM OF THE BIRDS, by the Swiss painter Paul Klee (1879-1940). Benteli Verlag, Berne.

An art can have a distinct aesthetic only if it has distinct materials, a distinct technique and a distinct aim. The materials of water-colour painting are translucent pigments, applied with a soft brush to a ground of white paper. Each of these materials has its special characteristics — the colours must be pure, the brush must be well-made of the finest hairs, the paper must have its own-sensuous quality, for very different effects can be obtained according to its roughness or smoothness, its degree of permeability and its whiteness. The technique of applying the colours to the paper will vary from artist to artist, but as compared with tempera or oil painting, great sureness and precision is required, for there is no possibility of overpainting or retouching. The art gets its most distinctive quality from its necessary spontaneity, and in this respect may be compared with the calligraphic art of the Far East. The aim, as in any other type of painting, is to create a harmonious composition in colour on a two-dimensional surface, but until comparatively recent times the medium has been applied almost exclusively to the depiction of landscapes. This is because the subtlety of the medium allows for the rendering of nuances of tone and colour beyond the range of tempera or oil.

Amateurish blots, clots & speckles

This capacity of water-colour is brought out in remarks of Ruskin on one of the later masters of the English water-colour school, Copley Fielding: "Water-colour, under the ordinary sketcher's mismanagement, drops and dries pretty nearly to its own fancy, slops over every outline, clots in every shade, seams itself with undesirable edges, speckles itself with inexplicable grit, and is never supposed capable of representing anything it is meant for, till most of it has been washed out. But the great primary masters of the trade could lay, with unerring precision of tone and equality of depth, the absolute tint they wanted without a flaw or a retouch ; and there is perhaps no greater marvel of artistic practice and finely accurate intention existing, in a simple kind, greater than the study of a Yorkshire waterfall, by Girtin, now in the British Museum, in which every sparkle, ripple, and current is left in frank light by the steady pencil which is at the same instant, and with the same touch, drawing the forms of the dark congeries of channelled rocks, while around them it disperses the glitter of their spray.

"Then further, on such basis of well-laid primary tint, the old water-colour men were wont to obtain their effects of atmosphere by the most delicate washes of transparent colour, reaching subtleties of gradation in misty light, which were wholly unthought of before their time. In this kind the depth of far-distant brightness, freshness, and mystery of morning air with which Copley Fielding used to invest the ridges of the South Downs, as they rose out of the blue Sussex champaign, remains, and I believe must remain, insuperable, while his sense of beauty in the cloud-forms associated with higher mountains, enabled him to invest the comparatively modest scenery of our own island—out of which he never travelled—with a charm seldom attained by the most ambitious painters of Alp or Appenine."

This remarkable passage manages to detail, not only all the characteristic virtues of the water-colour medium, but also its characteristic shortcomings. There is no doubt that the English school, particularly in Girtin and Turner, reached a perfection in this art which has never been excelled, and Ruskin, in *Modern Painters,* extolled the art with an insight and an eloquence that also have never been excelled. But Turner, by his technical virtuosity and overwhelming achievement, virtually brought the art to an end—only Cotman, seven years his junior, was strong enough to maintain an independent style: one might say, to maintain the tradition which Turner was destroying. For Turner, in his last phase, left far behind the topographical aims with which the art had originated. Always, as Ruskin had noted, primarily concerned with the light and colour of the scenes he depicted, he now

became absorbed with the elements themselves, freed from their incidental relation to physical objects. Writing about the late transparent water-colours of Venice and Switzerland, Laurence Binyon says truly that "the elements, in their energy and radiance, mean more and more to Turner, the works of man less and less. At first sight it is the miracle of the colour, the luminousness, the indescribable delicacy, that holds one ; but soon one marvels more at the amazing science behind it, the evocation of complex forms, however submerged in aerial hues, the fullness of the distances. It is the same with the alpine scenes, where the mountains retain their sculptured form yet seem built of light and air ; the lakes are unfathomable, the valleys recede into an infinite distance. The design is all in depth ; whorls of curving cloud lead the eye on and on into a vibrating mystery of light, which unifies the whole fabric of earth and air and water. Never had painting communicated with such subtlety and power the sense of infinity. For it is not merely the sense of infinite recession that it gives, the attraction of a final peace, such as we find in the Umbrian painters ; it is space conceived as something living, as a power which draws our spirits into itself but also wells out in impalpable radiance from the picture and absorbs and envelops our minds."

Turner : unrivaled by latter-day artists

WHEN we survey the century that has passed since Turner's death, we can discern no use of the medium by any painter of any country in the world that can compare with such intensity of vision and mastery of expression. Only Cézanne comes into comparison, and Cézanne's water-colours are essentially preparatory exercises for his paintings, quick notations of form and contour of great delicacy that perhaps express an ideal which he had hoped to achieve in his oil paintings. But from his letters it is evident that he never regarded water-colour as more than a convenience ; only towards the end of his life, when he was finding the effort demanded by oil painting too exhausting, did his water-colours become a self-sufficing medium of expression.

Apart from Cézanne, there have been perhaps only two significant developments of the art—one which might be said to exploit the freedom of Turner's last phase, without his sense of infinity; the other using the medium in a manner which would never have occurred to Turner or any of his predecessors—to convey symbolic images. Gauguin, with some help from medieval illuminations and Japanese coloured woodcuts, might be said to have revived the symbolic mode, and he has been followed by Kandinsky, Klee and Miró. The other mode, which we now call expressionist, has had a continuous development beginning with Van Gogh and extending to Nolde, Kokoschka, Rouault, Soutine and Sutherland. There are several artists who do not fit into these general categories —impressionists like Jongkind, Steer and De Pisis who continue the tradition of Constable or Girtin; and others, like Turner himself, who transcend all categories—notably Picasso. The art has lost what gave it its distinctive aesthetic—its desire to render the subtlest effects of atmosphere; but what it has lost in subtlety it has gained in power. But this power, in a Rouault or a Nolde, usually demands the addition of body colour, and once the translucency of the medium is sacrificed, the medium itself has been transformed. Artists like Klee and Miró have used the medium for new effects, subtle in a psychological rather than an atmospheric sense ; but finally it is an essential attitude of mind or spirit that is lacking in the modern artist—the quality which in Chinese aesthetics is called Ch'i yün. "Ch'i yün", explained the eighteenth-century painter Chang Kêng, "may be expressed by ink, by brush-work, by an idea, or by absence of idea... It is something beyond the feeling of the brush and the effect of ink, because it is the moving power of Heaven, which is suddenly disclosed. But only those who are quiet can understand it."

Science has the answer

WHAT IS THE CAUSE OF TIDAL WAVES?

by Gerald Wendt

THE primary causes of tidal waves are large earthquakes. Out at sea such waves are hard to detect because, though they travel at a speed of about 400 m.p.h., they are only a few feet high. The distance from the crest to the trough is some 15 miles long, and the wave period takes several minutes to pass by. When the tidal wave reaches the shallow water near a land mass, however, the front is slowed down and the fifteen miles of water piles up to form a steep-fronted surge that can wreak tremendous havoc as it hits the land.

In the Krakatoan earthquake, which occurred between Java and Sumatra towards the end of the 19th century, there were enormous casualties because the earthquake took place in shallow water close to the land and waves as high as 100 feet piled up and swept inland.

In the Pacific area where tidal waves cause tremendous havoc, ordinary earthquake phenomena are not easy to observe since many parts of the ocean are extremely deep. But a series of seismograph stations set up to detect 'quakes in the area can give advance warning of tidal waves.

The sound waves produced by earthquakes travel through the ground at a speed of about 5 miles a second—that is, much faster than tidal waves. When seismograph stations record large 'quakes, the exact arrival time of the beginning of the ground waves are compared, and from these the position of the earthquake can be calculated. Since tidal waves travel at roughly 400 miles per hour, it is relatively easy to predict their time of arrival at places where damage may be expected.

Why is sea-water salt and how does it retain its saltiness?

WHEN the hard rocks of the earth's crust are thrust up to form mountains they are exposed to the weather and thus to the chemical action of water, oxygen and carbonic acid from the air, and to alternate heating by the sun and cooling by frost and ice. They slowly crumble, which speeds the chemical action and permits the attack by plants also. The result is disintegration into gravel, sand and ultimately soil. Most of the products of this decomposition are solid materials that remain near by or tumble down the brooks and rivers. But others dissolve in the rain-waters and remain invisibly in the waters of the rivers. Thus all "fresh" water—except pure rain-water—contains a small but definite quantity of these dissolved "salts". Water that is called "hard" contains relatively large quantities.

All rivers run to the sea and carry the salts with them. In the course of the millions of years of geological time the salt has accumulated in the sea because evaporation from the surface takes only pure water and leaves the salt behind. As the rain falls and returns to the sea in rivers it brings more salt with each cycle. Thus the saltiness of the sea is slowly but steadily increasing. The fresh water from the rivers does not dilute the ocean and make it less salty because just as much water evaporates as the rivers pour in.

The level of the sea remains constant and so the salt-content slowly increases in the course of the centuries. At present the salt content of sea-water amounts to 35 parts per thousand. This means that one metric ton (2,000 pounds) of sea-water contains 70 pounds of salts. With only minor variations due to local conditions, it is the same in all the oceans, the world over.

Why does the moon exercise an influence on phenomena of life on earth?

THE centrifugal force of the moon is just sufficient to maintain it in its orbit and at a distance of about two hundred and fifty thousand miles from the earth. But neither the moon nor its centrifugal force have any direct influence on any phenomena of life on earth.

However, the moon—and the sun, too—have a direct and important bearing on the various "tides" which occur on our planet—the movements of the magma, or fluid strata under the earth's crust, the tides of the oceans, seas and lakes, and also the atmospheric "tides" which cause variations in height of the ionosphere. All these tidal movements have different but very indirect consequences on earthly phenomena. Another, and by no means negligible contribution on the part of the moon is that it periodically lights our night sky.

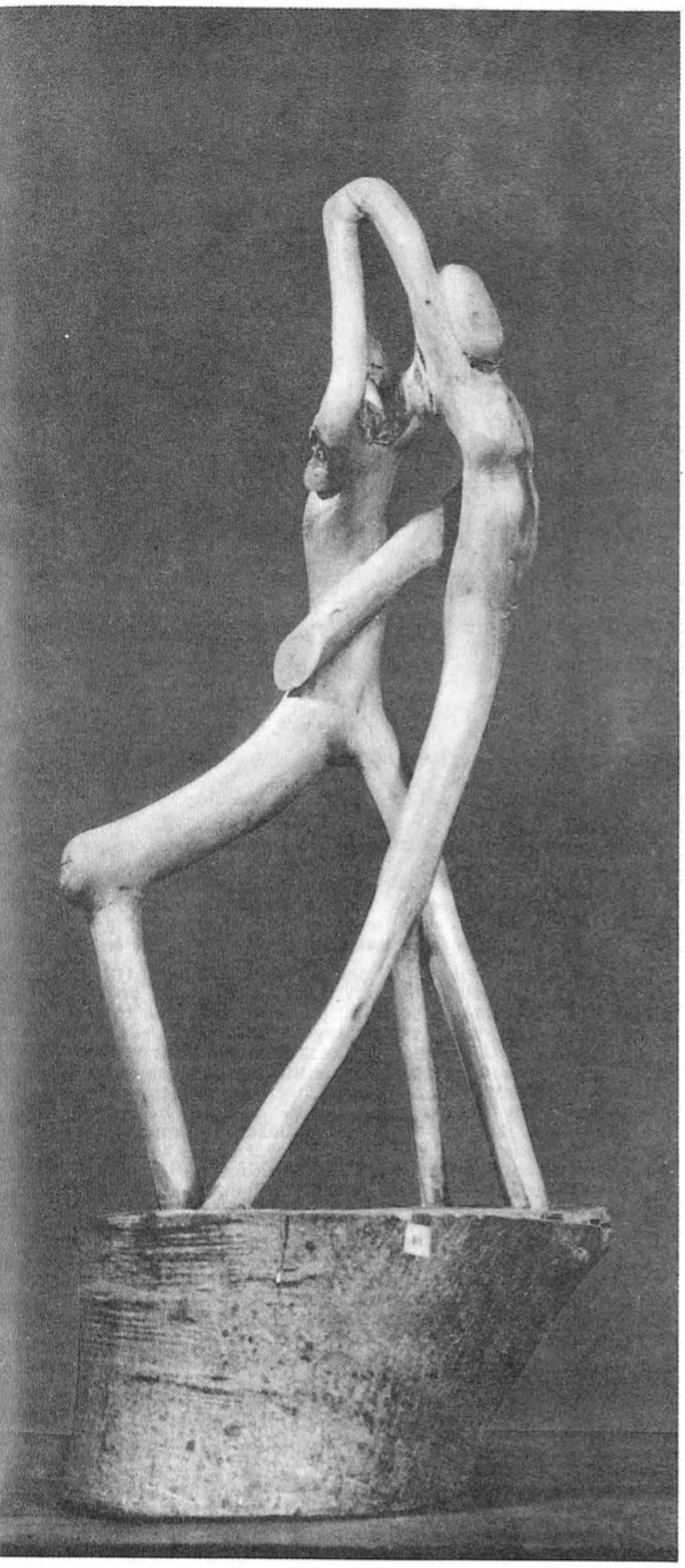
But apart from this the moon plays no part in any phenomena of life on earth. And all theories tending to prove that its rays influence the destinies of human beings are without foundation, for no such mysterious radiations have ever been detected by astrophysicists.

What would happen if the earth's ice caps melted completely?

IT is a fact that glaciers are receding in all parts of the earth, which indicates a slight warming of the average temperature. But it has not yet been established that the polar ice-caps are also melting. This would require an extended series of measurements of the thickness of the polar ice, which have not been made. But this is one of the objectives of the present International Geophysical Year.

The thickness of the ice on the Antarctic Continent is especially important since about 90 per cent of all the earth's snow and ice is there. It has been estimated to be between 2,000 feet and 8,000 feet thick on the average. At some points it is certainly 10,000 feet thick. If all this ice should melt, the level of the ocean would rise at least 85 feet and possibly 400 feet, which would indeed submerge most of the great seaport cities.

A Californian expert, Professor Robert P. Sharp, has estimated for the American Geophysical Union that the average of the Antarctic ice is in excess of one mile and that its complete melting would raise the sea-level all over the earth by 200 feet. He calls this ice "something of a Sword of Damocles hanging over the heads of all peoples living close to the sea." However, he also advises a relaxed attitude toward this possibility. It cannot happen fast. "Conceivably", he says, "it might happen in 10,000 to 20,000 years."



With pieces of leather, straw, felt, etc. Mrs. Arjun Ray has created strange pictures, statuettes, which at first seem to be made of porcelain, but which are really shells... and especially pieces of wood, the most beautiful of all her work. You cannot really call it sculpture. The sculptor chooses his medium, then, after a good deal of effort, he creates a form. No one save he can foresee what its shape will be; he alcone decides. Here, on the contrary it is the wood which decides. A wealth of forms and patterns lie hidden in these twisted roots and dead branches. The artist has merely helped to bring them to life.

IDEAS HIDDEN IN ROOTS AND BRANCHES

by Georges Fradier

A few years ago, when a collection of essays, richly illustrated with children's drawings and paintings, was published by Unesco under the title, *Education and Art*, a schoolteacher friend from the Alps wrote to me to say how absorbing he had found this beautifully presented volume. "But let us not fool ourselves," he added at once. "I have nothing against children dabbling with paints and having fun expressing themselves freely. The trouble is that by the time they reach ten or eleven it's all finished. Their feeling for colour and their imagination have flown out of the window.

"I admit that it's not the same in the big cities where children can get a fresh start at that age. They have big museums they can go to and, provided someone is in the least bit interested in showing them, they can be introduced to the world of art and its pervading atmosphere. But where I live there is just nothing that even faintly resembles the world of painting or sculpture.

"And I don't think that people are born with such a thing as an artistic sense. At any rate the old people up here, who have never had any initiation into art, spend their whole life without ever noticing the majestic beauty of our scenery. When I point out to my pupils how beautiful the pine trees are they merely shrug their shoulders and say: 'Yes, but with the cost of transport timber is hardly worth selling any more'."

I have waited until now to answer my friend's letter. Not that I have discovered any new method of solving his problem that would be hailed by educators and art authorities. It is simply that I have met an artist who, I think, could inspire even the most rough-and-tumble child with a feeling for beauty and taste for creative work.

This artist is a woman, and she is a practical person not a theorist. She has neither degrees nor diplomas. She is the wife of an important Calcutta architect, with children of her own and a large household to run. When she speaks of her work it is in a shy, diffident manner: "I don't even know if it's worth anything," she says.

By "it" she means strange art objects made of leather, straw, felt or cloth, figurines which at first seem to be made of porcelain but which are really shells... and especially pieces of wood, the most beautiful of all the works produced by Mrs. Arjun Ray. Sculpture is really not the word for them. The sculptor chooses his medium himself and after a good deal of work creates a form, which only he decides on and elaborates, Here, on the contrary, it is the wood which decides.

A twisted root, a dried-up branch. In each of these a form and pattern liees hidden. One needs only to spot it, and then help it a little so that it springs to life.

One figurine is called "After Me Cometh One." Mrs. Ray did not get up one morning saying "I'm going to do a statuette of St. John the Baptist." She found a branch lying on the grass split at one end and shaped like a trident at the other. She picked it up, and saw in it the image of an ascetic prophet, arms raised skyward. Someone else probably would not interpret it in the same way as she did. At any rate, on returning home, Mrs. Ray scraped off bark in places, removed a knot in the wood, deepened a notch and accentuated the outline. And there, suddenly, was the prophet, clad in a goat skin, "crying in the wilderness."

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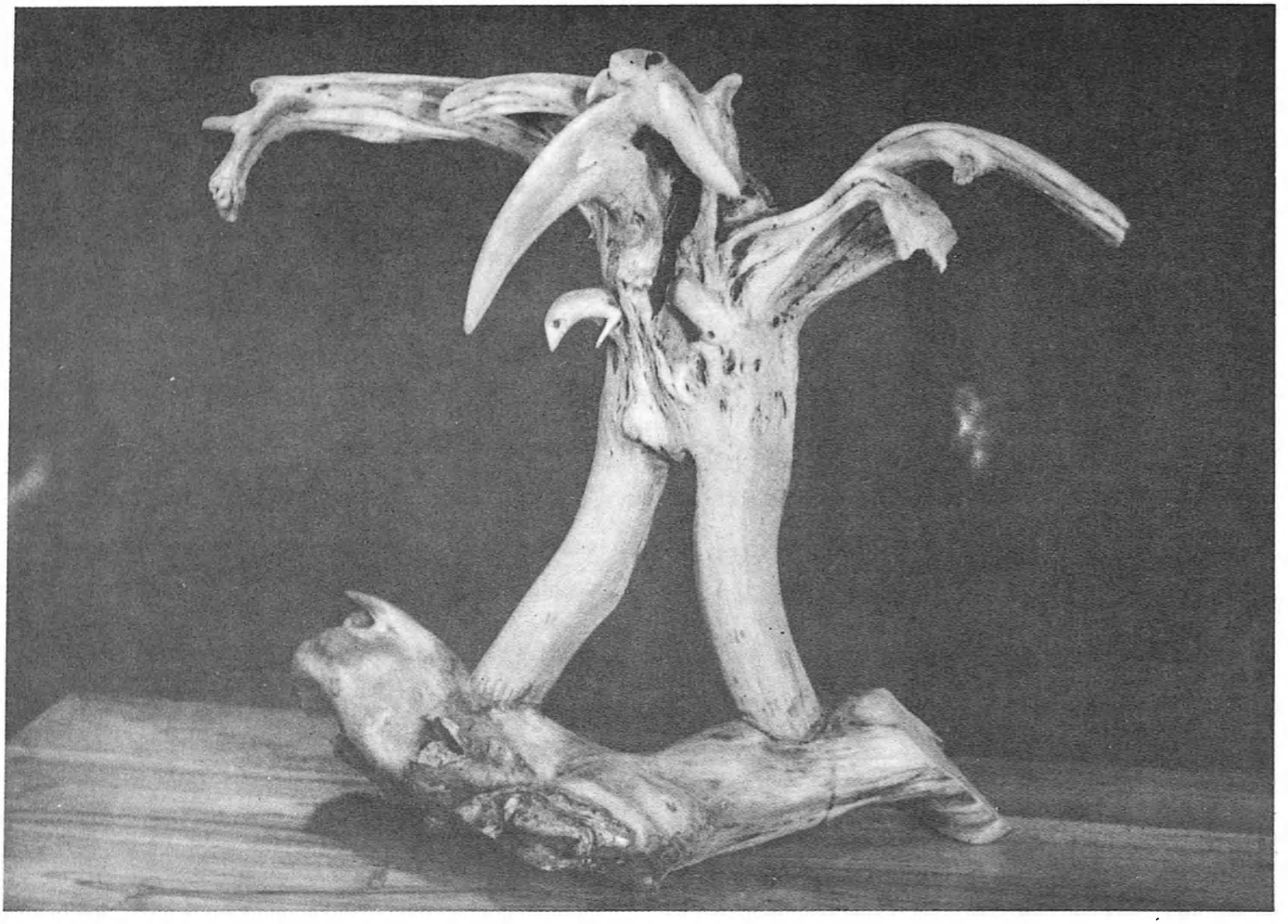


Polished, varnished and impregnated with oils (to protect them from insects and humidity) but never painted, the pieces of sap-wood, bark or root, become true works of art once mounted on a base.

Anyone, irrespective of his age or educational background, will recognize them as "living" shapes: two wrestlers struggling desperately together, a screaming monster, the great hand of Peace. Yet without Mrs. Arjun Ray these same persons would never have seen anything more than twisted roots and brambles and branches of deodar, cedar and gardenia.

It seems to me that my teacher friend might draw a useful lesson from the work of the lady in Calcutta. I repeat, there is nothing novel about what she has done. But a lesson need not be an original revelation to be useful. A sense of form stems from things seen rather than from notions acquired. Or to put it another way, sense and taste for form depend first of all on knowing how to look at things. Paul Valéry once wrote: "Examine all things on earth as though you had never seen them before." Mrs. Arjun Ray sees a frail dancer in a broken twig which a dozen people have passed by without a thought. In much the same way a painter sees limitless patterns of shape and colour in a simple composition of objects which the layman vaguely describes as "a window, a table and a flower pot."

Where is there a child between four and six who does not inspect everything around him with infinitesimal attention and interest? Not of course in as sophisticated and learned a fashion as does the painter, but the conception at least is the same. All children are sensitive to the suggestion of form, and their world is rich in images and metaphors. A pebble is always something more beautiful than a pebble ; a leaf is like silk, or like a face, or like a butterfly. The child collects scraps of old paper or old buttons just as he does sea shells or birds. Gravely and matter-of-fact, grownups put everything into categories and classes: "This is mineral so and so, that is mountain so and so. This is clean; that is dirty". But the child's mind says: "It's like..." A lion. An angel. A shoe "It's like...": the very first beginnings of graphic art.

And one might well ask oneself whether the role of the teacher—in this field only, obviously—should not be to permit their 10- and 12-year-old pupils to continue their game of make-believe by permitting them to go on searching for images without shame. Let them keep their vision of a world which is profoundly fascinating because of its infinite variety, and because everything around us is worth seeing, and each thing in turn suggests another, indeed a thousand other things. To allow children to escape for as long as possible from the impoverishment which characterizes adults whose view of life is limited to things useful, conventional and efficient is to remain an artist.

By learning to see, to feel and imagine, children learn to detach things from their surroundings. The strollers who did not notice the twig from which Mrs. Arjun Ray produced the figure of a dancer cannot fail to recognize the finished work: the dancer stands gracefully poised, ready to spring to life. True the artist has added a few touches to the guava branch, revealing what *she* could already see. But what really brings the dancing girl to life is that she stands out alone on an empty background. To use a rather worn simile: on a wall covered with pictures, each one is invisible.

I suggest, therefore, that my friend from the mountain school should get his pupils to display in class once or twice a week the natural "treasures" picked up during a walk, polished and "brought to life" by some minor alteration. At first they will believe that the form or pattern is due chiefly to chance. But, gradually, they will come to understand that no thing of beauty—whether it be a branch, a fir tree, marble or precious stone—is really beautiful until our eyes have "learned to see" it. There is enormous scope for children in this "game".

Mrs. Arjun Ray does not work only with dead wood. She uses feathers, shells, and even pieces of coal; a touch here, a slight twist there and the image springs to life. And she marvels: "What a wealth of ideas, forms and shapes lie hidden amid the trees and shrubs around us !"

Letters to the Editor

ASIAN SUBJECTS--A BORE...

Sir,

You have published some extremely interesting numbers which deserve congratulations, but there have been far too many dealing with India. There are other places in the world besides Asia.

R. de Cotignon
Paris, France

...OR SOURCE OF SELF KNOWLEDGE?

Sir,

In making better known the culture of the East—among other cultures—you are not only bringing different peoples closer to one another, but also opening up to Western nations the deepest well-springs of their own civilization.

A. Chatillon
Lausanne, Switzerland

AIR DENSITY 500 MILES UP

Sir,

Last November you published an article entitled "A Soviet Scientist Looks At 'Sputnik'," in which the author, K. Staniukovich writes: "The density of air at an altitude of 500 to 550 miles is so small that it evidently does not exceed 10 to 18 grammes per cubic centimetre." This figure is just about the density of lead and of platinum. What it should have said is 10 to 18 grammes per cubic metre, in other words about one million times less.

M. H. Friedel
Paris, France

'DIGESTS' & FIGURES

Sir,

THE UNESCO COURIER covers subjects which are so vast that they have to be reduced to a sort of "digest" or presented as statistics. As a result your magazine is perhaps of great use to people who do not make a point of reading specialist articles published by the daily press or to those who read few or no books at all. The subscription price is reasonable, and in several issues you have published reproductions of ancient works of art in places we would normally be unable to visit. However, if I wish to improve my mind through reading I feel I can do better by going along to my local library.

S. Delessert
Dully, Switzerland

GREETINGS FROM MOLDAVIA

Sir,

I am the village schoolmaster of Nagoriany in the Moldavian Republic of the U.S.S.R. While visiting Kichinev I was able to buy a copy of THE UNESCO COURIER to which I had been attracted by its striking appearance. On reading it I found its contents to be just as interesting and attractive as its cover and its presentation, and I noticed that the opinions of readers did not always concur with those of UNESCO or of the editors of the magazine.

We are very keen to contact schools in other lands, to exchange knowledge and ideas with them, to get to know our foreign colleagues really well and to develop mutual confidence, hoping that wisdom throughout the world will bar the road to collective suicide.

Victor Kassianenko
Rychkany Post Office
Nagoriany Village School
Soviet Socialist Republic
of Moldavia, U.S.S.R.

HIGHER STANDARDS PLEASE

Sir,

I should like to congratulate you on the care and objectivity which goes into the production of THE UNESCO COURIER. Quite rightly you adopt a position which is above all the political problems dividing the world, so that you see the world only from the humanistic viewpoint. Well done! It enables people of all nationalities, religions and races to recognize the things that bring them closer together and reminds them that they must make a common front to overcome all the problems facing them.

Your issues deal with problems of the greatest interest and, above all, your special numbers like "The Conquest of the Desert" and "Twenty-five Centuries of Buddhist Art and Culture" give one a precise view of certain problems.

However your treatment of some other questions is too superficial and leaves us with a thirst for more facts about the problems you have dealt with—a thirst that you alone with your world-wide documentation can satisfy.

I know that some of your readers would protest at the idea of raising the intellectual and scientific level of your magazine, and would accuse you of failing to remain in the realm of popular understanding. But I believe it is preferable for the diffusion and influence of THE UNESCO COURIER to raise rather than to lower its level. It is through contacts with highminded ideas that human minds are exalted.

What I am really sorry to see is your magazine looking like some small popular publication when it should remain as a review devoted to the study of the urgent human problems which face humanity today.

Pierre Ouette
Courbevoie, France

INTERNATIONAL COOKING

Sir,

I am president of a small club—the United Nations Youth Fellowship—which is a junior branch of the U.N. Association in Adelaide. Our 150 members include many nationalities, including Europeans and Asian students. We have had little contact with similar U.N. youth groups in other parts of the world. Perhaps we might be able to compare our activities and interests through THE UNESCO COURIER. Has there been an issue of THE UNESCO COURIER on international cooking and ways of eating yet? I'm sure we have much to learn here in Australia on that subject.

A.C. Adams
North Adelaide, South Australia

Ed. Note : See THE UNESCO COURIER, *April* 1957 (*"The Food We Eat"*) *which included recipes from an international cookbook published by the U.N. Nursery School, Geneva.*

FOR HUMAN SOLIDARITY

Sir,

By giving us useful and detailed information about different peoples, your magazine broadens our outlook on the world. We often think only in terms of a single civilization—our own—but THE UNESCO COURIER puts us into contact with others. It also enables us to keep abreast with questions of particular interest to the modern world. You are achieving a great deal, for you bring home to us the real meaning of human solidarity...

Madeleine Catella
Lyons, France

ESSENTIAL PUBLICATION

Sir,

Let me offer a word of profound appreciation and gratitude for THE UNESCO COURIER. I have arranged to have it supplied to this office as an essential publication. And my successor (on my retirement), Stuart Jackman, will continue the arrangement.

Leonard Hurst
London Missionary Society

'AUXILIARY ENCYCLOPEDIA'

Sir,

I have been a regular reader of your magazine since 1953 and I have consistently admired its class and appearance. All the issues I have read and kept since that time now constitute a kind of supplementary encyclopedia of the scientific, cultural and philanthropic activities of the nations. I was particularly struck by the issue of May, 1958 ("World Health: Ten Years of Progress".) It showed not only the technical difficulties arising out of public health problems around the world, but also brought home strongly to me the reasons why nations must unceasingly link their efforts to track down and wipe out epidemics on every continent.

J.M. Robillard
Montreal, Canada

From the Unesco Newsroom...

For reasons beyond our control the schedule of publication of THE UNESCO COURRIER has been considerably delayed. We ask our readers' continued indulgence and hope that the normal date of delivery will shortly be re-established.

HANDIER 'TALKING BOOKS': A project designed to give blind readers handier "talking books" and up to ten times as many as they now have by reducing production costs per book is being investigated by the United States Library of Congress, which is now studying the production of 8 1/3 rpm. recordings and record players. Record players would be smaller, lighter and more durable than present ones and smaller records could be mailed more easily. Records for each book would be reduced by three-quarters. Hemingway's *For Whom the Bell Tolls* would require only six records instead of 22 as today.

■ **TRAILING THE LOCUST:** *A combined Food and Agriculture Organization-*UNESCO *team left Europe recently to study the ecology of locusts in the Sudan and the Chad Territory, in Africa. This was the first of a series of similar expeditions scheduled for* 1959 *and* 1960 *which will cover the whole locust-infested area spreading from Morocco to India, through Africa and the Middle East. The present team consists of George Popov, an expert on locusts from the United Kingdom (appointed by the FAO) and Charles Rosetti, a Swiss plant ecologist (nominated by* UNESCO). *Together with Sudanese assistants they will study relations between vegetation, climate and soil and the proliferation of locusts.*

TWENTY-NINE FOR FREE FLOW Austria has become the 29th country to join a UNESCO-sponsored international agreement exempting books, newspapers, magazines, works of art and music scores from import duties. Also exempt are newsreels, educational films, sound recordings and scientific equipment if consigned to approved institutions. Besides lifting import duties, the agreement grants import licences and foreign exchange for books needed by public libraries. The agreement forms part of UNESCO's programme to promote the "free flow of ideas."

■ **ASIA IN THE CLASSROOM :** *Several thousand schoolchildren in the United Kingdom have recently been hearing special talks on Asian countries sponsored by the Council for Education in World Citizenship. These lectures were organized in co-operation with the U.K. National Commission for* UNESCO *in connexion with* UNESCO's *Major Project to encourage East - West understanding. The talks dealt either with one of four Asian countries — China, India, Indonesia and Pakistan — or with the changing situation in Asia generally, and were given by experts who had lived in the countries as well as by members of the staffs of Asian embassies.*

HANDLING ISOTOPES SAFELY: Safety recommendations for persons handling isotopes have been drawn up by experts from ten countries invited to Vienna by the International Atomic Energy Agency (IAEA) of the United Nations. These recommendations cover packaging, transport, use and disposal of radio-isotopes based on knowledge about the effect on health of varying degrees of radiation and permissible radiation levels. The IAEA is to work out health and safety codes for a wide range of operations in the atomic field and its work is being co-ordinated with that already carried out by other international organizations, particularly the World Health Organization and the International Labour Organization.

■ **NOW EIGHTY STRONG:** *The Federation of Malaya has now joined* UNESCO, *bringing the total number of Member States to* 80. *The Federation has taken part in* UNESCO's *work for the past four years as an Associate Member State. After proclaiming its independence in August* 1957, *it applied for membership of the United Nations and was admitted on September* 17. *The Federation of Malaya produces about half of the world's natural rubber and a third of its tin. Almost half of its six million people are Malay, more than two and a quarter million are Chinese and nearly* 750,000 *are Indian or Pakistani.*

A WOMAN'S NATIONALITY : A United Nations Convention on the nationality of married women and under which a wife may retain her nationality irrespective of marriage or divorce, or change of nationality by her husband, became effective last month. New Zealand was the latest country to sign it early in July. It had previously been ratified or acceded to by Ceylon, Cuba, the Dominican Republic, Ireland, Israel, Norway, Sweden and the United Kingdom.

■ **RIVER-BORNE MUSEUM:** *People living in provincial cities along the banks of the Vistula River in Poland who have little opportunity of travelling to Warsaw and seeing its big museums are now receiving visits from a floating museum. A pleasure steamer, the "Golden Duck" has been specially equipped to house some* 200 *items from the Warsaw Museum of Popular Art and Culture on Africa, Indonesia, Oceania and the Americas. Photographic panels illustrating the life, customs and architecture of these areas have been installed on the upper deck of the ship, while the exhibition itself, arranged on the lower deck includes weapons from Africa, statuettes carved by Eskimos, dancing masks from Africa and marionettes used in Indonesian shadow plays.*

SPOTTING BIRDS BY RADAR: Radar is most likely to become an invaluable tool for ornithologists studying migration habits of birds, according to Dr. David Lack, a British scientist. Radar echoes from birds were first identified during the war at listening posts working on aircraft interception in southern England. For security reasons these findings were not revealed, but Swiss scientists independently made similar discoveries and published their findings. In recent experiments high-flying and mist-concealed flocks of migrant birds which would normally have passed unnoticed have been detected. Dr. Lack predicts that radar may prove as important in research on bird migration as the sound spectrograph has proved in the study of bird-song.

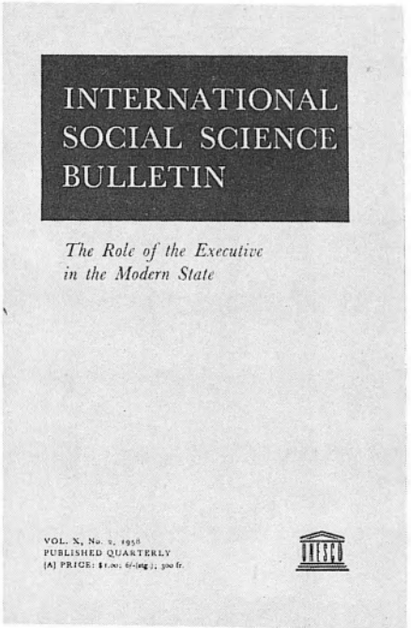
Imp. GEORGES LANG, PARIS. IMPRIMÉ EN FRANCE.

AN IMPORTANT SURVEY OF THE ROLE OF THE EXECUTIVE IN THE MODERN STATE

At a moment when the people of France are being asked to pronounce themselves on a new Constitution, the current issue of UNESCO's International Social Science Bulletin (Vol. X, N° 2) will interest readers with its timely survey on "The Role of the Executive in the Modern State".

The issue is based on a series of studies carried out last year by UNESCO'S Department of Social Sciences in six countries : France, Canada, U.S.S.R., U.S.A., United Kingdom, and Yugoslavia. An extensive amount of supplementary information was collected from correspondents in nine additional countries, which has resulted in a clear and detailed presentation of the current political scene.

The major section of the issue is devoted to separate surveys on each of the six countries studied, revealing the great diversity of background and the impossibility of generalizing on the role of the executive in contemporary society. In a preliminary article, Professor Jean Meynaud, of the University of Lausanne and the Ecole Pratique des Hautes Etudes, Paris, examines the commonplace remark that "parliamentary assemblies are ill-suited to the new responsibilities assumed by 20th century governments and that the larger share of these responsibilities has devolved upon the executive branch." He reviews the executive's tasks and responsibilities, his relation to the governmental system and to the administration, his reaction to pressure groups and political parties, and examines the delicate topic of the reform of the executive.

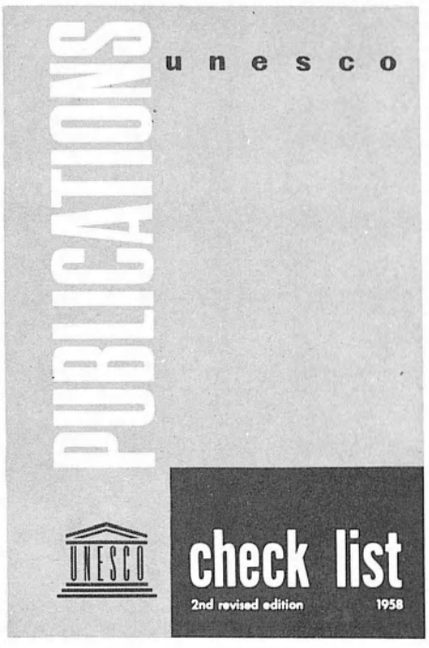


The International Social Science Bulletin appears quarterly in English and French, its contributors being recognized specialists in the fields of scientific interest chosen as the subject of each issue. It can be obtained from booksellers or directly from UNESCO distributors listed below at a price of U.S. $ 1.00; 6/-(stg); or 300 F. frs per issue. Annual subscription rate : U.S. $ 3.50; 21/-(stg); 1,000 F. frs (these rates apply only until Jan. 1. 1959, when an increase will go into effect).

Titles of some recent issues of the Social Science Bulletin : THE NEGRO IN THE UNITED STATES OF AMERICA (Vol. IX, N° 4); SOCIAL CONSEQUENCES OF AUTOMATION (Vol. X, N°1); DISAPPEARING CULTURES (Vol. IX, N° 3).

GUIDE TO UNESCO PUBLICATIONS

The second revised edition of the Check List of UNESCO publications has now been published. Free copies can be obtained from UNESCO'S National Distributors or by writing to UNESCO Sales Section, Place de Fontenoy, Paris. The latest Check List contains alphabetical lists of the following: (a) Titles of all UNESCO publications in English available for sale as of April 1, 1958. (b) All UNESCO periodicals currently published. (c) Current series or collections of UNESCO publications. (d) Currently available UNESCO publications in French or Spanish of which there has been published no equivalent English edition.



WHERE TO OBTAIN UNESCO PUBLICATIONS

Order from any bookseller, or write direct to the National Distributor in your country (See list below; names of distributors in countries not listed will be supplied on request). Payment is made in the national currency; rates quoted are for an annual subscription to THE UNESCO COURIER in any one language.

AFGHANISTAN. — Panuzaï, Press Department, Royal Afghan Ministry of Education, Kabul.
AUSTRALIA. — Melbourne University Press, 369 Lonsdale Street, Melbourne, C. 1, Victoria. (A. 13/-)
AUSTRIA. — Verlag Georg Fromme & C°., Spengergasse 39, Vienna V (sch. 37.50.)
BELGIUM. — For The Unesco Courier: Louis de Lannoy, 47, rue du Midi, Brussels, C.C.P. 338.000. (fr.b. 100.) Other publications: Office de Publicité, 16 rue Marcq, Bruxelles, CCP 285-98; N.V. Standaard-Boekhandel, Belgiëlei 151, Antwerp.
BRAZIL. — Livraria Agir Editora, Rua Mexico 98-B, Caixa Postal 3291, Rio de Janeiro.
BURMA. — S.P.C.K. (Burma) 549, Merchant Street, P.O. Box 222, Rangoon.
CANADA. — The Queen's Printer, The Superintendent of Publications, Ottawa, (Cn .)
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YUGOSLAVIA. — Jugoslovenska Knjiga, Terazije 27/II, Belgrade.

HOUSE IN A HONEYCOMB

Nature's geological tricks with wind and water have sculpted Cappadocian Plateau, Central Turkey, into one of the most bizarre volcanic landscapes in the world. Early Christians hacked out cells and chapels in the cones, and today, Turkish farmers and their families dwell in many of the honeycombed rocks. (See p. 18).

Marc Riboud-Magnum Photos