PHYSICS

Sun-Powered Furnaces

Sunshine concentrated by mirrors can give science high temperatures, more than 6,000 degrees Fahrenheit, to test materials for missiles and atomic power plants.

By WATSON DAVIS

➤ AT A TIME when nuclear bombs and atomic reactors are considered tops in high heat and energy, scientists are turning to the sun for thousands of degrees of temperature to use in experiments to develop temperature-resisting materials.

The sunshine is concentrated by telescope-like devices to produce heat of more than 6,000 degrees Fahrenheit.

The fuel is free. And the intense heat is produced in an atmosphere free of burning gases, bits of electrodes and other impurities, a decided advantage when the experiments are concerned with materials that have to be kept pure.

Rivaling the heat of electric arcs, hydrogen-oxygen torches and other such sources, solar furnaces are likely to become one of the more usual tools of research laboratories as a relatively cheap, convenient and safe producer of high heat.

Many New Solar Furnaces

A boom in solar furnaces is underway with new ones of various sizes being built or on the drawing boards.

An international conference devoted entirely to solar furnaces held in sunny Phoenix, Ariz., in January showed that research laboratories, industrial companies, universities and defense agencies are hard at work perfecting the way of bringing the heat of the heavens down to do earthly work.

The United States is to build not far from Alamogordo, N. Mex., near where the first atomic bomb was exploded, the latest and largest of solar furnaces. It is a giant 200-footer to serve the U. S. Air Force in investigations and testing. Only a 200-foot diameter furnace at Mont Louis in the French Pyrenees, built some years ago for the Centre National de la Recherche Scientifique, equals this projected U. S. apparatus.

At this French installation there is also an older nest of a large 35-foot and six small five-foot furnaces, while at Bouzareah, near Algiers, is another French solar furnace with a paraboloid of 8.4 meters (28-foot) diameter. This was originally built for nitrogen fixation, but is now used for research.

Massachusetts Institute of Technology has a medium temperature furnace built several years ago consisting of 400 flat mirrors concentrating on a single target.

India's National Physical Laboratory has a similar furnace with 192 mirrors of one square foot each concentrating light on a single foot-square area.

America's first solar furnace is the one built in 1932 at the California Institute of Technology. Instead of parabolic mirrors, it utilizes lenses, because they were left over from the building of Mt. Wilson Observatory. Nineteen lenses of two-foot diameter collect energy over about 57 square feet. Mounted like an astronomical telescope, it rotates to follow the sun.

A number of solar furnaces with openings varying from five to ten feet have been built by William M. Conn of Kansas City, Mo., and some of these, like many of the five-foot units built elsewhere, are made of converted Army searchlight mirrors.

You can find five-foot solar furnaces, most made from searchlights, at Fordham University, Nela Park at Cleveland, Arizona State College, Kennecott Copper Corp., at Salt Lake City, U. S. Bureau of Mines at Morgantown, W. Va., Stanford Research Institute at Menlo Park, Calif., and Convair at San Diego, Calif.

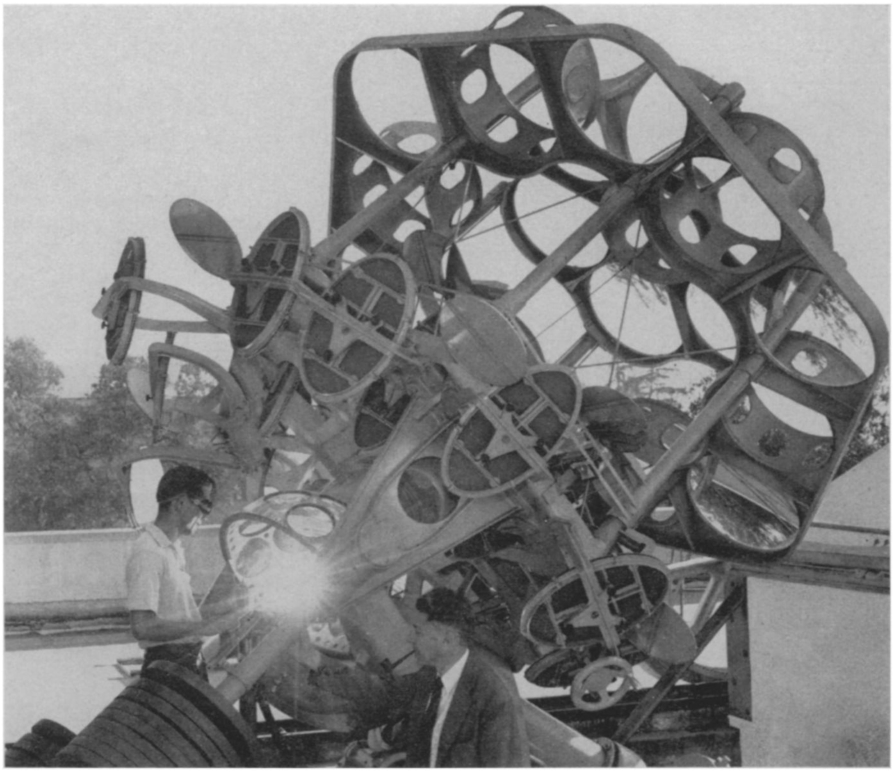
Five-foot furnaces have been built also in the USSR, Japan and Australia.

One research organization, Arthur D. Little, Inc., Cambridge, Mass., is preparing to put into production a solar furnace which laboratories can add to their array of apparatus in order to conduct high-temperature research. Only a relatively short period of sunshine each day would be needed with such a device to do the tests that will be necessary upon new materials being developed for withstanding high temperatures.

Advances in missiles and atomic power have accelerated the need for knowing what high temperature can do. Missiles heat up when they rush through thin air at supersonic speeds. The fissioning of uranium in reactors produces superheat. The sun is the cheapest and easiest power source for the torrid tests.

Principle Not New

The solar furnace is therefore coming into its own. But its principle is not new. According to an ancient account, Archi-



SOLAR FURNACE—Intense heat, without use of fuel or flame, is created in this first solar furnace to be built in the United States. The sun's heat is collected by lenses and brought to a focus to produce temperatures of 3,000 degrees Centigrade. This apparatus is used for high temperature research at the California Institute of Technology.

medes defended the city of Syracuse by setting fire to the invading navy of Marcellus, using "a burning glass composed of small square mirrors moving every way upon hinges, which when placed in the sun's rays, directed them upon the Roman fleet, so as to reduce it to ashes at the distance of a bow shot."

Lenses were used to concentrate great heat more than a couple of centuries ago. In 1695 a large burning glass was used to decompose a diamond previously considered unalterable. Metals and other substances that had resisted the heat of the strongest fires were melted with the sun's heat concentrated by large lenses. Lavoisier, the French chemist, in 1774 built a large double-lens furnace and he was nearly able to melt platinum, at a temperature that must have been close to 1,750 degrees Centigrade (3,182 degrees Fahrenheit).

Various Losses Cut Temperatures

Although it is possible, in theory, to obtain temperatures up to 4,500 degrees Centigrade, various losses cut the practical attained temperature to 3,500 degrees Centigrade, or about 6,300 degrees Fahrenheit. This corresponds to an equilibrium heat flux absorbed by the target of about 1,000 watts per square centimeter, if conduction and convection losses, about one-third of all losses, are disregarded.

The basic principle behind the solar furnace is that the sun's intensity yields from 0.8 to 1.1 kilowatts of energy per square meter at the earth's surface. These figures, rough approximations applying to many parts of the United States, will vary according to the season, altitude, latitude, clearness of the atmosphere and other factors. Gathering this energy and concentrating it at a focal point is the job of the solar furnace.

As the solar furnaces multiply and do more work, there will be better alloys for use in atomic reactors and in jet and rocket engines. At the point where the sunlight is concentrated so effectively in the solar furnace, it is possible to create little "hells" with controlled atmospheres, confined in refractory quartz containers. Out of these bits of sun on earth will come new knowledge for our technologic future.

Science News Letter, February 2, 1957

AERONAUTICS

Bombers' Fueling in Air Unneeded by Airline Jets

➤ MID-AIR REFUELING is not likely to be adopted by civilian airlines.

Experts in Washington were inclined to agree on this, despite the historic non-stop globe-circling flight of three B-52s.

"It is not efficient," one authority said. Another called it "uneconomical." A third said it did not look practical.

All thought that jet airliners would be able to handle fast transportation jobs cheaper and more efficiently.

The safety factor, also, is a prime consideration. Mid-air refueling is a highly dangerous operation.

The B-52 refueling in the historic flight was done by KC-97s, planes similar to Pan American's stratocruisers. Eventually, this work will be carried out by another model, the KC-135. This latter, also known as the Boeing Airplane Company's model 707, has been dubbed the stratotanker.

In the operation, the tanker planes first had to rendezvous in mid-air with the bombers they were to refuel. After maneuvering into position, these tankers dropped hoselines which were hooked into the bombers' intake receptacles. Then, for many nervous minutes, the pilots of both planes would "ride out" the refueling until it was completed.

Science News Letter, February 2, 1957

VETERINARY MEDICINE

Deer's Antlers Studied to Aid Man's Broken Bones

➤ COLORADO SCIENTISTS are attempting to find out what makes a buck deer grow a new set of antlers every year, and if human bones can mend the same way.

Heading the research work are Dr. Robert Davis, chairman of the department of veterinary anatomy at Colorado A & M College, Fort Collins, Colo., and Dr. Ben Eiseman, associate professor of surgery at the University of Colorado School of Medicine.

The five-year project will be supported by a $44,500 grant from the National Arthritis and Metabolic Diseases Council, a division of the National Institutes of Health.

"The tremendous rate of true bone deposition in the antlers of deer is unique," said Dr. Davis. "Some factor, either general or local, must produce such a bone growth. If by these studies such a factor can be isolated, it is possible that it or a related substance can be used to increase the rate of fracture healing in man."

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HOME ECONOMICS

More Honey Seen in Future Baking

➤ CAKES with honey, as well as honey cakes, are in store for the American housewife. Research at Kansas State College, Manhattan, Kans., shows that more and more honey will find its way into baked goods in the future.

Researchers, working with 15 different types of honey, have found that:

Substituting honey for all or part of the sugar in some baked goods adds to their flavor and color.

It is now possible for the first time to use honey alone to sweeten cakes commercially.

Cakes with a high concentration of honey stay moist and fresh-tasting longer than honeyless cakes.

Honey noticeably added to the flavor and color of some cookies, particularly sugar cookies, vanilla wafers, fruit bars and brownies.

Honey substituted for six percent of the sugar in white breads and 12% of the sugar in dark breads imparted a rich flavor and aroma to both.

The work was done in cooperation with the U. S. Department of Agriculture.

Science News Letter, February 2, 1957