HEALTH|SCIENCE

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Health Sense

BETSY A. LEHMAN

Bridging the doctor-patient divide

PUBLIC HEAL

Radia

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ENERGY

Seeking new ways to capture the sun

By Simson Garfinkel
SPECIAL TO THE GLOBE

REHOVOT, Israel – On the outskirts of this Israeli farming village 17 miles south of Tel Aviv, a stark spire reaches into the sky like a futuristic temple to the sun. From the front, the "solar tower" looks like an ultra-modern office complex, rising 14 stories from green fields that surround it.

But in the back, concealed behind protective earthen dikes, is a fan-shaped array of 64 mirrors, each 30 feet high, that swivel in concert under the command of a central computer.

Their purpose: to follow the sun and focus its light with blinding intensity into four experimental chambers that line the tower's north wall. Inside, shielded by a special concrete skin that can withstand a 1,000-degree blast of heat for up to 20 minutes, are laboratories filled with some of the world's most advanced solar research devices.

At the press of a button, a protective door in the wall of each chamber

TOWER, Page 46

Weizmann Institute's solar tower, seen between 30-foot-high mirrors, glistens in the sun at the Rehovot, Israel, research center.

psychologists, you can bet their literature would be full of olfaction.

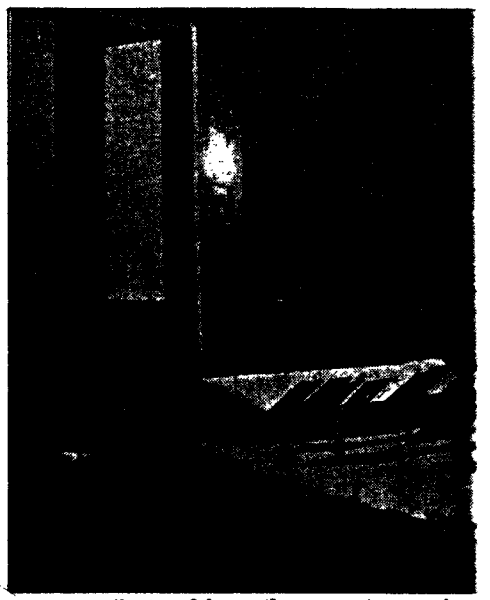
A bump in the brain

Only neurologists and brain researchers are in-

and – as the old vaudeville joke implies – we emit them as well as detect them. Several hundred kinds of molecules have been detected in the gases exuded by the human body. Most of this stuff, like nitrogen and

of molecular keys clicking away in my nose, but noth ing opens. No feelings of lust, appetite, annoyance, nostalgia. Nothing. And the doctors can't tell me wh I suspect the problem is in that relay station at the

Israel is seeking new ways to capture the sun's energy



Mirrors reflect and focus the sun onto experime

■ **TOWER**

Continued from Page 45

slides open and the mirrors swing into position one by one, building a concentrated beam equivalent to 3,000 suns.

In a sense, the tower is a temple to the sun; since it opened two years ago, the Solar Tower of the Energy Research Institute of the Weizmann Institute of Science has become a focal point for international solar energy research. Working with scientists from Europe and the United States, Weizmann researchers are developing new ways to change sunlight into electricity, heat and laser beams.

"I'm impressed the most by the people working there," says Roland Winston, a physicist at the University of Chicago who has created in his lab a light brighter than the surface of the sun. "[They are] very good, first-rate scientists who are clearly motivated and working hard."

More than motivated, the scientists are driven. Israel, although in the center of the oil-rich Mideast, has no oil or coal of its own (the Negev desert does have oil-bearing shale, but it is is too expensive to mine), and the perpetual state of war in the Mideast has denied Israel access to its neighbors' vast resources.

So Israel has turned to the sun, pouring effort and money into developing its one plentiful energy resource.

"We are facing today what other nations will be facing in the next century," says Dr. Israel Dostrovsky, director of the Energy Research Institute. "The world is turning away from fossil fuel because there is a finite supply. In Israel, we have already run out, because we never had any."

The $13 million tower, paid for by the Israeli government and the Weizmann's philanthropic organization in Canada, is the centerpiece of the institute's energy program.

Mirrors adjustable

As with a handful of similar installations around the world, the tower's purpose is research, not production. In labs arrayed at the base of the tower, scientists work out new ideas for harnessing the sun; then their experiments are built and tried out in the tower, as many as four at a time.

Operators control the amount of sunlight reaching each experiment by adjusting the number of mirrors pointed into its bay. (In a computer failure, the concentrated sun beam would move across the tower, but not damage anything inside. The installation is surrounded by man-made hills to protect the nearby community in the event of an accident.)

Dostrovsky has visions of not only solving Israel's energy problems, but learning to "bottle" the sun's energy and make his country become an energy exporter in the next century.

Israel is no stranger to solar energy; solar water heaters have dotted rooftops for years. And the Israeli company Luz International Ltd. has built eight large solar energy plants in the Southern California desert.

The one problem that has dogged solar power is storage – finding ways to collect sunlight during the day for use at night, or to save energy from the summer sun to warm homes in winter. To solve that problem, the institute is working on what Dostrovsky describes as a "chemical heat pipe."

When methane (natural gas) and steam are combined at 1600 degrees, they react to form hydrogen and carbon monoxide, a mixture called "synthesis gas." The mixture can be stored indefinitely at room temperature, or forced into tanks and shipped anywhere. Synthesis gas is like gunpowder: Under the right conditions, lots of stored energy will come out.

In the case of synthesis gas, the right condition is exposure to a catalyst, such as a metal screen made from nickel.

German development

When the gas touches the catalyst, the hydrogen and carbon monoxide recombine to form methane and steam, the temperature of the mixture climbs to 1,200 degrees Farenheit and the stored energy is released. The methane and steam can then be returned to the solar source and recycled.

The chemical heat pipe wasn't invented at the Weizmann: scientists in Germany years ago as a from nuclear centers. What using the sun

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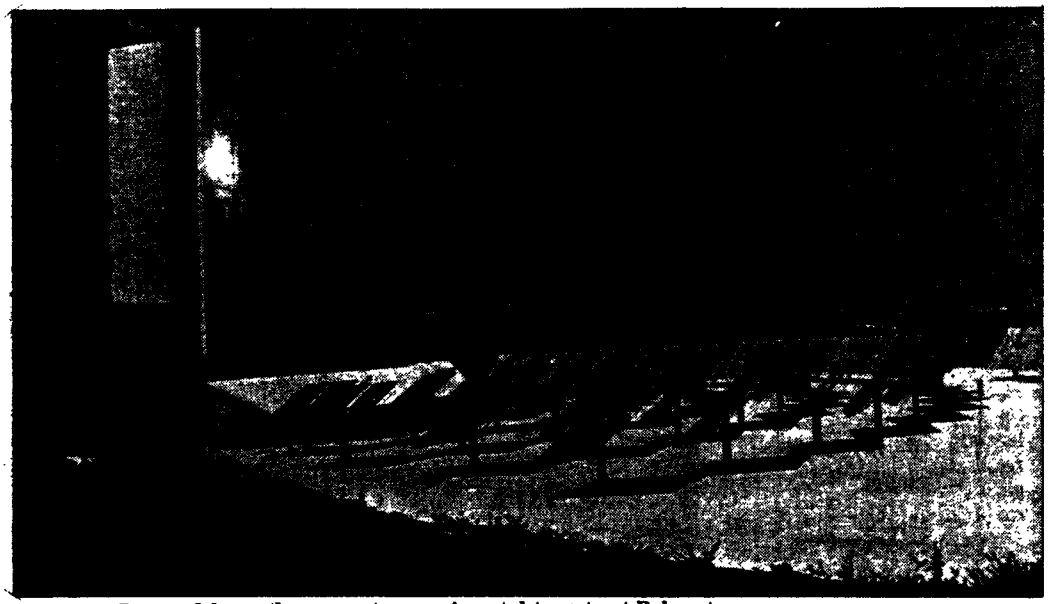

Mirrors reflect and focus the sun onto experimental targets at Rehovot. COURTESY / WEIZMANN INSTITUTE

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The chemical heat pipe wasn't invented at the Weizmann; scientists in Germany explored the process years ago as a way to transport heat from nuclear reactors to industrial centers. What is new is the idea of using the sun to drive the reaction.

"Nobody had ever driven a reformer with the sun," says Dostrovsky, referring to the reaction vessel where the synthesis gas is produced.

One obstacle has been the variability of sunlight; its energy fluctuates from minute to minute. Even in Israel, where the days are mostly sunny and long, there is considerable variation in the amount of energy reaching the ground.

"It's not [always] as sunny as you think," says researcher Irving Spiewak, who moved here after retiring from Oak Ridge National Laboratory in Tennessee four years ago. Dust can soak up energy in the air even when it "looks like a sunny day."

Solar power systems also have to start and stop every day as the sun rises and sets. Engineers thought the continual heating and cooling cycles might quickly damage the system, but the Israelis decided to give it a shot. If a solar reformer could be made to work, the payoff would be enormous.

So far, it looks like it might be successful.

Since March, a scale model of the reformer system has been run at the Weizmann Solar Furnace, driven by 22-foot parabolic mirror that can generate 30,000 watts of solar energy. This summer, the system was cycled more than a thousand times, each time moving 10 kilowatts of energy across the laboratory from the furnace to a small steam generator.

Now an experimental apparatus is being constructed to test the concept on a larger scale. "The system has been worked out in considerable detail at five kilowatts," says Spiewak. "I am scaling it up to 300 to 400 kilowatts – a factor of 100 larger. We hope to have something in operation by the end of the year."

Desert utility

That's still a thousand times smaller than a typical commercial power plant. But Dostrovsky believes the experiment will be enough to persuade "hard-nosed businessmen and engineers to examine the process and tell us if it is worth scaling up" to a commercial system.

Dostrovsky says an energy utility eventually could build a bigger solar tower in the Israeli desert – where land is cheap and sunlight even more plentiful – and send synthesis gas into the cities through a low-cost pipeline, or store it underground in Israel's depleted natural gas fields. Israel might export synthesis gas via tankers to other countries, which would return the spent gas for recharging, he says.

"It's promising," says Earl Rush, a researcher at the National Solar Thermal Test Facility at the Sandia National Laboratories in Albuquerque, N.M. "We had also [tried] it. Our funding didn't let us continue."

The Energy Research Institute is working on other ways to make solar energy economical as well. One idea is to use sunlight to gasify Israel's oil shale, so it could be handled more easily and burned more cleanly.

Converting oil-bearing shale into gas requires a lot of heat, however; most techniques burn half of the shale to produce the heat that is used to gasify the rest. By using sunlight, the energy yield would be doubled, says Dostrovsky.

Another project is using sunlight to drive solid-state lasers, which are widely used for cutting and welding in industry. They require tremendous amounts of electricity and cooling for their power supplies.

Simson L. Garfinkel is a freelance writer who lives in Cambridge.

Q **Because helium is so much lighter (less dense) than air,**

HOW & WHY

He said helium is extracted by refrigerating the gas so that its various components liquefy successive-