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THIS WEEK

ARTICLES

DEPARTMENTS

COVER: Barnard's star (arrow) is claimed to be the sun of an alien planetary system. This picture is a composite of two plates taken at different times and printed with a slight horizontal offset so that each star appears twice. Most of the double images are side by side, but Barnard's star shows a pronounced vertical displacement. A slight wobble in this motion is what betrays planets. See p. 424. (Photo courtesy of Sproul Observatory)

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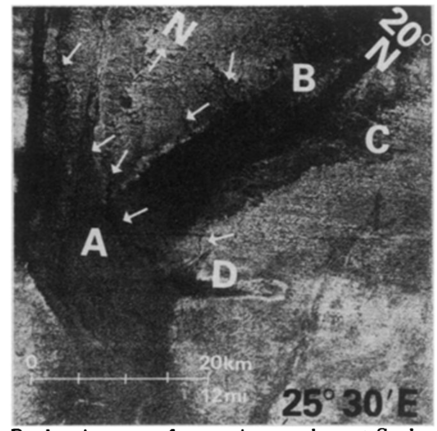
Unveiling the Sahara's Hidden Face

After several field trips and four years with Landsat photos covering the driest part of the Sahara desert, where it ranges across southern Egypt into Sudan, the U.S. Geological Survey's Carol Breed thought she was fairly familiar with the place. Then one day, a few months ago, she was handed a strip of film bearing the picture-like data from SIR-A, a synthetic-aperture imaging radar system that had been carried over the region during the space shuttle's second test flight last November. "I got the roll," she says, "and rolled it out on my light table—and nothing looks the same. I thought, 'My God, where is the sand sheet?'"



USGS/Jet Propulsion Laboratory

Radar image of area in northwest Sudan shows pattern of dark trunk valleys eroded in bedrock that gives bright response through veneer of windblown sand. Former rivers flowed south, as shown by confluence at A and stubby beveled tributaries at B, C and D. Later wadis (narrow, sinuous dark channels shown by arrows) have episodically reoccupied these relict valleys, probably during Quarternary pluvials. The broad relict valleys resemble some of the valleys on Mars.

Instead of the familiar, near-featureless terrain, broken only by an occasional low hill or rocky outcrop, the image revealed a vast network of channels, their dendritic patterning reminiscent of riverbeds and tributaries, from little ditches just at the radar's limit of resolution to huge swaths as wide as the Nile Valley. Among Breed's colleagues was Maurice Grolier, who had been in the area barely a month before. "Maurice was just amazed," Breed recalls. "He said, 'I just drove over that, and it's flat as a board. There's no trace of any of this.'" Just thousands upon thousands of square kilometers of sand, sand, sand, in places piled tens of meters thick.

Indeed, the Sahara's "hyper-arid core" is one of the driest places on earth, an area about an eighth the size of the United States over which rain deigns to fall perhaps two or three times in a century. On a scale called the "aridity index," which roughly describes how much more rain could be evaporated by the local sunfall than ever actually appears, the most parched sections of Death Valley rate a 7. The Sahara's core has a score of 200.

Yet geologists have long suspected that riverbeds and other large-scale fluvial remnants might exist in the region. Diverse evidence has suggested that, tens of millions of years ago, the present hyper-arid core might have been a grassy, subtropical savanna. A plateau called the Gilf Kebir, for example, erosion-resistant enough to still protrude above the sheeted sand, preserves the remains of ancient channels, while elsewhere, isolated patches of water-smoothed gravel can be seen. The problem has been that the Gilf Kebir's channels head down the slopes and disappear beneath the sand without a trace, that the wind has redistributed the gravel so that it no longer bears a clue to the routes of the waters that once carried it. Scientists such as the University of Arizona's C. Vance Haynes have recovered Stone-Age human artifacts from more recent epochs, yet in some places they have found no obvious signs of any ancient water source that might have sustained habitation.

Enter the space-borne radar of SIR-A. Though it did not provide its full planned coverage (its shuttle ride was cut short by more than 50 percent due to concerns about a malfunctioning fuel cell), its glimpses of the north African desert core now raise a dramatic possibility: the Sahara unmasked.

The radar, in effect, acted as an X-ray eye. A smooth, solid surface, or even a layer of water, will reflect a radar beam like a mirror. With a low-density surface like loosely packed sand, however, says Gerald Schaber of the USGS, most of the beam's energy can pass right through, to be reflected by whatever lies beneath. Unless, that is, it is a little moist, as it is over most of the planet. Then the moisture, acting differently than, say, the surface of a pond, increases the sand's electrical conductivity so that much of the energy is absorbed and never gets back to the radar receiver to create the telltale echo of its target. But in the Sahara's super-dry core region, Schaber says, the beam can penetrate far enough through the sand to reach—and reflect from—the underlying bedrock and possible gravel terraces and riverbanks surrounding the apparent ancient drainage system.

The actual thickness of the sand sheet at different parts of the core is not yet known. Finding out will initially require field expeditions and measurements, by either seismic sounding or actual sampling. Experience, however, says Schaber, should make it possible to infer the sand's depth from the "brightness" of the returned radar signal alone. Other gains, such as deeper maximum penetration and roughness measurements at different scales, are expected to result from varying such factors as the beam's wavelength, polarization and incidence angle. These modifications will be tried on another shuttle flight in the summer of 1984 on SIR-B, being developed at Jet Propulsion Laboratory in Pasadena, Calif., under the direction of Charles Elachi.

Most of the geological work on the newly unveiled Saharan core is being conducted at the USGS Branch of Astrogeologic Studies in Flagstaff, Ariz., where research is generally concerned with other planets. The desert studies group, in fact, is headed by Jack McCauley, who was inspired to start it following his experience with the Mariner 9 spacecraft's 1971 discovery of the desertlike nature of the surface of Mars.

McCauley describes the Sahara's core region — a wind-modified surface overlying a water-modified substrate — as "an aeolian takeover." Now the researchers are contemplating ideas of applying their new tool to studies of Mars, such as from an orbiting spacecraft. The planet is almost certainly dry enough for deep radar penetration, and there are enough signs of apparent water activity in the Martian past — and of abundant dust accumulations in the present — to suggest that a uniquely fascinating aspect of Mars may lie just a little more than skin deep.

Schaber, a geologist who has worked with radar since the mid-1960s, is particularly taken with the possibilities for Mars, and is excited about exploring the potential of deep-looking radar in a variety of applications, some of which may yet be unrealized. Says Schaber, "I've waited my whole career in radar studies to come across something like this." — *J. Eberhart*

Proteins that counter stress

In response to stress, the mammalian body is known to rally a variety of defenses — the limbic lobe and hypothalamus of the brain, the pituitary gland, the involuntary nervous system and adrenal gland hormones. But how do individual cells in the body respond to stress? They manufacture a new set of proteins, at least under some conditions, Graeme L. Hammond, Yiu-Kay Lai and Clement L. Markert of Yale University report in the June PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Cells react to the stress of heat shock by making proteins that they normally do not make — proteins of around 70,000 to 72,000 daltons molecular weight—various investigators have reported in recent months. So the Yale investigators wondered whether cells also make the same proteins in response to other kinds of stresses as well. To test their hypothesis, they exposed one group of rats to increased body temperature and a second group to decreased body temperature. They required a third group to swim until exhausted and imposed an extra workload on the heart of a fourth group of rats by physical alteration of the aorta (the major artery that carries blood from the heart to other body areas). The rats were then killed and their hearts removed to see whether they contained any messenger RNAs (mRNAs) that they normally did not. Two were found. The scientists then put the two new mRNAs in the test-tube so they could make proteins, then analyzed the proteins produced. The hearts from the rats that had experienced increased body temperature and the hearts of the rats that had had extra workloads imposed on them made two new types of proteins they did not normally make, and both were around 71,000 daltons in molecular weight. However, the hearts from the rats that had experienced decreased body temperature and that had swum till exhaustion did not make the two new kinds of proteins. So cells appear to make a new class of proteins in response to some, but not all, kinds of stress.

Why? It may be because the proteins are made only when a stress is severe enough to deplete a cell of its oxygen supply, thus leaving too little oxygen in the cell to turn lactic acid into energy and creating an excess of lactic acid in the cell that somehow activates new genes, new mRNAs and new stress-reactive proteins. One reason to think that this is the case is that Hammond and his colleagues found excess lactic acid in the hearts that made new proteins in response to stress, indicating that lactic acid was not being employed as energy. Yet they did not find an excess of it in the hearts that did not make new proteins in reaction to stress. But might lactic acid itself then activate new genes and new mRNAs that make new proteins? Hammond and his co-workers don't think so. However, they *do* think that the presence of excess lactic acid in a cell might create a favorable environment for the release of regulatory molecules that in turn activate the new genes.

And it's really those regulatory molecules, rather than stress proteins per se, that Hammond and his team are after. "If we could isolate these molecules," Hammond explained to SCIENCE NEWS, "it would have tremendous implications because the control mechanism of gene activation is one of the most profound and fundamental questions of biology and medicine right now and is at the basis of cancer.... My lab has been working for a long time to try to determine what the molecular signal is that activates genes—any gene." — *J.A. Treichel*

Court bolsters mental patients' rights

The Supreme Court made two decisions this week concerning the competing rights of institutionalized mental patients and state hospital authorities. In *Youngberg* v. *Romeo*, the Court ruled that the Constitution guarantees certain rights — including the right to safety, freedom from shackles, and the guarantee of "habilitation" — to mentally retarded citizens who have been committed to an institution. In a second decision, the Court returned *Mills* v. *Rogers* to the lower courts for further consideration, a move that, while not progressive, may favor the plaintiff, who is suing for the right to refuse psychoactive drugs.

Nicholas Romeo is a 33-year-old man with an I.Q. of 10 who, in 1976, sued Pennhurst State Hospital in Pennsylvania for violation of his rights; he had been injured 63 times, restrained unnecessarily, and denied appropriate training, the complaint alleged. The Supreme Court decision — written by Justice Lewis F. Powell for the 8-1 majority — said that the 14th Amendment guarantees these unprecedented rights, but the Court deferred to "professional judgment" on just what kind of training is necessary. Chief Justice Warren E. Burger dissented, arguing that Romeo has no constitutional right to training. Attorneys for both the American Psychological Association and the American Psychiatric Association have praised the Court's attempt to balance patients' rights against professional autonomy.

The issue of competing rights also underlies *Mills* v. *Rogers*. In 1975, Rubie Rogers, a mental patient, sued Boston State Hospital for violation of the right to refuse treatment with psychoactive medication. Rogers won, and the state appealed, arguing that the decision undermined the state's authority to maintain order and provide proper care. Meanwhile, however, the Massachusetts Supreme Court ruled in another case that non-institutionalized patients have the right to refuse treatment; in light of this ruling, the U.S. Supreme Court returned the Rogers case to the lower court to be reconsidered. Organized psychologists, who do not use drugs for treatment, had supported Rogers and the right to refuse drugs, and according to APA attorney Donald N. Bersoff the decision is a victory — though a narrow one — for patients' rights. But according to Joel I. Klein, who had written an opposing brief for the psychiatrists, the *Romeo* decision regarding professional judgment in treatment matters could be viewed as supporting the state's position in *Rogers* as well. "But we're disappointed the Court ducked the issue," Klein says. "The decision delays the national day of reckoning and moves the matter into the arcane realm of state law." — *W. Herbert*