

sharp stimulation to a brain area devoted to sensory perception drew out, not a sensation, but a motor response.

Dr. Libet believes the results may explain how persons unconsciously make split-second reactions to danger, yet not realize what has happened until a second or so later.

It is also possible that unconscious experiences are laid down as reflex memories, says Dr. Libet. People could then respond later on the basis of experience of which they were unaware.

Dr. Libet points out that much intellectual activity, even at high levels of complexity, appears to proceed in the brain without conscious experience. Then, not infrequently, an idea springs into the conscious mind and comes

under its more deliberate scrutiny.

If it is true that conscious experience requires the brain to continue reacting for as long as half a second, that would impose a certain ponderousness on thinking processes, says Dr. Libet.

But if, in contrast, only short reactions are needed for unconscious experiences, they might provide the kind of quick-acting, marginal thinking that facilitates complex integration in the mind.

"We were not trying to prove or disprove the existence of an unconscious process, we accepted it," says Dr. Libet. From all the evidence, this looks like its physiological basis.

Dr. Libet plans to publish a report of his work in *SCIENCE* of Dec. 22.

forbidding badlands of rocks, gullies, potholes and ridges. It was picked because it was so geologically different from the maria and also because Tycho is one of the moon's newest major surface features, so that its original appearance would be less worn down by the meteorites that constantly bombard the moon.

It is possible that the area around Tycho will show distinct chemical differences from the maria—higher acidity, more silicon, less iron and calcium—just as do earth's maria (the largely basaltic ocean floor) and highlands (the more acidic continents).

**In addition**, the 53-mile-wide Tycho may, as it was formed, have thrown out lunar material from as far as 12 miles below the surface, offering a ready-made excavation far down into the moon's crust.

To get the most out of its assignment, Surveyor 7 will have everything its predecessors had, and more. There will be TV, of course, and a chemical analyzer, plus magnets to look for iron, as well as a remote-control scoop like the one with which Surveyor 3 dug troughs and crushed rocks. A knob will be mounted atop the analyzer, so that the scoop can pick it up and set it down in different locations. In addition, there will be several mirrors: One set will enable the TV camera to take pictures looking underneath the spacecraft; another will be photographed only while reflecting the clear sky of space, to show any traces of dust that may be kicked up by Surveyor's activities; a third set will let the camera take stereo pictures without the need for the hazardous hop that was carried out by Surveyor 6. Despite the more elaborate instrumentation, Surveyor 7's payload will only weigh 22 pounds more than that of No. 6.

For the spacecraft to reach its target, a circle only 12.4 miles across, every step of the flight to the moon will have to be letter-perfect. "The scientific gain is worth the risk," says Surveyor program manager Benjamin Milwitzky, "but only if the spacecraft is going to be right on target." If even the slightest thing goes wrong, such as a tiny error in a midcourse correction, the destination will be changed to a safer one, a crater called Fra Mauro.

Almost 700 miles north of Tycho, Fra Mauro is about the same size, but the surrounding terrain is less hazardous for landing a spacecraft. Fra Mauro is also of interest, since it may contain material ejected from deep in the lunar crust during the formation of Mare Imbrium. Such material is likely to be chemically different from the rest of the surface, since the elements would probably have distributed themselves partly by weight during its volcanic past.

## MOON MODEL

### Scientists Now Certain of the Maria

Scientists are a cautious breed, and on a subject as publicity-prone as the moon they tend to be downright gunshy. When the Surveyor 5 robot spacecraft analyzed a patch of moon and sent a detailed description back to earth (SN: 10/14), most of the investigators steadfastly refused to admit that they had learned about anything but the tiny area directly beneath Surveyor's feet.

Now the researchers have changed their tune. The relatively smooth lunar maria, or seas, which cover from a fourth to a third of the moon's near side, are essentially the same all over, says Dr. Leonard D. Jaffe of the Jet Propulsion Laboratory in California, which runs the Surveyor flights. The other members of the team echo his confidence.

**The turnabout** was due to Surveyor 6, the fourth successful probe in the series, which landed on the moon Nov. 9, some 450 miles from Surveyor 5. Equipped with the same kind of automatic chemical analyzer that enabled its predecessor to count the percentages of atoms of different elements in the lunar rock, No. 6 produced a startlingly similar picture. The amounts of aluminum, magnesium and sodium were exactly the same, while oxygen, the most common element, varied only minutely from 58 percent at Surveyor 5's site to 57 percent beneath Surveyor 6. Silicon, the second most abundant element, matched to within experimental error.

Before the Surveyor program, Dr. Jaffe points out, scientific opinion about the moon ranged far and wide. Now there is a good deal of fairly well established knowledge, at least about the maria, where the manned Apollo landings will take place:

- Researchers used to argue over

whether the mare rock was acidic or basic, and whether it contained iron deposited by meteorites. Now it is agreed to be basic, much like some earthly basalt, and to have only traces of meteoritic iron.

- Was the surface bare rock, or a porous honeycomb, or was it covered with a layer of coarse or fine particles? The Surveyors have shown that there is indeed a carpet of very fine particles, most of them only one-thousandth of an inch in diameter, almost too small for the spacecraft cameras to see.

- The most pressing differences of opinion were those directly related to manned landing. Would the surface support a man, let alone an Apollo spacecraft? Estimates of its strength covered a million-to-one range, from less than a sixth of an ounce per square inch to some five tons. Radar beams reflected from the moon had indicated solid resistance, but for all anyone knew, the solid layer might have been at the bottom of a mile of powdery dust. Some engineers were visualizing special snowshoes for astronauts, to keep them from disappearing beneath a fluffy surface. Fortunately, it is now known, the surface is easily strong enough, capable of bearing up to eight pounds per square inch after sinking down only an inch or two.

**The next direct information** from the maria may not be received until astronauts (or cosmonauts) land there, although there is one Surveyor left to go. Surveyor 7, which could be launched as early as Jan. 7, will instead be aimed at a target so inhospitable that the National Aeronautics and Space Administration wouldn't dream of landing men on it.

Located about 18 miles north of the rim of the crater Tycho, the site is a