

## Research Notes

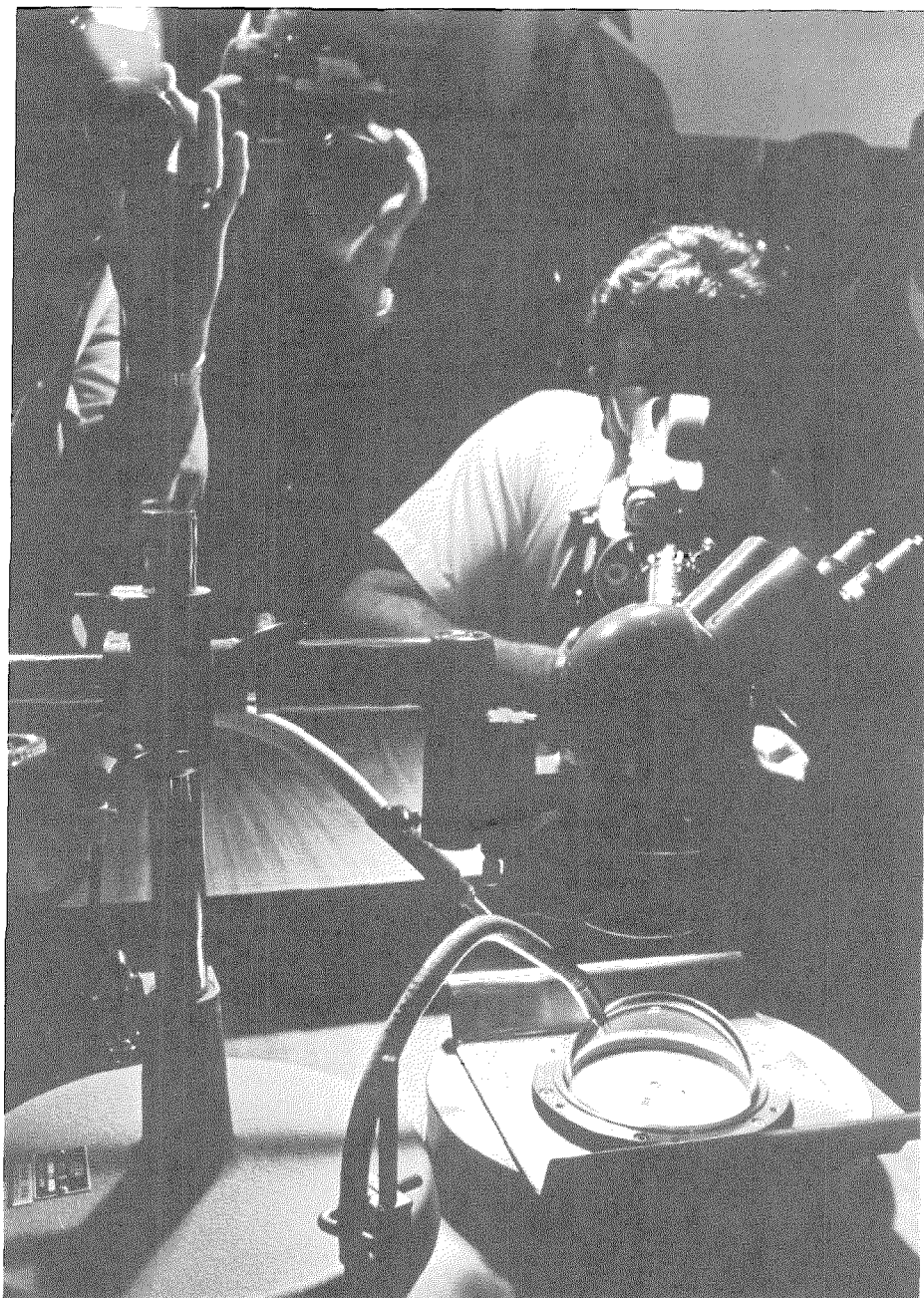
### *Rocks from the Moon*

Caltech geologists now have 100 grams of the moon to study. Among the questions they hope to answer: When were the pieces formed? Do they represent an early time of the solar system? Do the earth and moon come from a common chemical pot, or are they genetic strangers? What effect do cosmic rays and the solar wind have on the moon's surface? What were the temperatures of formation of the moon rocks? What kinds and sequences of geological processes have taken place on the lunar surface?

The deadline for completion of these preliminary studies is January 1970, when the Caltech men will join about 140 other investigator teams in Houston to compare and correlate results.

Geology division chairman Eugene Shoemaker is the principal investigator of the Apollo 11 field geology program, and Caltech has three principal investigators in the lunar sample program. Gerald Wasserburg, professor of geology and geophysics, and Leon Silver, professor of geology, are determining the ages of their samples by studying the decay products of radioactive isotopes in them. Their work will provide dates for several geological events at Tranquillity Base and will give the first absolute age for the formation of mare material on the moon. Samuel Epstein, professor of geochemistry, is studying relative abundances of stable isotopes—particularly oxygen and hydrogen—to see in what way they differ from the abundances in rocks on earth. Collaborating with the three principal investigators are Arden Albee, professor of geology; Donald Burnett, associate professor of nuclear geochemistry; Clair Patterson, senior research fellow in geochemistry; and Hugh Taylor Jr., professor of geology.

Both Shoemaker and Wasserburg were



*At a campus press conference where Caltech's three principal investigators explain how they will study their moon samples, three particles of lunar soil are shown briefly to photographers.*

advisers at the Manned Spaceflight Center in Houston during most of the preliminary studies of the lunar material. Wasserburg helped design some of the hand tools (built at Caltech early this summer) that were used to handle the rock samples behind the biological barriers.

Out of the preliminary work in Houston came three significant results. First, abundant glass is present in the fine-grained parts of the lunar soil. The observed glass is formed both by rapid cooling of molten material and by strong shock in crystalline material. Some glass, produced by meteorite impact, was expected, but the large amount surprised most scientists.

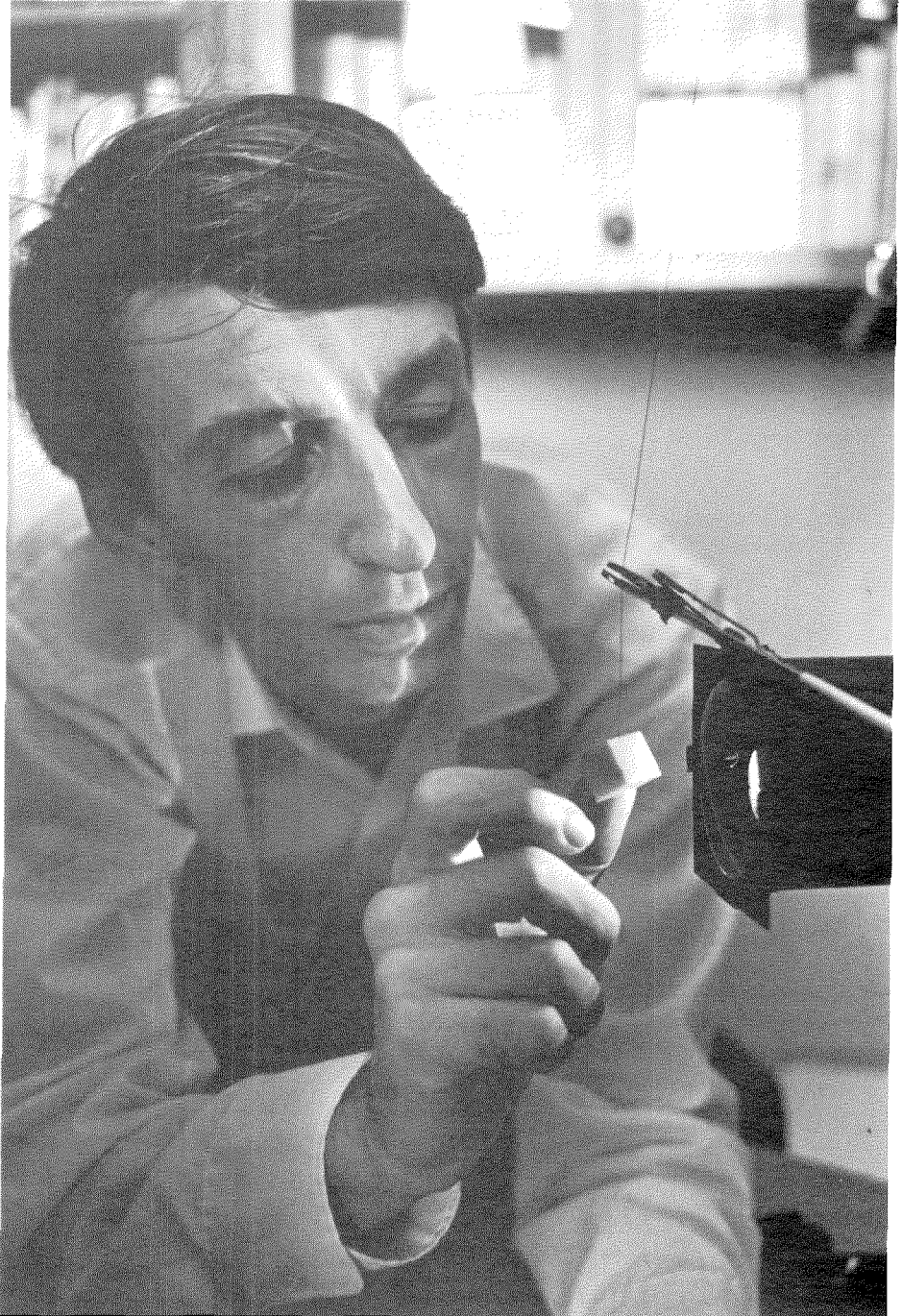
Second, many of the lunar rocks are very old—billions of years. Rocks of that age are rarely found on earth. This implies that the lunar surface at the landing site is old and has been relatively undisturbed over great spans of time.

Third, the fine material on the lunar surface is heavily impregnated with particles from the solar wind—a stream of hydrogen and heavier ions given off by the sun. Extraction of the particles from the lunar material will provide a direct determination of the isotopic composition of several elements of the sun's atmosphere.

### *Double Vision*

Human vision apparently consists of two separate seeing mechanisms. A second process, one that transmits an elemental kind of vision from the eyes to the subconscious mind, has now been identified in man. This system, which probably works through the brain stem rather than the cortex, functions mainly for background and peripheral vision and for perception of peripheral movement. It helps a person make general spatial and orientational adjustments to his surroundings. These may occur at a subconscious level while at the same time the classical system for central vision is attending to focal identification and discriminatory functions.

Colwyn Trevarthen, a senior research fellow in biology, who works with Roger Sperry, Hixon professor of psychobiology, suggests that the primitive optic system allows a person to respond automatically to what's going on in the space around him. If something unexpected moves outside the central field of attention, it registers first through this second, more primitive system before the classical visual system becomes aware of it.



*Biologist Colwyn Trevarthen uses a point source of light to project a cube silhouette on a screen used in testing peripheral vision, part of a second visual system.*

Trevarthen says that this second visual system in man very likely is evolved from brain stem structures that comprise the main sight center for birds, reptiles, and lower animal forms.

The discovery has led him to propose a modified theory of the cerebral mechanisms for visual perception in which the two kinds of visual data arrive in the cortex through different nerve channels and interact to produce the completed perception at the conscious level. As with most other parts of the brain, these optic systems come in right-left pairs. Thus the brain has two pairs of seeing systems, one of each kind being located in each half of the brain. The better known "primary" visual system transmits only one half of the visual space to each half of the brain; apparently the more primitive system transmits both halves of space to each side of the brain.

The different functions of the two visual systems are difficult or impossible to distinguish under most conditions, but they become exposable as a result of a rare type of brain surgery used to treat certain types of epileptic seizures. Trevarthen and Sperry studied six people in whom the nerve cross-connections that link the two cerebral hemispheres had

been severed. The process cuts off all mental communication between the right and left hemispheres, but does not significantly affect behavior of the subject under ordinary conditions.

### Pieces of Smog

A great deal is already known about the gaseous components of smog, but comparatively little is known about the kinds and numbers of very small particles in it. These particles, or aerosols, are believed to have three negative effects: they reduce visibility; they carry toxic chemicals, such as lead, into the lungs; and they may modify weather. (Particles can serve as the nuclei on which water droplets can form, resulting in cloudiness. Some scientists blame air pollution, in part, for what they consider a gradual cooling of the earth.)

A group of engineers at Caltech, under the direction of Sheldon Friedlander, professor of chemical engineering and environmental health engineering, has begun the first combined analysis of gases and particles in the air. They are studying the relation of gases and

particles to each other and the chemical changes that occur in them under the effects of sunlight and from contact with each other over a period of time.

The particles are being studied with instruments located in Caltech's W. M. Keck Engineering Laboratories. Air is collected through a plastic pipe that rises 22 feet above the roof of the three-story building. The instruments sort the particles in the air and count them by size, giving results every ten minutes.


With this technique, the atmosphere of the Los Angeles Basin is being analyzed on typically smoggy days as well as on some clear days. Sampling is occasionally done continuously for 24 hours to get a picture of how the chemical composition of smog changes with time and between daylight and night.

At the same time, Friedlander and John Seinfeld, assistant professor of chemical engineering, are developing a comprehensive mathematical model of Los Angeles Basin air. This, in combination with the results of the particle studies at Caltech and similar investigations being made in other parts of the country, will help experts make recommendations for improvement of the air in major industrial areas.

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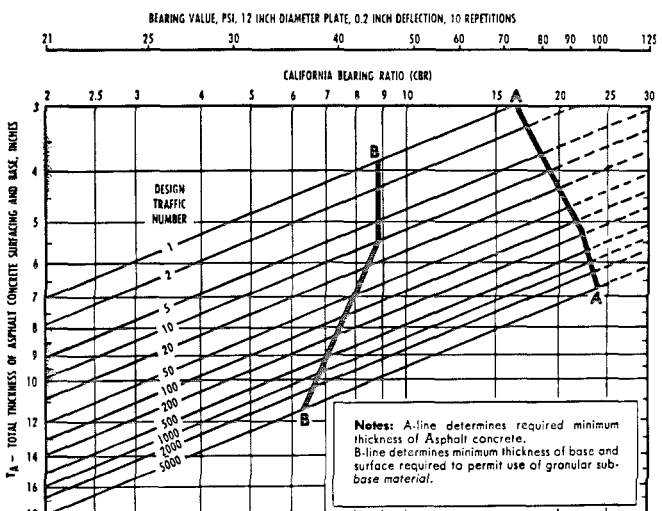
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Thickness Design Charts like this (from the MS-1 manual) are used in this computer-derived method. This chart enables the design engineer quickly to determine the over-all Asphalt pavement thickness required, based on projected traffic weight and known soil conditions.

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