APOLLO 15

## Off to the Apennines

Before Apollo 13, coasting to the moon during manned missions was relatively uneventful. But the dramatic explosion triggered by a short which aborted Apollo 13 occurred on the way to the moon, and since then the moonward journeys have been bothered by pesky, but potentially serious problems. During Apollo 14 there was a problem with the docking of the command and lunar modules shortly after the burn that propelled the spacecraft out of earth orbit.

This week as Apollo 15 began its moonward journey after a near perfect launch in nearly cloudless skies, another short threatened for a time to cancel the landing at Hadley/Apennine near the rim of Imbrium Basin. Apollo 15 would have had to be a 4- to 6-day lunar orbital mission.

The short occurred in the circuitry of the service module's propulsion system (SPS), the main spacecraft engine, one hour 48 minutes after liftoff ignition. After a successful docking, command module pilot Alfred M. Worden reported that the SPS thrust light had come on. The light indicates the engine is about to fire.

**For the next 24 hours,** engineers and flight controllers at the National Aeronautics and Space Administration's Manned Spacecraft Center in Houston worked with contractor engineers to devise various tests—from tapping the panel around the Delta-V thrust switch to actual firing of the SPS engine—to find the short. Had the grounded circuit been upstream from the pilot solenoid valves—between them and the circuit breakers—it would probably have popped the circuit breakers. This would have made inoperable half the SPS engine system. Only one engine would then have been left to fire the men out of lunar orbit—a situation that would have prohibited lunar landing because the lander engines would have to have been preserved as back-up engines. (The solenoid valves release nitrogen pressure, which actuates another valve, which then dumps the oxidizer and fuel to ignite the engine.) If the short were downstream from the solenoid valves, the problem would be annoying, but it could be circumvented manually.

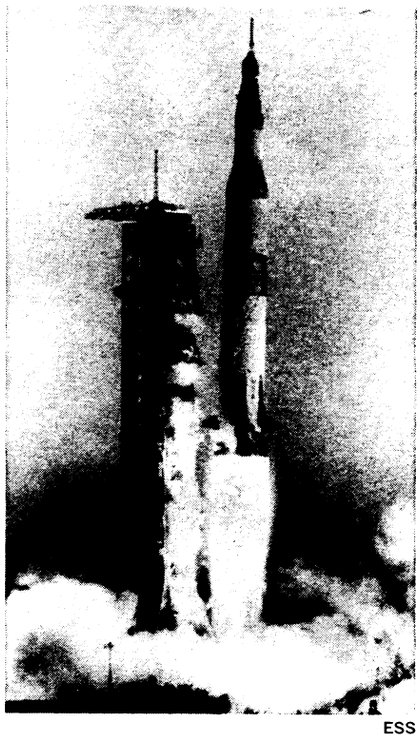
The tension mounted prior to the trial firing of the SPS engine at 2:15 p.m. (EDT) Tuesday. If the engine fired, the mission was saved. It did. "That's beautiful," said capsule communicator Joseph P. Allen, a scientist-astronaut. "That burn was exactly what we wanted to see. We will proceed with the normal mission."

The reply from the capsule was, "Let's go to Hadley." Allen replied, "That's a super idea."

Proceeding with a normal mission meant that if nothing else happened David R. Scott, commander, and James B. Irwin, lunar module pilot, would land Falcon on a plain called Palus Putredinis (the Marsh of Decay) at 6:15 p.m. Friday, July 30. They were then to spend three days exploring the base of Apennine Mountains, craters, the Hadley Rille and the plains (SN: 7/10/71, p. 28). The lunar jeep called Rover was to make its debut, allowing the men to cover a 28-square-mile area (SN: 6/12/71, p. 404).

Scientists hoped the men would find samples from at least six different geological features, which would help pinpoint when and how they were created.

Also to debut was the lunar orbital science package, located in one of the service module's bays. The instruments and cameras would examine and photograph about 20 percent of the moon's surface. The instruments would detect



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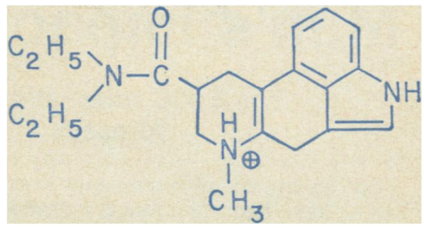
*Apollo 15: Three days on the moon.*

constituents of the soil, the cameras would map the surface and a laser altimeter would measure and mark the altitude of each feature photographed. Before leaving lunar orbit, a satellite containing instruments to measure the lunar gravitational field (including the influence of the mascons in the circular basins), particles in space around the moon, and physical and electrical properties on and around the moon, was to be released.

Splashdown next week should be around 4:45 p.m. Aug. 7. □

HALLUCINOGENS

## LSD and DNA




Lysergic acid diethylamide

Nature

*LSD: Dispute over effects on DNA.*

Various tactics have been used in the battle against drug abuse, but as the number of drug users continues to rise it becomes obvious that they are not working. The scare tactic, in particular, has been used in an attempt to curb the use of lysergic acid diethylamide (LSD).

In June of 1969 NATURE published a paper by Dr. Thomas E. Wagner, then of the Sloan-Kettering Institute for Cancer Research. "The observation of broken chromosomes in test animals and humans treated with the hallucinogen (LSD) has been well documented" the paper began. Dr. Wagner then went on to announce that, using a spectropolarimeter, he had discovered evidence indicating "that LSD interacts directly with a purified calf thymus DNA, probably by intercalation, causing conformational changes in the DNA." This meant that LSD comes between the DNA bases and interacts strongly at the gene level, unwinding the helix and causing mutations and changes in DNA activity. In other words, the LSD-DNA interaction is responsible for physical changes in the chromosomes, defective genes and possible mutations.

**The July 16** NATURE contains two papers that refute those findings. Drs. E. M. Smit and P. Borst of the University of Amsterdam state that, using a more specific and sensitive method for studying intercalation, no interaction between DNA and LSD was detectable. They therefore conclude that "chromosome damage in the presence of LSD is not a consequence of the intercalation of LSD into DNA."

Drs. A. H. Brady, Elizabeth Brady and F. C. Boucek of the University of Miami School of Medicine report similar findings based on completely different methods. And their experiments "have failed to show that LSD has any effect on DNA conformation." Dr. Brady says there "may be some kind of interaction but if there is it is very minimal and does not show up as any change in optical activity." And "if

LSD is responsible for any kind of mutant action it is not by direct interaction with the DNA molecule."

The University of Miami researchers were unable to find any optical activity changes when DNA and LSD were mixed and they could not repeat or confirm Dr. Wagner's spectra. Dr. Brady says that their experiments, the evidence of Drs. Smit and Borst and mounting physical and chemical evidence "are beginning to refute evidence that we might have been inclined to believe a year ago." □

CIRCULAR POLARIZATION

## Astronomers' new tool

Visible light is the age-old observing tool of astronomers. Nevertheless new kinds of information can be gained by studying characteristics of visible light not systematically investigated before. One such characteristic making news lately is circular polarization.

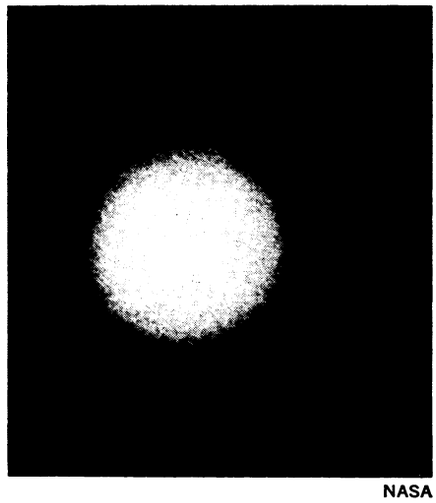
**The search** for circularly polarized light from astronomical bodies began as a means of looking for magnetic fields in certain kinds of white dwarf stars. Dr. James C. Kemp of the University of Oregon had put forward a theory that magnetic fields in white dwarfs would cause a net circular polarization. A few such stars have so far been found.

Circular polarization has also been found in the light reflected by the planets. The latest report, by Dr. Kemp and Drs. Ramon D. Wolstencroft of the University of Hawaii and John B. Swedlund of the University of Oregon in the July 16 NATURE, brings the total of circularly polarized planets to four, Mercury, Venus, Mars and Jupiter, plus the moon.

A quasar (3C 273) and a Seyfert galaxy (NGC 4151) also emit circularly polarized light, according to the report of a group at the Crimean Astrophysical Observatory in the Soviet Union led by Dr. Andrei Borisovich Severnyj. The report appears in International Astronomical Union Circular 2343, dated July 23.

Circular polarization imposes a particular order on the vibrations of a light wave. All light waves consist of vibrating electric and magnetic fields. The electric and magnetic vibrations are always perpendicular to each other. As long as they maintain that relationship, the vibrations can be in any direction in the plane perpendicular to the line along which the light wave is propagating, and in an ordinary wave the direction can vary at random from time to time. In a circularly polarized wave, the variation is regular and smooth and describes a circle like the hand of a clock, either clockwise or counterclockwise.

A number of things beside magnetism at the source can cause circular polarization. In particular, the circular polarization in light from the planets appears to be due to scattering that selects particular polarized components of the impinging sunlight. Dr. Kemp and several collaborators originally drew this conclusion in an earlier paper dealing with Jupiter. A note on that discovery (SN: 6/5/71, p. 386) reported their conclusion erroneously. The Crimean astronomers have not yet suggested



NASA

*Uranus: Target of polarization study.*

what may cause the polarization in the quasar and the galaxy.

The scattering that causes the circular polarization in the planets may occur at a gaseous surface, that is, in the planet's atmosphere or at the solid surface. The characteristics of the light vary according to where the reflection is taking place.

**Two planets,** Jupiter and Venus, show pronounced polar effects. The polarization at the north and south poles of the planets is in different senses, indicating, the observers conclude, that the polarization has to do with their atmospheres. For Mercury and the moon the indication is that the polarization is caused by reflection from a dusty solid surface. Mars shows both effects, atmospheric at blue wavelengths and dust at longer ones. Uranus and Neptune were also observed, but the data from them are not yet significant. There is hope, however, that they will become significant in the future.

All in all, the present observations of circular polarization promise to provide new data on the details of planetary surfaces and atmospheres. If other sources of polarization besides scattering turn out to exist, more varied information could be gained. For example, Martian plant material with optical properties like those of green leaves could cause circular polarization at 7,000 angstroms wavelength. □

POLLUTION AND ECONOMICS

## Measuring the real costs

A cliché heard with increasing frequency is that if the American people want a clean environment, they will have to pay for it—and their "high standard of living" will necessarily suffer. The statement, a favorite with Nixon Administration officials, is superficially plausible; it seems obvious that corporations that pollute must install expensive equipment to clean up their emissions and effluents. The money must come to them from higher prices to consumers, or from higher taxes to taxpayers through tax writeoffs on abatement equipment, through outright Federal grants for abatement research and development, and so forth.

**Such a view** oversimplifies reality, according to such economists as Harvard's John Kenneth Galbraith. These economists agree with environmentalists that many other questions must be asked. The key one, perhaps, is what is the cost of continuing to pollute the air and water? But there are others. For instance, there is the related question of how to measure the quality of American life and the extent to which more consumer goods and increasing energy consumption either add to or detract from this quality. Another question is whether the consumer or taxpayer must really always pay for abatement. Could some companies, for instance, reduce costs in other areas—such as advertising—so as to pay for pollution abatement?

None of these questions are easily answered, partly because they deal as often with unquantifiable intangibles as with tangible items to which a dollar value can be assigned. Galbraith has recently spoken of "external diseconomies," uncalculated human and ecological costs of modern technology. But it is difficult to calculate in dollars the cost of a massive fish kill (especially if the fish are not commercially valuable) and it is even more difficult to gauge and assign a dollar deficit to possible mental health effects of urban air pollution (SN: 7/17/71, p. 43).

Some of the diseconomies are measurable, of course. Some 100 dock workers were made seriously ill by air pollution along the Houston, Texas, Ship Channel in four air-pollution incidents since April 22. The medical costs (if not the pain and inconvenience) of the 100 workers should be clearly quantifiable. A Texas air-quality agency is asking for a shutdown of the chemical plant accused of causing the incidents.

But there are startlingly few detailed studies of the "external diseconomies." A 1913 Mellon Institute study of smoke pollution in Pittsburgh showed per capita costs averaged $20 a year;