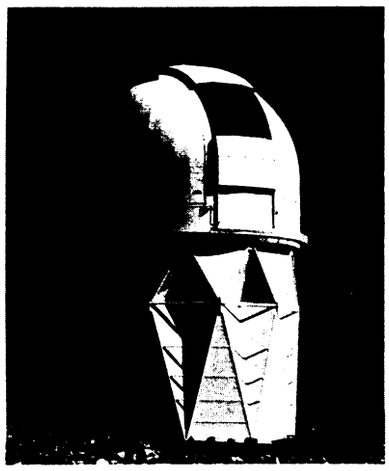
First light through Kitt Peak's 158-incher

One of the most active fields in astronomy is the study of objects at the farthest reaches of the visible universe. These distant galaxies and quasars fascinate astronomers because of their possible contributions to both astrophysics and cosmology.

Such objects can be studied only with the largest telescopes in existence. But astronomers wishing to observe the most distant parts of the universe have encountered severe competition for time on the biggest telescopes. There are just too few large telescopes to go around.

Some of this slack will be taken up by the new 158-inch Mayall telescope nearing completion at Kitt Peak National Observatory in southern Arizona. This week the Mayall telescope underwent the ceremony known as "letting in the first light." The event is comparable to the launching of a ship: The basic parts are in place and proven sound, but additions and adjustments remain to be made before the telescope is fully operational.

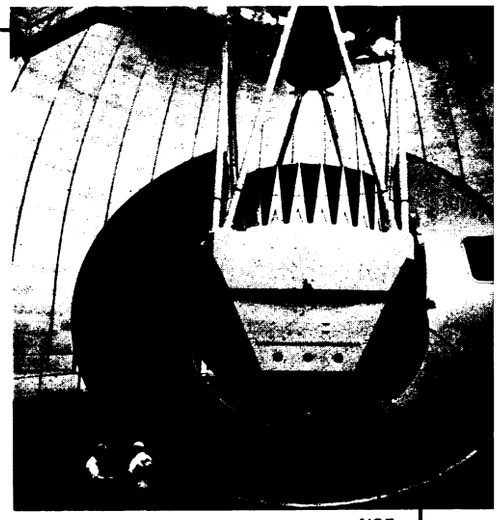


Dome is high as 19-story building.

The telescope, named in honor of Nicholas U. Mayall, retired director of the observatory, will be the second largest reflecting telescope in the world when it is dedicated in June. The only larger one at present is the 200-inch instrument at Mt. Palomar in California. The Russians are building a telescope with a 236-inch aperture at Zelinchuk in the Caucasus Mountains, and a telescope described as nearly a twin to the Mayall is being built at the Cerro Tololo Inter-American Observatory in Chile.

The Mayall will have a wider field of view than any existing telescope, six times wider than that of the largest telescope. This will give about 40 times as much sky coverage. Photographic plates as large as 14 inches square will record an area of the sky about twice as large as the moon. The wide field of view should make searches for faint and distant objects somewhat easier.

The new telescope will have three main focal positions, prime focus, Cassegrain and Coudé. The prime focus lies within the telescope tube at the point where light rays reflected by the concave primary mirror converge. An astronomer in an observing cage inside the tube can record the image. For the Cassegrain focus, a secondary mirror reflects the converging beams back down the tube through a 50-inch hole in the primary to a focus slightly behind the primary. This is expected to be the most popular system. In the Coudé focus mirrors send the converging beam laterally outside the tube to a focus in the telescope building where equipment can be set up to analyze the light.



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New telescope mounted in its dome.

The telescope is housed in a circular building 105 feet in diameter and 185 feet high (equal to a 19-story building). The dome, which rotates, weighs 500 tons. Major contracts for construction were let in 1967, and construction started in 1968. The National Science Foundation provided the $10 million cost.

lieves, could have been avoided if the weather modifiers and their sponsors had invited extensive local involvement during the early planning stages of the projects. Positive relationships could have been built up, questions answered and fears allayed. "The science is sufficiently vague," he says, "that many things can be explained away."

W. J. D. Kennedy of the National Center for Atmospheric Research in Boulder agrees that good public relations are necessary. He says, "Weather modification scientists and sponsoring government agencies have failed to recognize how fragile this important resource really is." Tension between the scientist and the public, he says, "should be a matter of concern for the pragmatic scientist who wants to press on with his work." If a serious rift occurs, it is possible that Federal lawmakers will step in with restrictive legislation that would melt any public relations snow job.

Last week, for instance, Rep. Frank E. Evans (D–Colo.) introduced a weather modification bill (H.R. 4770) that some scientists feel would make it extremely difficult for commercial and experimental weather modifiers to operate. The bill, in its present form, requires that weather modifiers obtain a Federal permit and a state license (to ensure local participation) before any work be attempted. After a rigorous review of the operator's qualifications and the aims of the project, a bond (up to $1 million) would have to be posted on each project to protect persons or property injured by the project. The bill would also require extensive reporting before, during and after the project.

Haas feels that such restrictive legislation can be avoided if the weather modifiers tread lightly. But Kennedy warns that "weather modification scientists may be in for some difficult years unless they adopt a more enlightened and more effective policy of interaction with the public." □

Radar off Saturn's rings: Chunks of solid debris

Radar astronomy is the one non-passive form of the science. In other cases astronomers must observe the emanations given off by celestial bodies and draw what conclusions they can from them. With radar, astronomers can send a signal to a celestial body and receive the reflection. This often gives information, especially about surface conditions, that passive watching does not.

So far radar is useful only with bodies in the solar system to which a signal can be sent and reflected in strength. Radar has been especially prominent in studies of Venus and Mercury, but it has been gradually moving farther out to distant parts of the system. Its latest achievement, reported by the Jet Propulsion Laboratory in Pasadena, is the reflection of a signal off the rings of Saturn.

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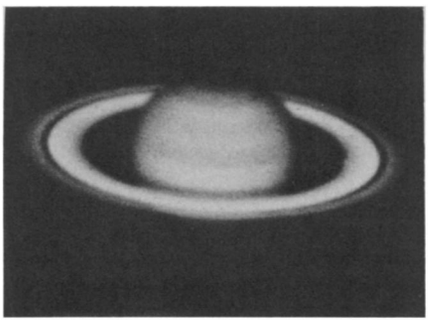

Meter-sized chunks of junk in rings.

Saturn's rings are unique in the solar system and have fascinated observers for centuries. In time past astronomers have thought the rings were the remains of a satellite that strayed too near the planet and was shattered by tidal forces. Lately the belief has grown that they are composed of fairly tenuous matter: ice crystals, dust or gas. So strong was this supposition that the National Aeronautics and Space Administration has been advised that they pose little or no hazard to future spacecraft.

The radar results disagree with this idea. They reveal solid chunks, a meter or more in diameter, and possibly much larger. They have to be closely packed, although not too closely since starlight can be seen shining through them. The rings "must be considered an extreme hazard to any spacecraft sent in or near the rings," warns Richard M. Goldstein, who did the observation with George A. Morris Jr.

In 1977 NASA plans to launch a space probe that will fly by Jupiter in 1979 and Saturn in 1981. The closest approach to Saturn will be about 207,000 kilometers. In spite of past advice about the rings, NASA has decided that the first approach to Saturn will be from a very safe distance. The rings extend to 140,000 kilometers from the planet. They are three in number and begin about 90,000 kilometers out. The width of the principal inner ring is estimated at 25,000 kilometers; the outer ring at 16,000.

Saturn itself reflected no radar signal. This could indicate that the planet has no solid surface or that its atmosphere absorbed the radar signal before the signal reached the surface.

The work was done in December and January with the 210-foot antenna at the Goldstone station on the Mojave Desert in California. Saturn was about 1.12 billion kilometers away. The signals took two and a half hours for the round trip.

"We received much stronger bounce-back signals than we expected from such a distance," says Goldstein. "The signals from the rings were five times stronger than Venus would be at that size and distance." □

PKU: New insights into cause and effects

Phenylketonuria (PKU) is the most common disorder of amino acid metabolism in man. Until a few years ago, a buildup of the amino acid phenylalanine in children with PKU triggered severe, irreversible brain damage. Now newborns are screened regularly for the disease. If they are found to have it, they are put on diets lacking in phenylalanine. This way, no phenylalanine can build up in their bodies and damage their brains.

Although PKU can now be prevented, scientists still have much to learn about its precise cause and effects. Investigators know, for example, that the cause of classical PKU is a deficiency in a particular liver enzyme, phenylalanine 4-hydroxylase. This enzyme is needed to break phenylalanine down, so that it can leave the body and not damage the brain. They have not been certain, however, whether the deficiency lies in an absence of enzyme or in some structural defect in the enzyme. In the February PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, Paul A. Friedman and his team of neurochemists at the National Institute of Mental Health report the first evidence which argues for a structural defect.

They took a sample of liver tissue from a patient with classical PKU and found that it contained a structurally altered phenylalanine 4-hydroxylase with small, but significant activity. They believe that the structurally altered enzyme probably results from a mutation in the gene coding for it. They have also found that deficient phenylalanine 4-hydroxylase activity has nothing to do with a deficiency in iron or in other chemicals that help the enzyme metabolize phenylalanine.

As for the effects of PKU—brain damage—R. L. Miller, R. A. Hawkins and R. L. Veech of St. Elizabeths Hospital in Washington have found that the damage may result from the blocking of sugar-metabolizing enzymes in the brain by phenylalanine. They report their findings in the March 2 SCIENCE.

They injected phenylalanine, in concentrations comparable to that found in PKU patients, into the brains of newborn and adult rats. Thanks to a technique Veech had developed, they were able to remove and freeze the brains in half a second, so they could examine the effects of the phenylalanine injections on brain sugar-metabolizing enzymes. They found that pyruvate kinase, one of the crucial sugar-metabolizing enzymes, was blocked by phenylalanine in both newborn and adult rats. Other researchers have also found, in brain tissue rather than in live animal studies, that phenylalanine can block this enzyme.

The authors caution that enzyme blockage does not necessarily mean disruption of sugar metabolism and energy production. The brain may have other biochemical pathways around the blocked enzyme. Just last week, in fact, Hawkins and his co-workers found that the brains of adult rats do have such alternate routes. But he notes that the infant brain is known to contain only about 10 percent of the sugar-metabolizing enzymes found in the adult brain. So phenylalanine blockage of sugar-metabolizing enzymes might very well disrupt sugar metabolism in the young brain, but not in the adult brain. He and his colleagues now want to test this possibility in young rats.

The St. Elizabeths Hospital neurochemists are not sure whether a possible disruption in brain sugar metabolism might tie in with known damage in PKU victims of the myelin sheaths surrounding nerve fibers. Some other researchers recently reported that phenylalanine can inhibit the synthesis of myelin (fat). So it is quite feasible, Hawkins says, that phenylalanine might inhibit both sugar and fat metabolism in the brain. Either or both kinds of inhibition might cause brain damage. □

Nutrition briefs . . .

The U.S. Department of Agriculture has issued a cost-per-protein-equivalent guide to help shoppers overcome the skyrocketing cost of meat. A typical serving of roast rib of beef, the guide points out, costs three times as much as a serving of turkey providing the same amount of protein. And though bologna costs less than half the price per pound of rib roast, to get the same amount of protein, a much larger portion of bologna must be served, at a higher net price. For comparison purposes, the guide charts the cost of providing one-third the minimum daily requirement of protein (20 grams) by various meats or substitutes. A three-ounce serving of lean beef, lamb, pork, turkey or fish easily provides the 20 grams, but the cost varies from 20¢ for a three-ounce serving of hamburger to 59¢ for three ounces of rib roast (Aug. '72 prices). The cheapest way to eat 20 grams of protein is to cook up a cup of dried beans (6¢) or eat four and a half tablespoons of peanut butter (12¢). Eggs, chicken, some fish and beef liver were also listed as bargains. Among the most expensive items were 20-gram protein equivalents of bacon (10 slices 52¢), sausage (½ pound 45¢) and frankfurters (3½ for 33¢).

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Time was when U.S. standards of purity kept many imported food products off supermarket shelves. Now the