ASTRONOMY

Three Giant Eyes

New 120-inch telescope on Mount Hamilton will be completed within a few years. This will give California the world's three largest telescopes.

See Front Cover

By MARTHA G. MORROW

➤ THREE GIANT eyes will be scanning the heavens from California mountain tops within a year or two. The 200-inch telescope high on Mount Palomar and the 100-inch atop nearby Mount Wilson are already hard at work. A new 120-inch telescope, second largest in the world, is now being created on Mount Hamilton. It will be housed in the building shown in the foreground on the cover of this week's SCIENCE NEWS LETTER.

When the third big eye goes to work, Californians can boast of the three largest telescopes in the world. And well they might brag, for the state of California is footing the bills for the 120-inch telescope. This is the first large telescope ever authorized by a state legislature.

A giant's house has just been completed for the telescope. The room in which the instrument will be kept is 94 feet high and 97 feet across. Almost 4,000 sacks of cement were used in laying the foundations. The door is so wide trucks can be driven right into the room. A 45-cubic-foot refrigerator has been installed for storing plates to be used in photographing the heavens.

These three giant eyes of California, all mirror or reflecting telescopes, will work as a team, reports Dr. C. D. Shane, director of the University of California's Lick Observatory on Mount Hamilton. There will be no duplication of observations. Each will have its own specific task, but the observing program of one telescope will be coordinated with that of the other two. Sometimes two together will try to solve one problem.

Predict Operation in 1954

The new 120-inch telescope will join an already-illustrious family of instruments at Lick Observatory. The 36-inch refracting or lens telescope, once the world's best, for over a half century has claimed distinction as the second largest of its type in the world. Here one also finds a camera with a 20-inch lens designed specially for photographing the heavens, and other keen-eyed telescopes.

The 120-inch telescope is far from finished. It probably will not go into operation until about 1954. But the gigantic mirror blank, critical part of the new instrument, is already in the new building.

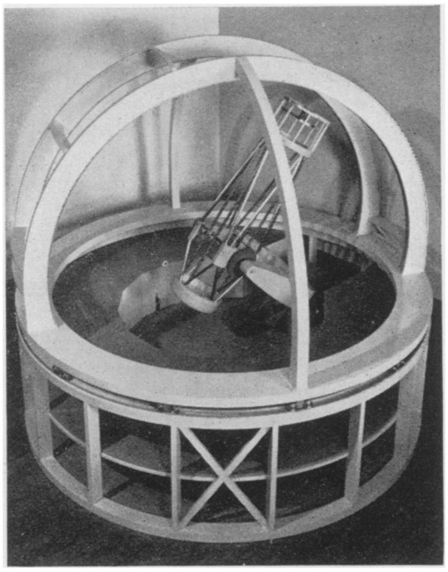
The glass blank, ten feet across, was recently installed in the basement grinding pit of the new observatory building. Soon rough parts will be worn away to produce a perfect parabolic curve.

From the grinding pit extends a tunnel 11 feet high, 11 feet wide and 73 feet long. This was dug so that after grinding, the ribbed disk can be tested right there in the building to be sure that light which strikes it when stood on its edge is focused to a pinpoint.

The four-ton mirror blank was a lucky find. It did not have to be created at great expense. It had already been cast back in 1933, and was gathering dust in a Pasadena basement. The pyrex disk was sold to Lick Observatory at its original cost.

The lens was originally made for the California Institute of Technology, to be used in testing the 200-inch mirror put into operation just four years ago. But another method of testing was used on the Giant of Palomar, so its smaller stepsister had never been polished. Now this bargain-basement lens has become a telescopic Cinderella.

Originally Lick Observatory astronomers planned to use a conventional solid-back mirror for the telescope. But inquiries showed that it would be difficult to have a suitable glass made in the United States. About this time Palomar's 200-inch mirror with its ribbed back was proven an unquestionable success. So the planners switched to this lighter, more-available type. In purchasing the 120-inch test mirror, they sped up completion of the telescope by about two years and cut in half the overall weight of the mirror.



TELESCOPE MODEL—How the 120-inch telescope and its dome are expected to look upon completion is shown in this photograph of a model.

The grinding machinery for the mirror, 16 inches thick, also was bought from the California Institute of Technology. The know-how for putting the lens into shape is being supplied by Don Hendrix of Mount Wilson and Palomar Observatories of the Carnegie Institution of Washington and the California Institute of Technology.

Astronomers working with the new instrument will ride high above the mirror. A cage at the tip-top of the telescope tube, 50 feet above the lens, will carry the observer and necessary equipment. Here at the prime focus photographs can be taken.

To cut off as little light as possible, this cage will be elliptical instead of circular. Only about 11% of the light which otherwise would fall on the mirror will be intercepted by the elliptical cage, 48 inches by 32 inches across. This 120-inch telescope and the 200-inch one are the only telescopes in the world built to carry an astronomer in the tube.

First Fork-Type Support

For the first time, a long fork-type support will be used on a large telescope. This two-pronged, 70-ton steel fork can be motor-driven at will around its polar axis. A second motor will drive the 35-ton tube holding the mirror at its lower end. The whole sky, except a band close to the horizon, can be studied with the telescope.

The hollow fork will have an overall length of 23 feet, eight feet longer than is needed for the telescope lens and tube. This extra length is provided so that a Cassegrain spectrograph, which fans out the light of a star or nebula into its rainbow colors, can be located directly beneath the large mirror. This arrangement saves the light that otherwise would be lost by another reflection.

Total cost of the telescope and its housing will run somewhere around $1,800,000. This is about double the amount estimated a decade ago when the project was first approved by the California Legislature. But lessons learned in constructing the two giant eyes of California and other large reflectors are helping University of California astronomers keep the cost to a minimum despite ever-rising prices.

A tiny model of the telescope, one-sixteenth its actual size, was built some years ago by the designer, W. W. Baustain. With this he sought in a miniature observatory to solve in advance the problems which would be encountered in the telescope's operation. Many improvements have been devised since this first model was made.

To keep the telescope as cool during the daytime as at night, the steel dome will be insulated with aluminum-foil. A relatively light main shutter 22 feet wide will travel up and over the dome. When stars high in the sky are being studied, the partially-closed shutter will serve as a windscreen.

In the new building the lens can be tested both in flat and upright positions without being taken out of the grinding room. A section of the floor above the grinding machine can easily be removed and a knife-edge test stand mounted on the crane carriage 89 feet above the mirror, still safe in the grinding pit. This arrangement plus the light tunnel will cut to a minimum the time spent in testing the lens.

"The design of the telescope is really quite conservative," states Dr. Shane. "It was kept this way so that almost any type of auxiliary equipment usable on large telescopes could be installed when needed."

The new telescope will take astronomers 5,500 billion billion miles out into space. It will make visible faint stars and cities of stars beyond the reach of all but the Palomar giant. Although it will not be in operation for a few years, astronomers are planning how to use its time to best advantage.

When the moon is new and the night sky visible in all its glory, the motion and rotation of star systems far out in space will be studied by Dr. Nicholas U. Mayall and other astronomers of Lick Observatory. When the full moon makes the sky too bright, Lick's Dr. George Herbig and Dr. Otto Struve of the Leuschner Observatory in Berkeley will have a chance to study the dispersed light of stars in order to determine their structure and chemical makeup.

Lick astronomers Drs. Gerald Kron and Olin J. Eggen are looking forward to attaching their photoelectric equipment to the new telescope to determine more exactly light changes in certain faint stars and nebulae. Dr. Shane expects to search for faraway systems of millions of stars and estimate their number in sample sky regions.

Whatever time is left from these studies also will be well spent. This new giant eye, like its astronomical brothers, will work hard to extend man's knowledge of the vast universe of which our earth is a tiny part.

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ANIMAL NUTRITION

Chickens Make Protein

Radioactive sulfur injected into chickens shows up in egg as cystine, proving that poultry can convert inorganic sulfur to a protein.

➤ CHICKENS can make one of their own proteins from inorganic sulfur, a feat previously believed possible only for green plants and microorganisms. It is the first time that an animal has been known to make a protein from inorganic sulfur.

The protein the chickens make is cystine. And the fact that they can build this protein may mean cheaper feed bills for the farmer, although further experiments are needed to find out exactly how much cystine is made by the chicken.

Discovery of the protein-building process was described by L. J. Machlin of the U. S. Department of Agriculture, Beltsville, Md. He reported to the American Institute of Nutrition meeting in New York that radioactive sulfur was used to show that chickens can make their own cystine. Dr. H. R. Bird, Dr. P. B. Pearson and C. A. Denton were co-workers in the experiments.

The scientists injected very dilute sulfuric acid containing radioactive sulfur into the hens. When they tested the eggs laid by these hens, radioactive sulfur was found.

Proteins are made up of amino acids, nature's building blocks, of which there are about 20. Two of these, methionine and cystine, contain sulfur and are found in nearly all proteins.

Green plants and microorganisms make methionine and cystine using inorganic sulfur such as sulfuric acid and its salts, but this process was supposed to be impossible for animals. They were believed to get all of their sulfur-containing amino acids by eating plants or by eating the meat of other animals that ate plants.

To find out exactly what was the form of the radioactive sulfur, the proteins were broken down into amino acids and the sulfur-containing cystine and methionine separated by paper chromatography.

"When the paper strip having methionine was brought close to a Geiger counter," Dr. Bird told Science Service, "there was only the usual number of background clicks. When, however, the paper strip containing cystine was tested, the counter sounded like a corn popper."

Thus they showed that the hens were able to use inorganic sulfate to make cystine but not methionine. The chickens have to depend on their diet for pre-formed methionine.

Now the poultry specialists would like to find out just how much cystine is made by chickens, Dr. Bird stated. The radioactive detecting method is so sensitive that only very small amounts of cystine may be involved. He also pointed out that the chickens on which these experiments were performed were already getting adequate amounts of both cystine and methionine in their standard diets, so would not need to make it for themselves at all, although they did anyway. It would be interesting, he said, to test chickens not fed cystine for then there might be some biological incentive to make the protein.

But the fact that the hen can make cystine at all is of great importance, because the United States has never had enough protein to feed its livestock population for most efficient production of meat, milk and eggs.

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