ASTRONOMY

200-Inch to Test Theories

Hope to determine such problems as whether the universe is expanding, abundance of chemical elements in stars and if there are canals on Mars.

By MARTHA MORROW

See Front Cover

➤ THE 200-inch telescope on Palomar Mountain, in San Diego County, Calif., so enormous it completely overawes one, will only be given tasks fit for such a benevolent giant.

By taking a snapshot of Mars for the first time, it should allow astronomers to decide whether intelligent beings have lived on the planet.

Most of the time of the "big eye" will be reserved for hunting stellar "game" too distant or too faint to be caught by smaller instruments. It will be able to see millions of groups of stars so distant that the light it records started on its way to us a billion years ago.

The telescope will finally swing into action next June or July, predict officials of the California Institute of Technology and the Mount Wilson Observatory, responsible for its operation.

Its first problems will be designed to confirm, if possible, many theories which already exist. It may be within the power of this keenest-eyed of all telescopes to determine:

Whether the universe is expanding.

The relative abundance of chemical elements in the stars.

Whether there are canals on the planet Mars.

Structure of the Universe

The 200-inch telescope, because of its ability to penetrate into space twice as far as has ever been possible before, may help astronomers decide the structure and behavior of the universe as a whole. Up to the present, astronomers have had to infer the nature of the universe from the sample around us—the only portion they could see.

The Palomar telescope will permit us to explore a volume of space about eight times as great as that now available. It will give astronomers a larger sample with which to work.

Light from distant groups of millions of stars, when broken up by a prism, has been found shifted to the red end of the spectra. Many astrophysicists believe this indicates that these far-away nebulae are racing away from the earth and that the entire universe is expanding. By gathering in light from twice as great a distance as was ever possible before, the giant eye should make it possible to confirm this theory or indicate that this phenomenon must be attributed to some new principle of nature.

Enough light will be gathered by the 200-inch telescope to make it possible to spread the spectra of stars over a much wider area than ever before. By fanning out the light even farther, more detailed study of the spectra of stars and nebulae can be undertaken. By comparing data already obtained with what the new telescope tells us, astronomers may determine the relative abundance of chemical elements of stars and nebulae.

Such new data will bear directly on two fundamental problems: the source of stellar energy and the origin of chemical elements.

Great Light-Gathering Power

The telescope was not designed to study near-by planets, but to reach out farther into the universe than ever before, Dr. Ira S. Bowen, director of the Mount Wilson Observatory, who will also direct the observatory atop Palomar Mountain when it is completed, reports. But because of its great light-gathering power, the 200-inch makes it possible for the first time to take a snapshot of the planet.

All photographs of Mars in the past have had to be time exposures, many minutes being needed for the planet's faint light to show up sufficiently on the plate. But the shimmer or twinkling of the planet also showed up on the film and made it impossible to obtain a clear picture.

The 200-inch telescope will gather enough light to produce a picture that should be sharp enough to disclose the canals, if they exist. These so-called canals, if found, would probably be accepted as indication that intelligent life exists on Mars today or was there in the past.

These are a few examples of what may be accomplished with the 200-inch telescope, that will surpass all others in resolving power, dispersion and space penetration. But many years will probably pass before these and other questions, that have been puzzling man for hundreds and even thousands of years, can be answered.

For the first time the new 200-inch Palomar telescope will enable astronomers to see visually some of the far distant nebulae with which they have been working for years.

Dr. Edwin P. Hubble, of Mount Wilson and Palomar Observatories, a leading investigator of the distant galaxies, looks forward eagerly to the night this will happen.

"Some of the nebulae we have been working on for many years with Mount Wilson's 100-inch telescope were not visible through the telescope but did show up on photographic plates, Dr. Hubble explained. "These we shall now be able to see through the 200-inch."

But ever striving to push back the veil of distance, Dr. Hubble and his associates will again be working with a set of nebulae, this time a new set, that cannot be seen visually. Only after photographic plates have soaked up their light for many minutes, or even hours, will they show up as pinpoints of brightness.

Distant nebulae such as these are very important in studying the evolution of star systems.

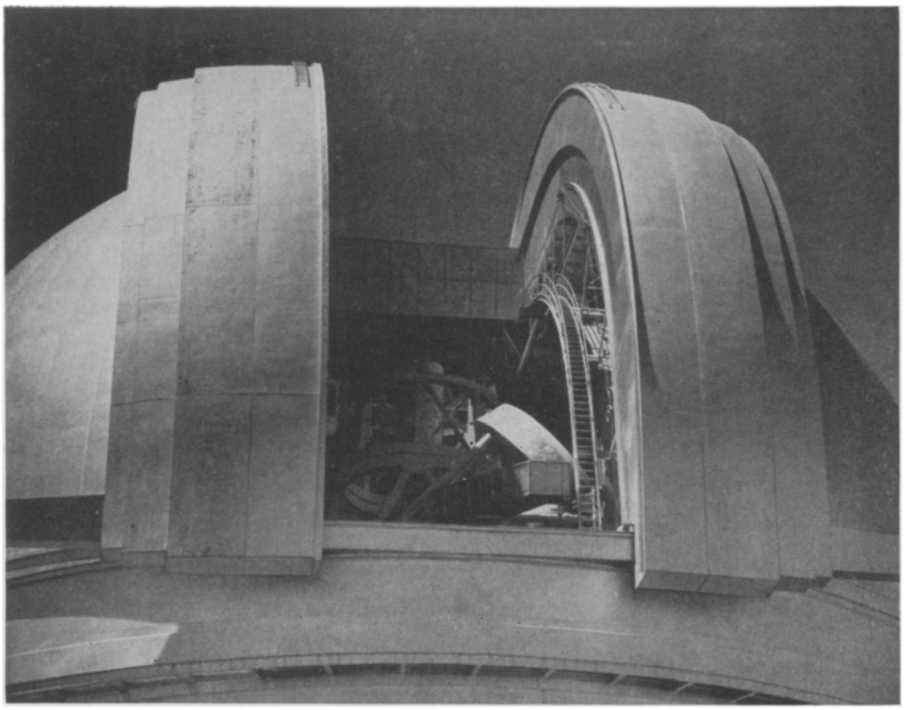
The 200-inch telescope is the world's most complete push-button observatory. The tremendous telescope atop Palomar Mountain is so perfectly balanced that a push of a button sets it in motion.

Telescope Moved Electrically

The telescope tube, complete with its cage, is 55 feet long and weighs 140 tons. Unlike small telescopes, that can be swung into position by a push of the hand or by simple mechanical means, the telescope is moved electrically.

So that little time will be lost when seeing is good, the telescope can be set so it automatically seeks a star's position. This automatic setting is accurate to one second of arc.

The telescope not only locates the star, but follows it across the sky. The speed with which the telescope slowly moves is adjusted to agree with the rate at which the star climbs up from the horizon. Either the astronomer who "rides"



PALOMAR TELESCOPE—This shows the 200-inch dome with its shutters open, revealing a portion of the telescrope and the prime focus platform.

the telescope or his assistant at the controls below can set the telescope into motion.

A lot of light is thrown away by the 200-inch mirror of Palomar's giant telescope without cutting down its efficiency.

In the center of the mirror there is a hole 40 inches across. This is the exact size of the lens in the world's largest refracting telescope at Yerkes Observatory. This opening in the mirror was needed so light from the Cassegrain mirror could be brought to a focus below the mirror. It is not large enough to in any way affect the utility of the mirror. A certain amount of light must be cut off in all reflecting telescopes.

This is the first telescope so large that the amount of light it is feasible to throw away can hold a man. It is the only telescope in the world in which an observer actually rides. Photographs are taken and the astronomer actually sits in a 72-inch cage at the telescope's prime focus, high above the mirror, as shown on the cover of this week's SCIENCE NEWS LETTER. It is approached by a moveable carriage.

At present the supports on the 15-ton mirror are being adjusted and readjusted so that its parabolic surface will be accurate to within two millionths of an inch, irrespective of the direction in which the massive piece of glass is tilted. This high degree of accuracy was made possible by Dr. John A. Anderson, who supervised the mirror's grinding and polishing.

The mirror, including the cellular back, is approximately 24 inches thick at the edges and 20½ inches at the center. But its solid face is only about 4½ inches thick.

Begin Work Early in Summer

The telescope is expected to begin work early this summer. At first it will be used solely for photographic work. Only the one gigantic mirror, in perfect adjustment, is needed for this. The plate is placed at the telescope's prime focus and six to a dozen photographs can be made a night, depending on the exposure required.

Although the 200-inch is the primary and most important mirror, the telescope will have six others. Three of these are convex and three flat. They will be used for the Cassegrain and Coude focuses.

The auxiliary mirrors, themselves several feet across, will be mounted in the telescope so that they can be used in any combination necessary. When not needed, they can be moved into positions where they do not obstruct other focuses.

Several enormous prisms will also be needed to complete the telescope. These are needed to study the spectra of distant nebulae or faint stars.

It will probably be another two or three years before the telescope is really completed with all its auxiliary equipment, estimates Dr. Bowen. Although direct photography will be possible early this summer, spectroscopic studies must be postponed until the other mirrors and prisms are in position.

Another push-button telescope, located near-by on Palomar peak, is also expected to begin work this summer. This is the 48-inch Schmidt-type telescope, the largest of its type.

The Schmidt will map the skies and search for objects worthy of the "big eye's" time. This telescope is itself capable of reaching millions of light years out into space (a light year is the vast distance over which light, traveling 186,000 miles a second, passes in a year).

The Schmidt at a glance sees much more than the 200-inch. On one plate it shows a field 36 square degrees in area. The 200-inch telescopic giant pinpoints its vision on a field only a quarter of a square degree in area.

These two major telescopes and the

Do You Know?

The buttery taste of *margarine* is obtained from milk which is treated with lactic acid bacteria, the same bacteria which give butter its distinctive flavor.

Light travels at about 11,000,000 miles a minute, so a *light-year,* a unit of distance used by astronomers, is about 6,000,000,000,000 miles.

Efforts to prolong the life of automotive and aviation engine pistons by coating the tops with pure *beryllium,* made in Germany during the war, gave promising results.

Bands of fertilizer along the rows, coupled with fertilizer plowed under, is said to be the best method of application for *tomato* plants.

What is known as *bicolor lespedeza* provides a seed which quail and other wildlife enjoy.

Eggs labelled Extra Large must weigh at least 27 ounces to the dozen.

other smaller ones on Palomar Mountain are the property of the California Institute of Technology. The observatory, however, will be run jointly by Cal. Tech and the Carnegie Institution of Washington. The work at Mount Wilson and Palomar will be so integrated that the excellent telescopes on these near-by mountains, each best suited to a specific task, will be used to maximum advantage.

The 200-inch telescope represents man's most daring effort to reach out into space. It results primarily from the vision, foresight and efforts of the late Dr. George Ellery Hale, "father" of Mount Wilson Observatory. He obtained from the Rockefeller Foundation the money with which to build the Palomar telescope and observatory. In all, more than six and a half million dollars was given to Cal. Tech. for this vast scientific instrument.

The telescope's construction has been under the direction of an observatory council headed by Dr. Hale and, after his death, by Dr. Max Mason.

Dr. Hale did not live to see his dream come true, but he did see it well on its way to completion. It is up to others—to those who use its fruits to unlock the secrets of the universe—to justify this tremendous undertaking.

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ASTRONOMY

Minor Planet Near Earth

Tiny asteroid is fourth or fifth known to have entered the earth's orbit. It will come within 15,500,000 miles of the earth and 84,000,000 miles of the sun.

➤ A NEW tiny planet, one of only four or five known to have entered the earth's orbit, has been spotted by C. A. Wirtanen of Lick Observatory of the University of California. It will come within 15,500,000 miles of the earth and 84,000,000 miles of the sun.

Minor planets usually whirl around the sun in orbits lying between the paths followed by Mars and Jupiter. But instead of staying between the orbits of these two large planets and thus keeping 140,000,000 to 485,000,00 miles from the sun, this asteroid gets even closer to the sun than does the earth.

When first spotted on photographic plates, the asteroid was of about the 13th magnitude, and thus visible only through a powerful telescope, states Dr. C. D. Shane, Lick Observatory director. Since then it has brightened slightly as it approached the earth, and is now 12th magnitude.

The tiny planet, about two miles in diameter, was discovered on March 7. It was found to be rapidly approaching the earth. On March 22 it was about 111,500,000 miles from the sun (the earth is 93,000,000 miles from the sun) and within 21,000,000 miles of the earth, calculates Dr. Leland E. Cunningham of the university's Students' Observatory. By March 30 it was less than 18,000,000 miles away. But there is no danger of this flying mountain crashing into our planet—it can never come nearer than 15,500,000 miles of the earth, study of its path shows.

Only three or four asteroids of the known 1,600 previously have entered the earth's orbit. One of these came almost as near to the sun as the planet Mercury, the innermost of the planets. Each of these faint asteroids was visible for such a short time, however, that it was impossible to accurately calculate their paths and the length of time needed for them to race around the sun. They have since been lost in space.

Wirtanen's new asteroid, on the other hand, will probably not be lost. It has already been observed on several nights.

Going rapidly south of the earth, about the middle of April the planet will be directly under the earth, where it can be seen all night by observers in the southern hemisphere. At that time it will be just about as close to the earth as it can come.

The minor planet will make its closest approach to the sun on May 21. It will then be 9,000,000 miles closer to the sun than is the earth. But despite its nearness to the sun, it will probably be two or three magnitudes fainter than it is now.

This is because we will not be seeing the fully illuminated disk of the planet, but only a part of it. Just as the moon at quarter is not as bright as when we see its entire disk lighted by the sun, so this asteroid will appear fainter even though nearer the sun than at present.

Science News Letter, April 3, 1948