of about two inches in the central section of the slab. It is expected that the mirror will be spherical and ready for its first tests by next spring. Then will come the delicate job of parabolizing its surfaces to the final exact shape. This is expected, with luck, to be finished sometime in 1939. Finally for testing purposes when the mirror is installed, a small central section will again be made spherical, co-axial with the parabola. This will be just another unique feature of the 200-inch, but one which is expected to be of great value.

When the surface has been ground accurately to its final shape, there remains the formation of the reflecting surface. This will be aluminum deposited on the glass by evaporation while the whole mirror is in a very good vacuum. Such a process results in a better mirror than the more conventional silver. This technique was developed at the the Institute by Dr. J. D. Strong only a few years ago, but has already been applied successfully to many telescopes from the 100-inch down.

The complete optical system of the 200-inch contains some half dozen auxiliary mirrors ranging in size from about 40" on down. Work is now in progress on these mirrors at the Optical Shop, grinding being done at a number of small machines that look like toys when compared with the 200-inch grinding machine.

THE DOME

By Mark Serrurier, '26

At the present time, a force of about 25 men is busy erecting the dome for the 200-inch telescope building. In a general way, this dome is similar in appearance, and performs the same functions as the dome for the 100-inch telescope.

Since the 100-inch telescope was built many new materials and processes have been developed which had to be considered in designing the new 200-inch dome. Stainless steel and dural were considered, but no justification was found for using either of these for the structure of the dome. Aluminum foil, however, was adopted as the material for insulating the dome.

The development of the coated rod has made welded joints reliable. The use of welding is increasing so rapidly that it was given very careful consideration in order that the finished structure would still be considered modern some years in the future.

Furthermore, welding lent itself to the so-called monocoque type of construction which has been developed to such a high degree by the airplane industry. Here again was something which would stamp the dome as a modern structure for many years to come.

The design group was very fortunate in having on the campus Dr. von Karman and Professor Martel, who directed the theoretical and experimental research necessary to make a proper design. Ernie Sechler, 27, and Bill Bollay, assisted them in this work. In order to check the theoretical results and the applicability of previous tests by others, tests were made on a small model of the dome. The model consisted of a copper hemisphere 36 inches in diameter with a copper cylinder soldered to it. The model was tested in a great variety of ways, before and after cutting the slot.

The model was loaded by floating in mercury; that is the model was inverted and fastened to a concrete basin just a little larger than itself, and then the mercury was poured in. Concentrated loads were applied through a system of levers.

Various steel fabricating companies were consulted about the size of the plates, cost of dishing plates, minimum thickness of plates and method of erection.

A thumbnail description of the dome would read about as follows: The dome consists of a hemisphere 137 feet in diameter on top of a cylinder 27 feet high. The hemisphere is made from 3/8-inch plates which were dished to the proper radius in the shop. The maximum size which could be economically handled was 7 by 22 feet. The framework was designed so that the plates were laid with their long dimension vertical and the joints between them came over a member of the frame work. The joint between the plates was a butt weld. The cylinder is made from 3/8-inch plates, 100 inches wide and about 27 feet long. On each side of the shutter opening is an arch which is 3 feet wide and 8 feet deep. Near the bottom of the cylinder is a balcony which is also a horizontal plate girder whose function is to keep the bottom of the dome circular. The dome, which will weigh approximately 1,000 tons, will be entirely welded, no rivets or bolts being used.

CONSTRUCTION ON PALOMAR

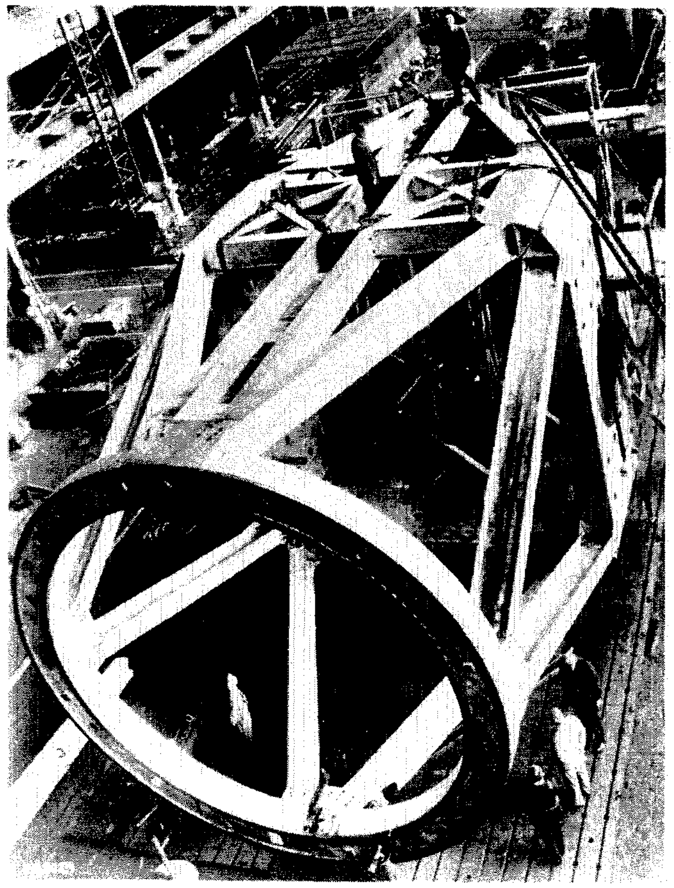
By Bruce Rule, '32

In addition to the extensive grinding program for the 200-inch mirror, and aside from the numerous engineering problems in the design and construction of the tube, its mounting and its housing stucture or dome, there are other interesting features in the Palomar Mountain Telescope project: such as providing of complete utilities at the mountain site, entirely independent of the outside world except for supply trucks.

First work was begun at the site in the fall of 1935. A water supply below the site was developed, a pumping plant installed, a million gallon storage reservoir and elevated tanks built, and the necessary pipe lines laid. Then a Diesel powered generating plant followed to supply light and power for the workcamp, cottages, shops and telescope. Butane storage tanks were installed for heating and cooking. Local roads were constructed, brush cleared, fire lines installed, sanitation system completed, and a local automatic dialing telephone system put into operation.

With headquarters on the Institute campus, the problem of supervision and communication to and from the site was solved by an automatic two-way short wave radio telephone which is giving reliable service and has been on more than one occasion the only contact with the outside world.

In outward appearance the 200-inch Dome building will be similar to the Mt. Wilson 100-inch, but larger. In the cylindrical housing below the dome proper, the ground



Telescope Frame During Construction at Westinghouse Plant

floor will be given over to various offices, a library, and laboratory. The mezzanine floor will contain machinery rooms for the telescope and elevator, the main switchboard, the battery room, telescope control cables and racks. The observing floor, covered by the round insulated dome with its shutters, will contain, of course, the telescope proper will all the necessary control desks, panels and equipment to operate the instrument. In addition, there will be an insulated visitors' gallery (to prevent temperature rise in the room rather than from exclusiveness), dark rooms, coudé observing room, small instrument shop, and mirror handling equipment. Stairway and elevator lead to the rotating balcony platform above, on which will be located switchboards, machinery for the shutter, wind screen in shutter opening, and the prime focus elevator which will carry observers up to the cage located at the top of the telescope tube. A stairway leading from the balcony level to the dome attic gives access to the main crane and the electrical machinery and working lights that serve in conjunction with lower wall units to illuminate the interior and floor 92 feet below. These units are heat insulated from the interior room.

The crane is a 60 ton main hoist and 5 ton auxiliary hoist that rotates as part of the dome. Electrical connection for this, along with other dome power and light, must be fed through collectors and slip rings that total about two miles long, for connections must finally be made to the switchboard room, control points, or balanced telescope cables leading to the polar axis of the telescope.

THE TELESCOPE

By M. B. Karelitz, '25

A large reflecting telescope is a complicated instrument which collects light from celestial objects and concentrates it either at its focal point, called the prime focus, or, by a series of additional reflections from auxiliary mirrors, at other focal points on the telescope convenient for direct photographic or spectrographic work.

The major advantages of the 200-inch telescope over other large instruments in existence are (1) its considerably larger light collecting capacity, permitting reduction in the time of exposures and the photographing of more distant objects in space, and (2) its design permitting astronomical work directly on the telescope tube at the prime focus of the 200-inch mirror, thus avoiding the loss of light through additional reflections that were required in the 100-inch and other smaller telescopes used to date.

In the design of the 200-inch telescope special attention is being paid to reducing the time necessary for changing the auxiliary mirror combinations for work at different focal points. Instead of changing cages at the top of the tube in order to use the different auxiliary mirrors, as has been done up to the present, all mirrors will be permanently located on the telescope and will be swung in and out of position by means of motorized mechanisms. Not only can the auxiliary mirrors be placed by pushing buttons, but even the telescope itself can be set into the desired field of vision automatically.

In its optical and mechanical parts such as bearings, drives, etc., the 200-inch telescope differs materially from the older ones, since recent advances in different engineering fields can be incorporated in their design.

The large size and necessary accuracy of the component parts of the telescope require machines and equipment of unusual size. Special machines for cutting the large driving gears had to be built on the campus. The tube proper, the mounting and bearing assemblies of the telescope are being manufactured by the Westinghouse Electric and Manufacturing Company at its S. Philadelphia and E. Pittsburgh plants. Even there large machine tools had to be modified and a huge annealing oven had to be installed. Smaller parts, especially those requiring great accuracy, are being manufactured in the Astrophysics Instrument Shop on the campus.

THE SCHMIDT TELESCOPE

William H. Pickering, '32

The first astronomical instrument actually installed and put into operation on Palomar is an 18" Schmidt telescope which took its first photograph on September 5, 1936. This telescope is a new type of instrument designed for photographing large areas of the sky. It is essentially a camera with an 18" lens working at an aperture of F2. By astronomical standards it is also a very wide angle lens. Actually the field of view is about 10° in diameter. This field is free of distortion to the very edge. By taking forty minute exposures, objects down to about magnitude 17.5 can be photographed.