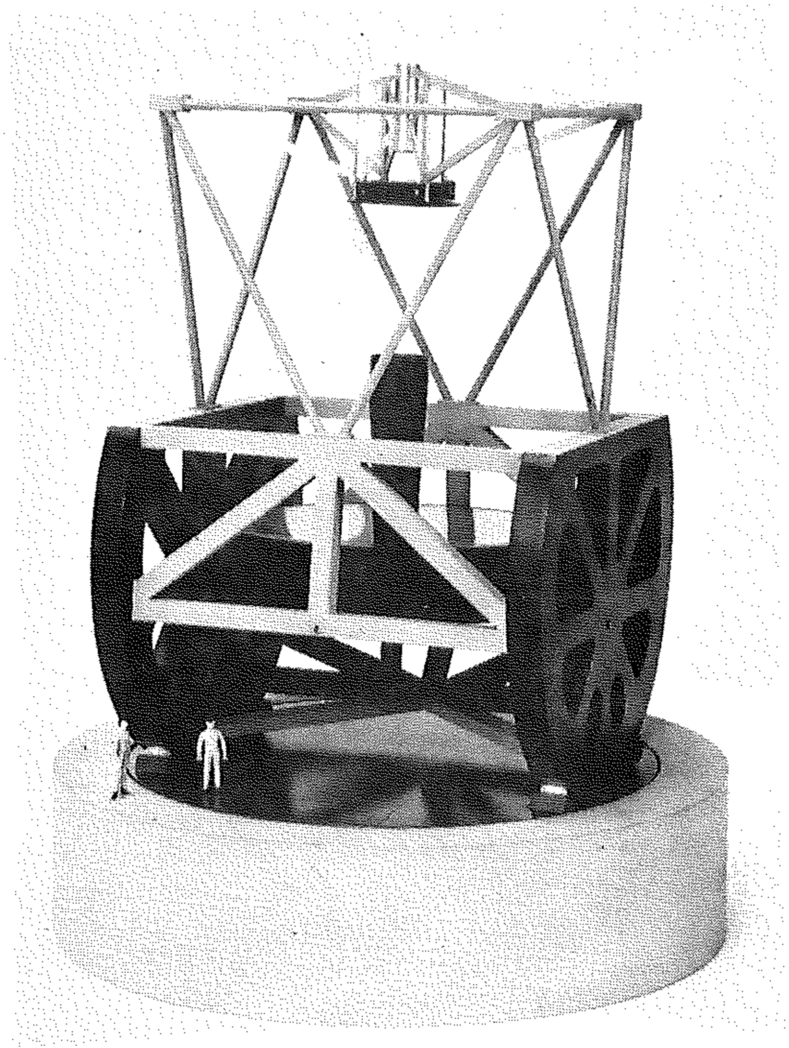
MAGELLAN PROJECT

University of Arizona | Carnegie Institution of Washington | The Johns Hopkins University



Introduction to the Magellan Project

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Introduction

During the past year or two the Magellan Project has produced a number of engineering reports. The earlier ones were mostly progress reports that described another iteration of the telescope or building design. Consequently their distribution was limited to the active participants in the design. However, it has now been suggested that the reports become more generally available and that we issue some of the earlier reports as well as the current ones. A great majority of the reports were prepared by our consultants: L & F Industries who have done the design work on the mounting and more recently have given some attention to the telescope enclosure, Robert Hoggan & Associates who has prepared the first design of the stationary section of the building and Dr. Harland Epps who has done all the optical design for the telescope.

By way of introducing the series we are reproducing a report with the title "Progress of the Magellan Project" presented by Stephen Shectman in December 1988 at the *Symposium on Japanese National Large Telescope and Related Engineering Developments* in Tokyo, Japan. This report will give you the current mechanical status of the 8-meter telescope and the status of other aspects of the project as of December 1988. Recent work has been directed toward the telescope enclosure and service building and on optical details.

Earlier reports will be issued as time permits. Current reports will be issued in a timely fashion.

I hope you will find the reports informative. Comments and suggestions are always appreciated.

PROGRESS OF THE MAGELLAN PROJECT

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The Magellan Project is a joint effort of the Carnegie Institution of Washington, the University of Arizona and the Johns Hopkins University, to build and operate an 8-meter telescope at the Las Campanas Observatory in Chile. The primary mirror will be an f/1.2 borosilicate honeycomb, identical to the ones being developed for the Columbus project.

Most of the work on the project has been the result of three activities. A Science Working Group, including representatives from each of the institutions, has developed the specifications for the telescope and instrumentation. Conceptual designs for the telescope mount, enclosure, and aluminizing facility have been developed by the project office, in collaboration with L&F Industries of Los Angeles, California. Finally, a detailed comparison of wind and seeing conditions for specific locations at the Las Campanas site is in progress.

The principal working focus of the telescope will be the Cassegrain. The baseline figure for the primary is a paraboloid. Two secondaries will be available, for the optical and for the infrared. The optical Cassegrain focus will include an optional wide-field corrector. Two designs for this corrector have been made by Epps, both of which include three fused-silica lenses and an atmospheric dispersion compensator. One corrector includes aspheric surfaces but produces a flat focal plane, the other contains only spherical surfaces but produces slightly better images on a curved focal plane. Our current preference is for the latter. The field diameter will be 40 arc-minutes. The corrected final focal ratio for these designs is f/6.5. Faster values are undesireable for two reasons; the required secondary is larger, and the design of satisfactory collimators for wide-field spectrographs is more difficult.

The focal ratio for the infrared Cassegrain focus will be f/15. This will permit using a smaller, chopping secondary mirror with lower emissivity. The optical design also provides for a Nasmyth focus by deflecting the beam behind the primary mirror to a re-imaged horizontal focus. This focus is not coincident with the altitude axis, but mounting instruments on a de-rotator achieves the critical requirement for gravity-invariance.

Design studies have been carried out for two kinds of alt-azimuth mountings. The first concept, based on a conventional yoke structure, has been superseded by a design which we call the alt-az disk mounting, originally suggested to us by Warren Davison of the University of Arizona. An artist's rendering of this mounting is presented in Figure 1. The altitude motion is provided by suspending the primary mirror cell between two large vertical disks which are supported by hydrostatic bearings. These bearings are in turn mounted on a large horizontal turntable, which provides the azimuth motion. The horizontal turntable is supported on separate horizontal and vertical hydrostatic bearings. Careful placement of the bearings results in the application of all forces to the azimuth disk exactly in the horizontal plane. The lowest resonant frequency for this mounting is 7.5 Hz, with a moving weight of 190 tons. The dynamical performance of this mounting is appreciably better than can be achieved with a yoke structure of comparable weight and cost. The construction of the mounting makes use of welded plate elements as well as space-frame style truss elements. For either the alt-az disk or the yoke type of mounting, this type of construction was found to be more efficient than a pure space-frame.

The large-diameter bearings for the azimuth disk will have to be finished on-site, but the kinematic mounting of the altitude disks, together with a relatively flexible out-of-plane structure for the azimuth disk, means that the precision required for these bearings is relatively low. The altitude disks can be fabricated in the factory and shipped to Las Campanas complete, but the azimuth disk must be shipped in two sections and assembled at the site.

The azimuth turntable will be mounted flush with the observing floor, and an instrument clearance of 3 meters will be provided between the Cassegrain focus and the floor. The trusswork connecting the two altitude disks is not symmetrical, and provides unencumbered access to the Cassegrain area from one direction (the rear in Figure 1). We expect to use friction drives and encoders for both the azimuth and altitude motions. The top structure of the telescope incorporates a square secondary support ring, which avoids the use of any bending members above the altitude disks. The secondaries will be supported on a compound spider system, with the IR secondary (or possibly an optical prime focus corrector) always in place. Using a handling fixture on the observing floor, the optical secondary will be removable when the telescope is in the horizontal position. The optical secondary cell completes its own spider when it is installed in the telescope. Additional spider vanes, to resist torsion at the secondary, can be added if required.

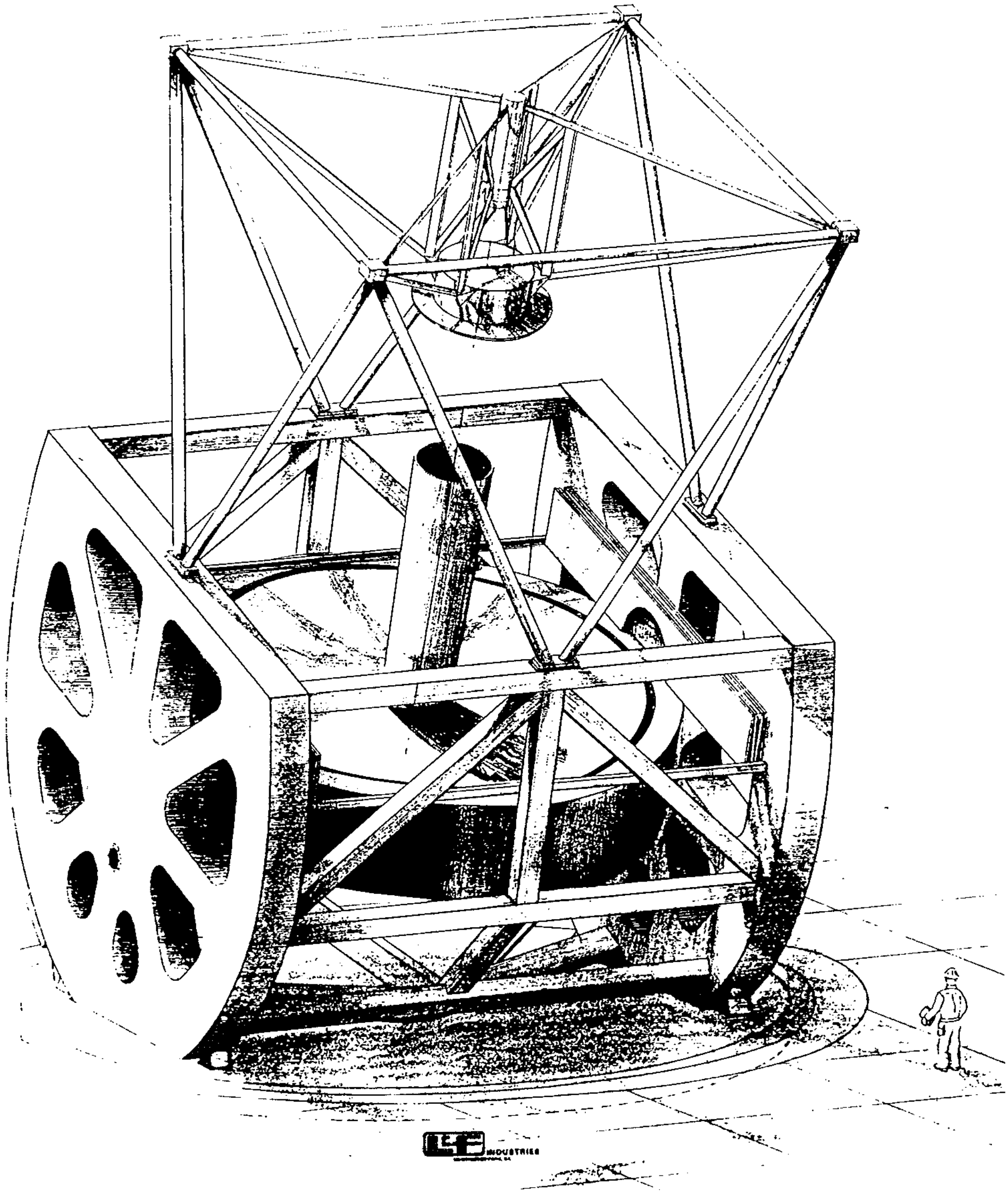
The alt-az disk configuration results in very convenient access to the Cassegrain focus, but practical limits on the size of the altitude disks result in the primary mirror being mounted slightly forward of the altitude axis. This increases the mechanical clearance required in front of the telescope. The compound spider arrangement also increases the clearance requirement for the telescope, to a radius of 11.9 meters. The enclosure is being designed to provide a clearance radius of 12.8 meters.

Our initial design study for the enclosure was based on a co-rotating square building similar to the one constructed for the Apache Point 3.5-meter telescope. The moving weight for this design was greater than 500 tons. We are presently investigating the design of a lightweight hemispherical dome. The moving weight for such a dome would be in the range of 100 tons. With a hemispherical dome, there is sufficient clearance between the observing floor and the dome rail to permit a handling cart for the primary mirror and cell to be rolled from the observing chamber to an aluminizing facility in an attached support building. Since the telescope pier raises the level of the observing floor 4 meters above ground level, there is adequate space for control rooms, laboratories, and the necessary utilities in the lower level of the support building.

Our present concept for the aluminizing facility involves an aluminizing chamber consisting of three sections. The stationary top section would contain the pumps and filaments, and would be fixed to overhead supports. The center section would be the mirror cell, and the bottom section the mirror handling cart. The mirror cell would be required to withstand vacuum pressure only around its perimeter. The dirty vacuum of the cart and cell sections would be separated from the high vacuum of the top section by a low-pressure seal. In order to store the tank in vacuum, the handling cart section would be attached directly to the stationary upper section.

A detailed site survey is presently underway at Las Campanas, under the supervision of Dr. Eric Persson. Wind velocities at heights of 9 and 18 meters above ground level are being recorded at 4 sites. At the two prime sites, image motion telescopes monitor the seeing at a height of 8 meters.

At the present time, the conceptual design of the facility is essentially complete. By mid-1990, we expect to have enough data from the site survey to permit the exact site for the telescope to be chosen. Rapid progress in the development of the mirror technology is being made at the University of Arizona, and we expect that the project will shortly enter the phase of detailed design and construction.



Hiltner and Shectman
Figure 1