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AED

For A. E. D.

The Lowell Observatory and Its Work.

A. E. DOUGLASS.

Jan 30 - 1895

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SHUTTER.

We consider the great size of opening in the dome an especially good feature. It is eight feet in width and extends from the sill to some four feet beyond the apex. The problem of suitably covering this area gave considerable trouble but the present shutter answers the purpose very well. It is simply a curtain of unpainted canvas, which lets down from the top, and it is stretched and held in place by wooden bars crossing outside and fastened only at the ends, as it appears in Plate XXVII, fig. 1. This allows rain to flow freely down the center. On each side of the opening is a track and outside that is a line of rollers which takes a large part of the weight of the curtain. A shoulder is made to project over the ends of the cross-bars to keep them from lifting outwards. Below all is placed a kind of box to receive the curtain when it is lowered, and inside is a rope for pulling it down in case it does not drop of its own weight. It is raised by means of two ropes which pass up at the side of the opening, cross the top of the dome, and descend beside the bar for turning the dome, passing thence round the windlass shown in Plate XXVII, fig. 2. In dry summer weather this shutter works admirably—it can be pulled up without the windlass. When wet it is necessary to use the windlass. But it behaves mischievously in winter when a foot of snow stands on it or when it freezes to the track as the snow melts—fortunate it is that snow storms are rare! But this could be prevented to a large extent by putting some kind of a covering over the sides of the curtain which would keep out the snow. Since those photographs, (Plate XXVII, figs. 1 and 2), were taken a moveable roof has been placed over the upper ten feet of the shutter when it is almost level. This roof can be slid backwards or forwards by ropes which descend to a cleat near the windlass.*

OBSERVING CHAIR AND PLATFORMS.

When the dome was completed the floor proved too low for convenience. Accordingly an amphitheater-platform was constructed as shown in Plate XXVIII, fig. 1. This extends through an horizontal arc of over 200° and has its center due north of the pier; a space of three feet is left between it and the wall. The amphitheater consists of three steps which may be used as seats. Below these is a narrow flooring whereon an invalid chair enables the observer to work upon zenith objects in comfort.

* The shutter was devised by Mr. Douglas.—P. L.

Above the steps is a platform and a circular track upon which the observing chair moves. The chair itself has hinged seats, after the pattern given in Chamber's Astronomy, Vol. II, page 217.

The platform extending south of the pier which gives access to the clock-work and general machinery of the telescope has proved itself serviceable in every respect. The steps leading up to it have a slant of 60° from the horizontal. The top of the platform is of the width of the pier and cannot interfere with the movement of the telescope. A detachable extension is placed on one side to give easy access to the clock, sector, slow motion and clamp screws—shown in the accompanying plate, as are also the additional steps for climbing on top of the bed-plate. The hole for the driving weight to pass down through is shown beside them. The top of the platform has a slightly raised edge which enables the foot to feel its position. The plate also shows the east side of this platform and stairway. The opposite side gives entrance to the interior which is furnished with a closet, cupboard and the necessary shelves and drawers. The governing clock of the telescope is kept in the closet.

XXVII

There is also shown a high staging which was built for a special purpose. At the top of the San Francisco peaks, nearly ten miles distant, is a canvas disc over four feet in diameter, put there at a known distance for the purpose of measuring the constants of the micrometer. When the telescope is pointed at the disc this staging is necessary to give access to the eye-end of the telescope.

RESIDENCE.

The description of the Observatory is practically completed by a brief mention of the residence. This building contains a study, two bed-rooms, a work-room and a dark-room. The slope of the hill is taken advantage of to put two rooms below—one intended for a bath room and the other used for storing wood. The building is warm and cosy in the coldest weather. It is situated one hundred feet north of the dome in order to interfere as little as possible with the seeing.

WORK OF THE OBSERVATORY.—MARS.

The director's main purpose in building the Observatory was to study this planet and to that end the larger part of the time of the three observers has been devoted. The original plan of observation was to follow the development of the seasons, or any other changes and record them chiefly by means of drawings. In

POWERS EMPLOYED.

Professor Pickering has customarily used 1260 and 840 on the satellites of Jupiter. Mars has been subjected to various magnifications. When more than 16" in apparent diameter 320 and 440 were used on him to increase contrast. Between 8" and 16" in diameter choice varied between 617 and 440. Under 8", 860 has advantages. The lack of contrast at opposition was so marked as to preclude the use of powers above 440.

METEOROLOGICAL OBSERVATIONS.

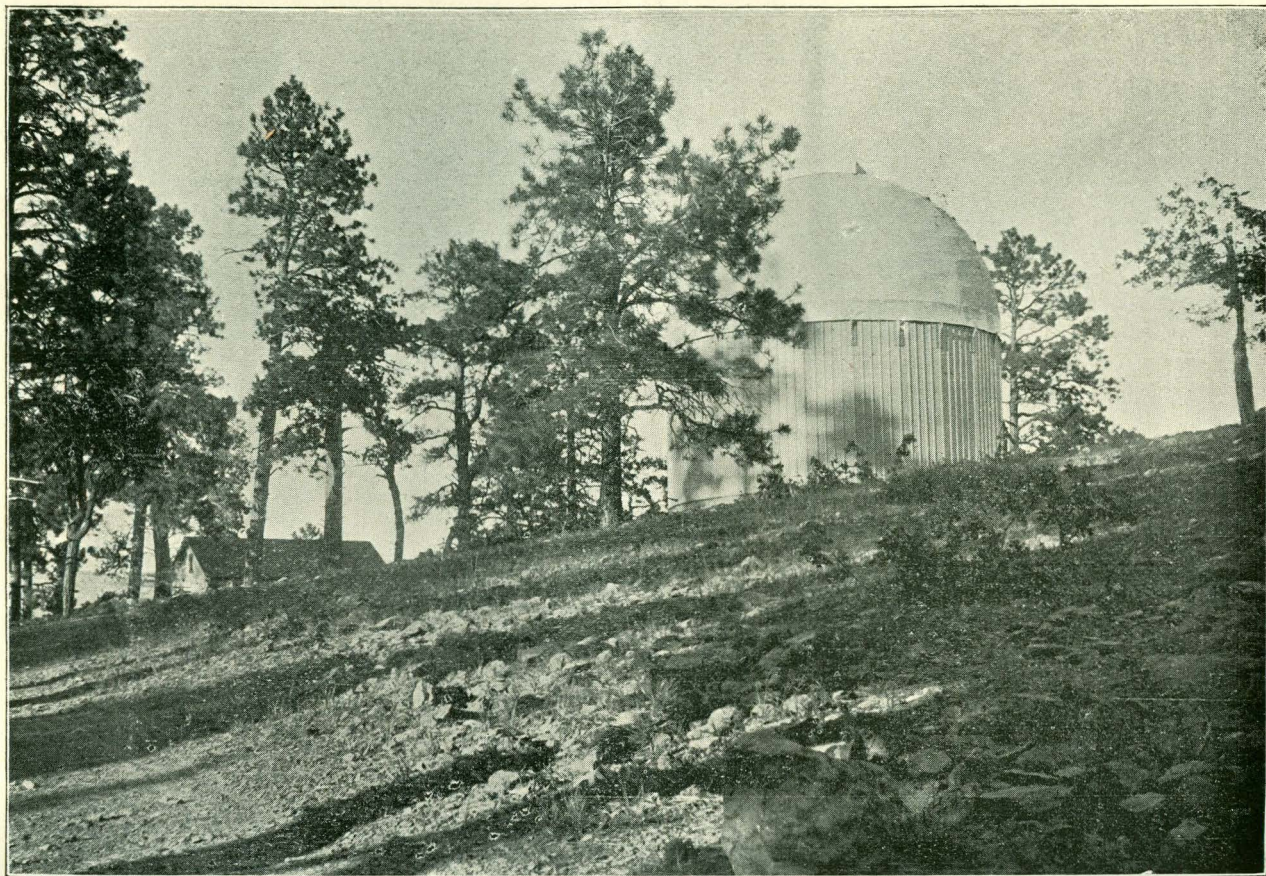
In addition to simple meteorological notes such as temperature, wind and cloudiness, observations of the atmospheric currents have been maintained on clear nights since the latter part of September. This is done by first placing the eye directly in the focus of the objective when turned upon some bright star—or planet of small diameter—and noting the wave-like appearances which cross the illuminated glass, and secondly, by turning the eye-piece outside the principal focus so that the height of a wave-system can be roughly determined by the extension necessary to bring it into view.*

Under this head and in conclusion may fitly come a word or two in regard to the seeing. The scale we use was devised by Professor W. H. Pickering (it is given in the article just referred to). From the beginning of last April until well through November the weather was good and the seeing for the most part eminently satisfactory. But during December and January it has been cloudy for weeks at a time and with scarcely an exception the few clear nights vouchsafed us have been conspicuously poor—heightening the contrast between the torrid and temperate zone atmospheres with which we are visited in turn, greatly to the disadvantage of the latter.

LOWELL OBSERVATORY, Flagstaff, Arizona,
Jan. 30, 1895.

*Am. American Meteorological
Journal March, 1895.*

PLATE XXVI.



RESIDENCE.

LOWELL OBSERVATORY DOME FROM SOUTH-WEST.

FLAGSTAFF, ARIZONA.

POPULAR ASTRONOMY, 19. 1895.

THE LOWELL OBSERVATORY AND ITS WORK.

A. E. DOUGLASS.

FOR POPULAR ASTRONOMY.

After briefly testing the general character of the atmosphere in several places in Arizona, Flagstaff, on the great plateau through which the Cañon of the Colorado finds its way, was selected. It is a trifle short of 7,000 feet above the sea and is ten miles south of the San Francisco Peaks whose highest point is 12,800 feet in elevation. The Observatory is a mile north-west of the railroad station and three hundred and fifty feet above it on the extreme eastern edge of the "Mesa" (Spanish for "table") which extends a long distance west and north of the town. The whole country is covered with large pine trees save in the town itself. The townspeople from the first have been most generous to us not only in social courtesies but financially in giving a plot of land in the selected location and in building a road thereto, an item if no small expense.

The time occupied in building the dome and in mounting the 18-inch telescope was unusually short. The first ground was broken on April 23, 1894, and on June 1 regular observations on Mars were begun after a delay of several days due to cloudy weather.

EQUIPMENT.

The Observatory is supplied with a 6-inch, a 12-inch, and an 18-inch refractor (the two latter on the same mounting), photographic apparatus, eye-end appliances for the 18-inch, a dome, and a residence. The computing room or study, pertaining to the Observatory is at present in the hotel near the center of the town.

THE 18-INCH TELESCOPE.

The lens is by Brashear and has given great satisfaction during the time it has been in use. Its focal length is 315.5 in. The telescope is supplied with a micrometer and a good set of positive and negative eyepieces.

Among the special eye-end appliances may be mentioned: (a) A spectroscope kindly loaned us by Brashear, its maker, with a 60° prism of glass and a similar one of quartz. (b) A polariscope of the Airy pattern, which can be placed between the eyepiece and the eye. (c) Scales of canals used in measuring the width and density of the Martian canals. The first scales experimented with

were photographic reductions of India-ink drawings, but the scales which give most satisfaction were ruled on glass by Dr. Ewell, of Chicago. Each canal on the scale consists of fine lines ruled by a dividing engine, the width and density of a canal being at once accurately known by the number and spacing of the lines.

(d) Comparison apparatus, constructed by Brashear from the design of Professor W. H. Pickering, by which one is enabled to bring two bodies, such as the Moon and a planet, into the same field at the same time. On the objective side of the eye-piece is a thin glass plate at an angle of 45° , casting into the eyepiece light which approaches through an arm at right angles and capable of motion about the optical axis of the telescope. A second mirror parallel to the first is placed in the outer end of this arm and can be rotated about the axis of the arm; by means of these two motions any part of the sky can be brought into view. Between the two mirrors is the objective of this secondary telescope. Besides the mere visual comparison which may thus be made, a specially constructed spectroscope may be attached in place of the eye-piece, or any other of the eye-end appliances except the micrometer, can be used. A second function of this comparison apparatus is to throw into view illuminated scales of canals or ellipses. This can be done by removing the second mirror and putting in its place the transparent scale with a light behind it, and replacing the small objective by one of shorter focus. The focus of the apparatus is always obtained by movement of the objective and the apparent size of the scale can be altered by changing the relative positions of the scale and objective. This apparatus deserves further application. By substituting two transparent lines for the scale a micrometer could be formed which has none of the disadvantages of opaque lines crossing the field; or, by means of a single open slit alterable by a micrometer screw, extremely small objects could be measured with the facility now pertaining to large ones alone.

The telescope is supported on one of the Clark mountings. In fact it is the same bed-plate and clock-work formerly used for the 13-inch Clark refractor of the Harvard College Observatory.* With an 18-inch telescope the mounting is somewhat unsteady yet not seriously so. Its chief objections seem to be the necessity of changing the driving sector every two hours, and the limited extent of slow-motion in right ascension. Control is effected by an independent pendulum clock and the spring governor. The

* The bed-plate and the 12-inch telescope are the property of that institution, being leased to Mr. Lowell.

PLATE XXVII.

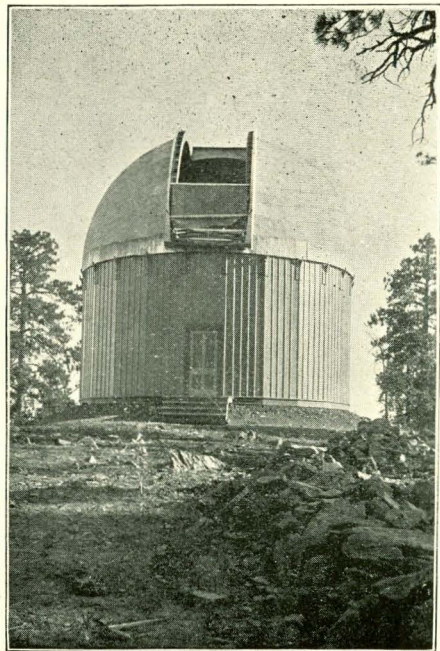


FIG. 1. DOME FROM NORTH SHOWING SHUTTER.

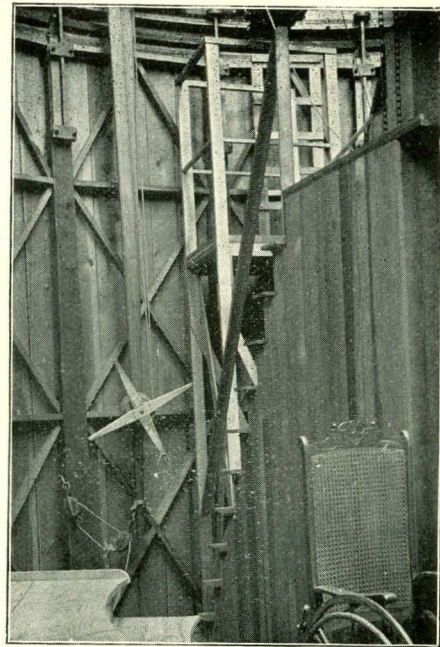


FIG. 2. WINDLASS FOR RAISING SHUTTER.

PLATE XXVIII.

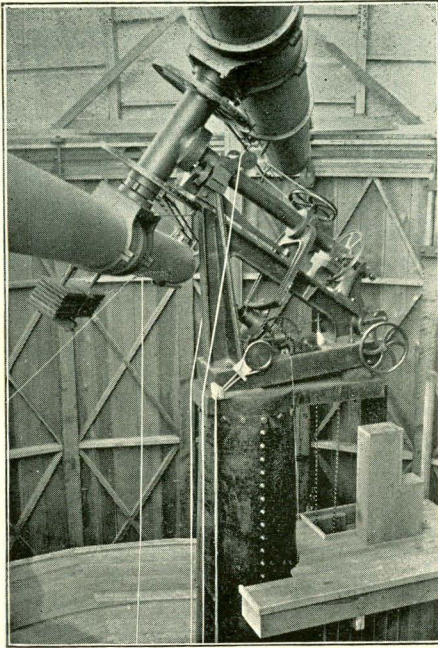


FIG. 2. MOUNTING.

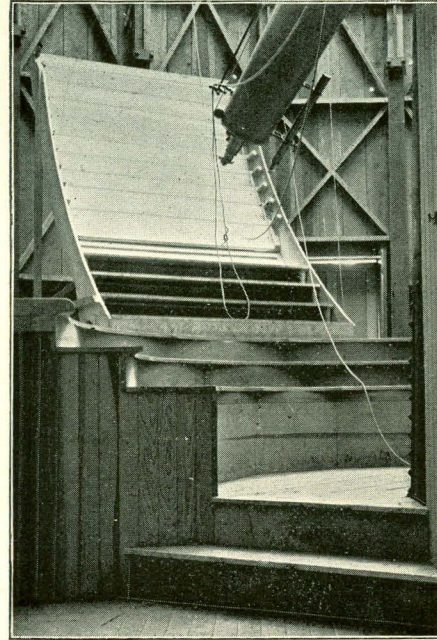


FIG. 1. OBSERVING CHAIR.

PLATE XXVIII.

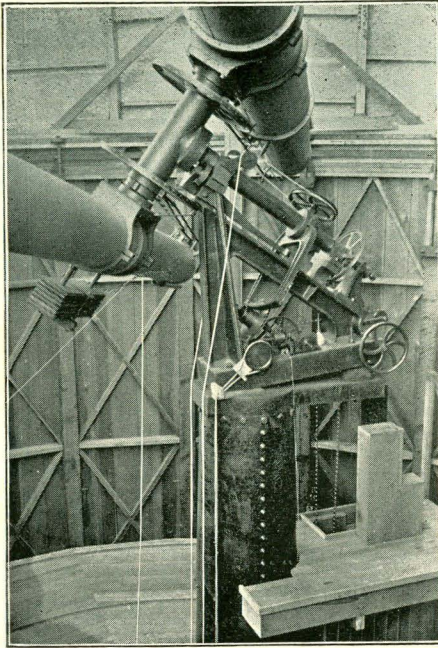


FIG. 2. MOUNTING.

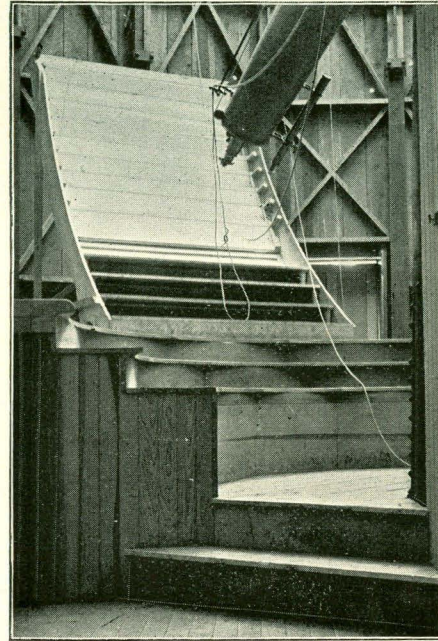


FIG. 1. OBSERVING CHAIR.

pier of the instrument consists in two tubes of boiler iron, the lower one ten feet long and buried in the ground with cement nearly its entire length; the upper is fourteen feet long, projects some twelve feet above the floor of the dome and supports the bed plate upon its top. Of course no wood-work of the building is allowed to touch the pier.

THE 12-INCH TELESCOPE.

This was made by Clark and if I am correctly informed was a model for Lick telescope. The figuring of the lens was never finished, however, and therefore its present use is entirely photographic. It is supplied with enlarging apparatus, and the residence contains a dark-room and all its accessories but since the commencement of the Observatory we have spent very little time at this work. It is mounted as a counterpoise on the declination axis of the 18-inch.

THE 6-INCH TELESCOPE.

This is one of Clark's portable instruments and can scarcely be surpassed in beauty of definition. It was the instrument used in atmospheric tests in different parts of Arizona. Since then we have used it on various occasions and at present it is in town for the purpose of studying the difference in atmosphere between the hill and the valley.

DOME.

The lower part of the building is circular in section, and consists of twenty-four cedar posts set deep into the ground and well braced by horizontals and diagonals, the whole being covered on the outside with thin boards so that the interior quickly assumes the temperature of the outside air. The method of bracing it may be seen in the photograph of the mounting (Plate XXVIII, fig. 2). A live-ring of eighteen bevelled wheels running between hardwood tracks supports the dome proper. The stationary guide-wheels for the ring and the dome may be distinguished in the photograph. Above a frame such as described by Professor W. H. Pickering in *Astronomy and Astro-Physics* for January, 1894, is stretched wire netting, and on top of that well-painted canvas. The radius of curvature of the dome is seventeen feet. The revolving part weighs approximately three and one-half tons which is rotated by a block and tackle attached to the lower end of a post fastened securely to the dome and projecting downward to within three or four feet of the floor.