The occultations are visible throughout the United States. The local times vary from about three hours before local midnight for the Pacific Coast to about two hours after local midnight for the Atlantic Coast.

The diagram represents the brighter star in the Pleiades. The numbers or letters are those assigned by Bessel. In the two tables the magnitudes of the stars are given and also the Flamsteed or Bode numbers corresponding to the Bessel numbers of some of the stars.

**Magnitudes of Pleiades Stars.**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>6.5</td>
<td>1</td>
<td>7.0</td>
<td>19</td>
<td>7.5</td>
</tr>
<tr>
<td>b</td>
<td>4.7</td>
<td>8</td>
<td>8.0</td>
<td>20</td>
<td>8.0</td>
</tr>
<tr>
<td>m</td>
<td>6.3</td>
<td>9</td>
<td>8.1</td>
<td>21</td>
<td>8.6</td>
</tr>
<tr>
<td>e</td>
<td>5.0</td>
<td>d</td>
<td>4.5</td>
<td>22</td>
<td>7.0</td>
</tr>
<tr>
<td>1</td>
<td>8.2</td>
<td>10</td>
<td>8.0</td>
<td>23</td>
<td>8.0</td>
</tr>
<tr>
<td>2</td>
<td>8.8</td>
<td>11</td>
<td>9.1</td>
<td>24</td>
<td>7.0</td>
</tr>
<tr>
<td>3</td>
<td>9.0</td>
<td>12</td>
<td>7.5</td>
<td>n</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>8.1</td>
<td>13</td>
<td>8.5</td>
<td>25</td>
<td>8.2</td>
</tr>
<tr>
<td>5</td>
<td>9.1</td>
<td>14</td>
<td>9.0</td>
<td>26</td>
<td>9.0</td>
</tr>
<tr>
<td>6</td>
<td>9.0</td>
<td>15</td>
<td>8.5</td>
<td>27</td>
<td>8.5</td>
</tr>
<tr>
<td>c</td>
<td>4.8</td>
<td>17</td>
<td>7.9</td>
<td>28</td>
<td>7.0</td>
</tr>
<tr>
<td>7</td>
<td>8.2</td>
<td>18</td>
<td>8.0</td>
<td>29</td>
<td>7.8</td>
</tr>
<tr>
<td>k</td>
<td>7.0</td>
<td>p</td>
<td>8.0</td>
<td>s</td>
<td>7.0</td>
</tr>
</tbody>
</table>

**Table for the Identification of Some of the Brighter Pleiades Stars.**

<table>
<thead>
<tr>
<th>Flamsteed or Bode No.</th>
<th>Bessel No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Tauri</td>
<td>g</td>
</tr>
<tr>
<td>17 &quot;</td>
<td>b</td>
</tr>
<tr>
<td>18 &quot;</td>
<td>m</td>
</tr>
<tr>
<td>19 = q</td>
<td>m</td>
</tr>
<tr>
<td>20 &quot;</td>
<td>c</td>
</tr>
<tr>
<td>21 &quot;</td>
<td>k</td>
</tr>
<tr>
<td>22 &quot;</td>
<td>l</td>
</tr>
<tr>
<td>23 &quot;</td>
<td>d</td>
</tr>
<tr>
<td>24 &quot;</td>
<td>p</td>
</tr>
<tr>
<td>25 = η</td>
<td>η</td>
</tr>
<tr>
<td>104B &quot;</td>
<td>23 &quot;</td>
</tr>
<tr>
<td>105B &quot;</td>
<td>29 &quot;</td>
</tr>
<tr>
<td>26 &quot;</td>
<td>s</td>
</tr>
<tr>
<td>27 &quot;</td>
<td>t</td>
</tr>
<tr>
<td>28 &quot;</td>
<td>h</td>
</tr>
</tbody>
</table>

Pleiadum = Celaeno
Electra = Taygeta
Maia = Asterope
Merope = Alcyone
Atlas = Pleione

---

**The Adler Planetarium and Astronomical Museum of Chicago**

_by Philip Fox, Director_

**The Astronomical Museum.**

[Continued from page 549]

*Telescopes.* The telescope is the most important instrument of astronomy. Its origin is obscure. It would seem that Roger Bacon
(1214-1292) must have seen a telescope either at home or abroad, or have made one, for he wrote:"9 "Glasses or diaphanous bodies may be so formed that the most remote objects may appear just at hand . . . that we may read the smallest letters at an incredible distance." Also, there can be little doubt that Leonard Digges in 1550 or thereabouts, after study of Bacon, made "perspective glasses" wherewith he was able "to discover every particular in the country roundabout." It is of interest to read that Thomas Harriot (1560-1621) mathematician and philosopher, "tutor of Sir Walter Raleigh and correspondent of Kepler," used a "perspective glass" in Virginia when he accompanied Sir Richard Grenville's expedition in 1585. Digges, who died in 1570 and who has already been cited as the maker of the theodolite, may have made reflectors as well, for this use of concave mirrors is revealed in writings of the time. The Dutch claimants to the invention of the telescope, Hans Lipperhey, Zacharias Jansen, and James Metius, date from 1608. The serious use of the telescope in astronomical observation must be ascribed to Galileo who in 1610 made the first great telescopic discovery, the four brightest moons of Jupiter, an epoch-making event in the history of astronomy and of world history, an observation revolutionary in its effect on the course of human thought.

Forty-one telescopes were obtained in the Mensing Collection, of which five are reflectors. About a third of the refractors are incomplete, lacking either the objective or ocular. The reflectors, however, are complete, ready for use. For the most part the refractors are constructed with a series of draw tubes. The materials of the tubes are wood, metal, ivory, or paper; the latter in general being covered with parchment or leather finished plain, shagreen, or beautifully tooled. The makers of some of the telescopes are immediately ascertainable by signatures engraved on the tubes, for example:

A.M. 422 Initials "A. G." (c. 1650) Focal-length, 1.18 m.
A.M. 424 "John Marshall, Lutgat Street: London" (c. 1680) F, 2.98 m.
A.M. 434 "Passemant Rue de la Monnoye A La Pomme Dor A Paris." (c. 1740) F, 1.7 m.

Others have names etched on the objectives, a practice which should be adopted by modern opticians:

A.M. 426 "Pierro Patroni in Milano," (c. 1660) F, 2.07 m.
A.M. 431 "Francus Baillon fec. Mediolani (Milano) 1738" F, 1.70 m.
A.M. 442 "George Lepere, Quai de l'Horloge du Palais 1744"

The group of telescopes in Fig. 45 has, at the top, replicas of the first telescopes of Galileo. The originals are in the Tribuna di Galileo in

9 Bacon, Epist. ad Parisisenem.
Florence. The replicas were prepared by the Curator Giulio Cipriani of that city. The two great telescopes just below, A.M. 428 A and 428, have focal lengths of 5 m and 5.75 m respectively, apertures 6.8 cm. One of them has been identified tentatively as a Campani. The telescopes of this optician won fame by the discovery with their use of the fifth and third and fourth satellites of Saturn, in the years 1672 and 1684.

The longer of the two telescopes below the Campani is A.M. 427. It is probably French though Mensing notes that the decoration suggests Torino. It is dark green Morocco, beautifully tooled with vignettes and lioncels in hundredfold repetition. It must have been made for a person of importance entitled to a coat-of-arms as indicated by the heraldic lioncels. Focal-length is 2.13 m. Its date is the latter part of the seventeenth century.

Fig. 46. South Museum Hall with Cabinets of Telescopes and Geodetic Instruments, Herschel’s 6-inch Telescope, and Modern Refractor.
The conical telescope in the left foreground, A.M. 421, is one of the most important pieces in the entire Museum. Optically, it is of the Galilean type. The decoration places it in France at about 1630. It is one of the oldest intact telescopes in existence. The leather is beautifully tooled with gold figures of vines and flowers and birds. There are five draw tubes; the aperture is 2.5 cm, the focal-length 69 cm.

The conical companion to the right, A.M. 423, is of ivory, most delicately carved. There are five draw tubes which permit an extension to 87 cm.

The cabinets for the display of the telescopes and certain geodetic instruments are shown in Fig. 46. In the center of the cabinet to the
right is a reflector of extraordinary beauty, A.M. 435, which is shown singly in Fig. 47. It is richly embossed in silver ornaments of the Zodiacal figures and acanthus leaves and fleur-de-lis, probably made for Louis XV (1710-1774). The aperture is 100 mm, the length of the tube 77.5 cm. The speculum is very bright. A practical test of the instrument shows very satisfactory performance.

Fig. 46 shows also two large telescopes—a modern 8-inch refractor with lens by Alvan Clark & Sons, with a modern equatorial mounting by William Gaertner, a loan from the President of the Chicago Astronomical Society, the distinguished architect, Mr. Richard E. Schmidt; and in the background one of the chief prizes of the Museum, a 6-inch reflector by William Herschel. The latter is complete with speculum. This is a much appreciated gift from the British Admiralty through the kind offices of the Astronomer Royal, Sir Frank Dyson. During the meetings of the American Astronomical Society in September 1930 no piece in the museum received more eager attention.

The Museum has a 4-inch Steinheil, gift of Mr. Oscar G. Mayer; a 5-inch Mellish; a 3-inch Vion; a 4-inch Mogey, and a 4-inch Zeiss, loaned respectively by Mr. H. S. Rich and by Carl Zeiss Inc. These may be carried into the open on the upper terrace for observation of the sky.

The Museum contains also the mounting and tube of Burnham's famous 6-inch refractor and the original mounting of the 18½-inch refractor of the Dearborn Observatory. These two items are of especial interest in Chicago. With the 6-inch, Burnham began his productive labors on double stars in Chicago, discovering 451 pairs with its use. This is loaned to the Museum by the Washburn Observatory of the University of Wisconsin. The 18½-inch Clark refractor erected in Chicago in 1865 on the campus of the original University of Chicago in Douglass Park and later transferred to Northwestern University in Evanston, was from its erection until 1876 the greatest refractor in the world. Truman Henry Safford, S. W. Burnham, Elias Colbert, G. W. Hough, and the writer, as successive directors of the observatory, used this telescope in its original form. It was given a new Warner & Swasey mounting in 1912. The old mounting is a gift of the Chicago Astronomical Society.

The discussion of telescopes cannot be concluded without mention of the model of an observatory, shown in Fig. 9; the model of the top of Mount Wilson; the Meridian Circle of the Harvard College Observatory here on loan; and the coelostat and vertical telescope which bring a solar image into the corridor to the spectrohelioscope. The observatory model is based on the U. S. Naval Observatory in Washington, D. C., with the offices omitted, a building of excellent architectural design by R. M. Hunt. The model has a rotating dome, rising floor, and moving telescope. With one pressure of a button the dome moves, the telescope swings to a pointing in the slit, and the floor comes to proper
adjustment. The dome is transparent so that the operation can be seen from all sides. The model of the top of Mt. Wilson with the many telescopes, laboratories, etc., constructed by Mr. Ferdinand Ellerman, is on loan from the Carnegie Institution of Washington. Its dimensions are 36x70x16 inches.

The meridian circle is being set up on the lower floor and will be directed to a moving artificial sky. A chronograph, gift of the U. S. Navy, will be used with it to show the method of recording time.

The coelostat and vertical telescope by William Gaertner is on the upper terrace (Fig. 48). Its mirrors are of pyrex. They throw the sunlight to a 6-inch lens of 20 feet focal-length of the vertical telescope. Used with the spectrohelioscope it is the one instrument of primary research of the institution.

A Foucault Pendulum of the Longdon design; apparatus for showing precessional motion, conservation of angular momentum; spectroscopes for demonstration of the various principles of spectroscopy; a large grinding machine, gift of Carl Zeiss, Jena, in operation in the museum corridors,—show the scope of the general exhibits.

Mementoes of two astronomers of the last generation whose characters and careers were such that they shall be legendary, attract appreciative attention, like that accorded to Herschel's telescope. Few men of science have caught the popular fancy and at the same time the
Philip Fox

admiration of scholars in measure comparable to the two great astronomers who for so many years worked side by side at the Lick Observatory and later at the Yerkes Observatory, Sherburne Wesley Burnham and Edward Emerson Barnard—so alike in their unswerving devotion to observing, to whom a clear sky and a telescope meant opportunity and obligation. Burnham, excelling in everything he undertook, an expert rifle shot, artistic photographer, a speed stenographer, a figure of international repute while still employed as a clerk in the Federal Court, modest in all things, charitable but despising sham, a rare friend to many people, keen of vision, orderly in his routine as the stars themselves, working swiftly with economy of time, devoting his attention almost exclusively to double stars, accomplishing in observing and in the compilation of his General Catalogue of Double Stars one of the greatest pieces of work in practical astronomy the world has seen. Barnard, who entered astronomy by way of a photographic apprenticeship, worked through hardship and poverty to rank as one of the greatest observers of all time, who built a house with prize money awarded for discovery of comets, whose eye first saw the fifth satellite of Jupiter, whose interest covered all phases of observing visual and photographic, of childlike simplicity and enthusiasm, with will of steel to hold his vigil through bitter cold.

Burnham’s sons and daughters have deposited here his barometer, protractor, planimeter, an arithmograph which he designed and which was made by E. Kandler & Co. of Chicago, a circular slide-rule which he computed and which was built by Warner & Swasey at Cleveland, Ohio, a daguerreotype of him and his sister when he was sixteen years old, a miniature as he was in his eighty-first year, a gold medal received as a photographic award, and his gold medal from the Royal Astronomical Society, the great manuscript copies of his Catalogue of Double Stars. Mention has been made elsewhere of the tube of his 6-inch telescope.

The Yerkes Observatory of the University of Chicago has loaned for exhibition nine medals awarded to Edward Emerson Barnard for astronomical discoveries: Three bronze medals, the Donohoe Medal of the Astronomical Society of the Pacific for the discovery of Comets, 29 March 1881, 2 October 1891, and 12 October 1892; three gold medals from the Institut de France, Academie des Sciences,—Prix Lalande, 1892, Medaille Arago, 1893, Prix Janssen 1900; Gold Medal of the Royal Astronomical Society 1897; Prix J. Janssen, Societe Astronomique de France 1906; Catherine Wolfe Bruce Gold Medal of the Astronomical Society of the Pacific 1917.

The Yerkes Observatory of the University of Chicago has loaned also the radiometer built by Ernest Fox Nichols and used by him at the Yerkes Observatory in the first detection of the heat of the stars. With a similar instrument, in collaboration with Gordon Ferrie Hull, he later detected the pressure of light.
It is customary in some countries to strike medals in recognition of notable scholarly achievements or as award for attainments. The cabinet holding Burnham’s and Barnard’s medals contains also a collection of medals principally from the French national collection. Among them—Newton—Law of Universal Gravitation; Leverrier—Discovery of Neptune; Cassini—Foundation of the Paris Observatory; Franklin—Lightning from the Clouds; Janssen-Lockyer—Observation of Solar Prominences with Spectroscope; Hind-Luther-Goldschmidt—Discovery One Hundredth Asteroid; Measures of Meridian Arcs, Ecuador and Labrador; large portrait medallion of François Arago (1786-1853), French astronomer, geodesist, physicist, academician.

Meteorites have an appropriate place in an astronomical museum. They are the only heavenly bodies which can be put on exhibition in tangible form. Mr. Moise Dreyfus of Chicago has presented a small stony meteorite to our cabinets. No attempt has been made to assemble further specimens, for the neighboring Field Museum has a superb collection and effort for the study of these bodies might be spent more profitably toward the enrichment of that collection than in beginning a new one.

Library. As part of his original gift, Mr. Adler presented about two hundred books, a nucleus for an astronomical reference library. To these have been added about 500 volumes by gift. So far as purchases are concerned, the primary effort has been toward the acquisition of books on old instruments and their uses, such books for example as:

Apianus—Instrument Buch—Ingolstad 1533
Cosimo Bartoli—Del Modo di Misurare, Veneti 1614
Valer. Regnartius—Astrolabiorum—Bononia 1610
Mallet—La Geometrie Pratique—Paris 1702
Bion—Instruments Mathematique—Paris 1725
Eg. Danti—Astrolabio—Fiorenza 1569.

In the last it is interesting to see in the introductory pages two poems by a member of the Strozzi family, Giouambatista Strozzi il Gionine (1551-1634).

“Spirto divin ch’ergendo el Cielo il volto, . . . .”

Of gifts, the principal ones are: from Mr. G. H. Jones of Chicago 327 volumes from the library of Professor Elias Colbert including sets of Galileo, Kepler, Laplace, many old works, Manilius, Euler. From Mrs. George H. Mason, daughter of Professor Colbert, the “Phaenomena” of Aratus, 1589. From Mrs. W. O. Beal and sons 59 volumes from the library of Professor Beal including a set of Tisserand’s “Traite de Mécanique Celeste”; British Astronomical Association, 25 volumes of their Journal; British Nautical Almanac Office, 15 volumes, 1920 to 1933; U. S. Nautical Almanac Office, 58 volumes, 1867 to 1933. Other donations to the library in the form of pictures, manuscripts, and books have been received from: N. J. Bowditch, F. E.
Transparencies. Photography is the most powerful aid to the telescope in astronomical research, with the cumulative action of long exposures, the accuracy and permanency of delineation, the wide field of the portrait lens, the registration of analyzed light in the spectrograph, it has marvelously extended the boundaries of knowledge of the heavens. At the same time, it provides the most vivid means of portraying the results. Nowhere has the Chinese proverb “One picture is worth a thousand words” better exemplification than in astronomy. Of the various possibilities of photographic display, illuminated transparencies are the most accurate as well as the most brilliant.

Seventy-two large transparencies from the finest negatives made with the world’s greatest telescopes are mounted in niches in the museum walls provided for this purpose in the design of the building. The short time allotted for the organization of the Museum restricted the selection of negatives to those of American observatories. Photographs from foreign observatories must be added. The North and South Museum Halls each contain eighteen transparencies, size 24x30 inches, the East Corridor, thirty-six of size 17½x24 inches.

Those of the South Hall are devoted to the Solar System, with distribution of subjects as follows: on the inner wall, sixty-six of the Moon logically arranged, including an 8½-day, a 16-day, an 18-day Moon and three enlarged portions, the regions of Tycho, Archimedes, and Copernicus. On the outer wall: five of the Sun—two coronae, a direct photograph of the disk, a spectroheliogram in hydrogen and one in calcium; seven of comets—four of Morehouse’ Comet, showing changes, one each of Halley’s, Brook’s, and 1910a.

In the East Corridor the Solar System subjects include six on sections of the solar disk, one disk and prominence, and three of prominences; nine of planets. In addition, there are two for the greatest telescopes of each type; two for their housings; one portrait; one of star trails; nine of clusters, novae, and nebulae; and two of stellar spectra.

The transparencies of the North Hall are devoted entirely to the Sidereal System. The six transparencies on the inner wall are of the Milky Way from negatives by Barnard and Ross. On the outer wall, seven are of galactic nebulae, three of spirals, and two of the Magellanic Clouds.

Immediately below each transparency there is a legend (see Fig. 46)

---

* See Fig. 2, p. 127, *Popular Astronomy*, March, 1932.
in transparency negative form, white letters on black field, which gives such explanatory material as can be included within the limits of the space, always including the name of the astronomer who took the photograph, the instrument, date, and exposure time where pertinent. When the transparencies were made, a few extra were provided that some change of display could be made from time to time. The following observatories are represented:

Yerkes Observatory, 29 plates of Moon, Sun, comets, planets, nebulae, Milky Way, instruments.
Mount Wilson Observatory, 31 plates of the same classifications plus one of large scale stellar spectra.
Lowell Observatory, Plates of Halley’s Comet and 1910a.
Plates of Pluto, Mars, and Saturn.
Lick Observatory, Composite photographs of Jupiter.
Harvard College Observatory, Two plates of the Magellanic Clouds.
University of Michigan Observatory, One composite plate of representative stellar spectra.
Dearborn Observatory, One composite plate of Jupiter.

The transparencies from the Mt. Wilson and Lick Observatories were made by Mr. Ferdinand Ellerman of the Mt. Wilson Observatory, whose well-known photographic skill is sufficient guarantee of their quality. The Lowell Observatory transparencies were made at Flagstaff by members of the observatory staff. Extraordinary pains were taken in their preparation, especially the composite plate of Mars with fifteen exposures from as many negatives showing the seasonal variation of the polar cap. The transparencies from the Yerkes, Michigan, Harvard, and Dearborn Observatory negatives were made by Mr. Charles A. Crowell of Chicago. Taken as a whole these superb pictures tell with graphic emphasis the story of astronomy’s view of the universe.

Here is a museum devoted to the noblest aspiration of man’s mind, the understanding of the universe. Here he may let his mind grope outward into limitless space nor remain forever earthbound, shrinking the universe to his petty stature. Better be again a clod of clay of that Earth from which he came than never to have risen to the height from which the wide vision of creation may be obtained and have felt that glorious exaltation of him who cried:

“Then felt I like some watcher of the Sky.”

**Adler Planetarium and Astronomical Museum, Chicago, Illinois, 12 May 1932.**

---

*This date is the second anniversary of the opening of the Museum and Planetarium. In the two years the visitors number 1,242,172.*

---

**Courtesy Maria Mitchell Observatory • Provided by the NASA Astrophysics Data System**